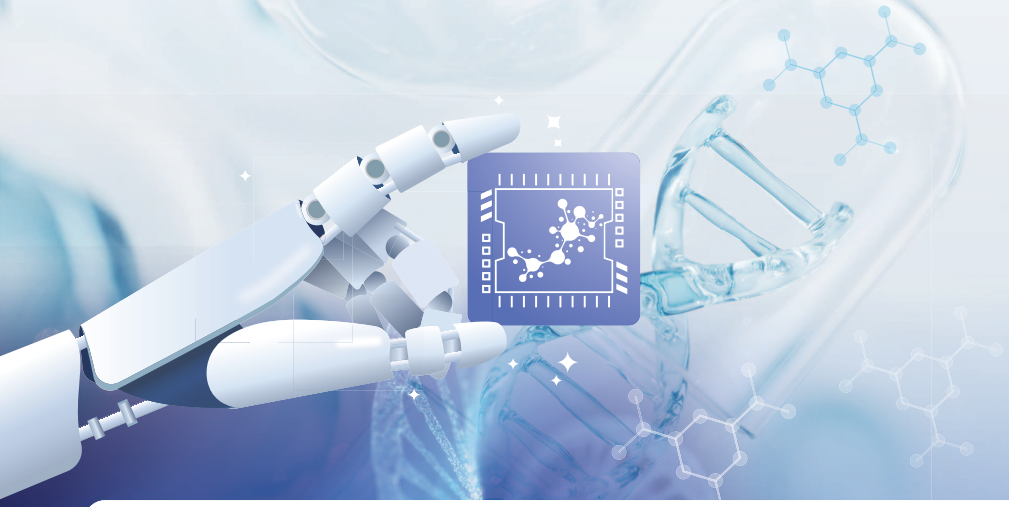
2026 (사)한국산업식품공학회 춘계 정기총회 및 학술대회

Transforming Food Systems through the Convergence of FoodTech, Health, and Sustainability

| 푸드테크, 건강, 지속가능성의 융합으로 이끄는 식품 시스템의 대전환 |

2026.4.16~18 | 여수, 소노캄 그랜드볼룸



주최 한국산업식품공학회 Korean Society for Food Engineering

후원

농촌진흥청 국립식량과학원 | KFRI 한국식품연구원 | WiKim 세계김치연구소 World Institute of Kimchi | KNU 강원대학교 강릉 RISE사업단

Lab of Nano-Biomaterials Konkuk University | 국립부경대학교 블루푸드융합기술연구소 | 하늘농가 | FOODPOLIS 한국식품산업클러스터진흥원

한양대학교 HANYANG UNIVERSITY | ATP group | BK bio | 전라남도 관광재단 | 여수시

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춘계 정기총회 및 학술대회

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한국산업식품공학회
Korean Society for Food Engineering

GREETINGS

존경하는 한국산업식품공학회 회원 여러분!

존경하는 (사)한국산업식품공학회 회원 여러분

우리 산업식품공학회는 회원 여러분의 적극적인 참여와 성원 속에서 지난 30년간 지속적으로 성장해 왔으며, 이에 깊은 감사의 말씀을 드립니다. 빠르게 변화하는 산업 환경과 기술 혁신의 흐름 속에서 학회의 역할 또한 더욱 중요해지고 있습니다. 우리 학회는 산 · 학 · 연을 연결하는 소통의 장으로서 식품산업의 미래를 함께 설계하고 실천하는 중심 플랫폼이 되고자 항상 노력하고 있습니다.

2026년 춘계학술대회는 4월 16일 (목)부터 18일 (토)까지 국제 해양관광의 중심 전라남도 여수시 소노캄 호텔에서 3일간 개최됩니다. 이번 학술대회는 "Transforming Food Systems through the Convergence of FoodTech, Health, and Sustainability (푸드테크, 건강, 지속가능성의 융합으로 이끄는 식품시스템의 대전환)"를 주제로 기술 혁신과 건강, 그리고 지속가능성을 아우르는 식품시스템의 새로운 방향을 모색하고자 합니다.

이번 학술대회에서는 가공 · 공학, 기능성식품, AI 기반 식품시스템, 스마트팩토리, 김치 및 밀 산업 전략, K-푸드 세계화, 푸드테크 공유공장, 냉동 및 유리화 제어, 블루푸드 융복합 기술 등 다양한 주제를 폭넓게 다룰 예정이며, 이에 따라 미래 식품산업의 구조적 변화를 가늠할 수 있는 중요한 논의의 장이 될 것입니다.

또한 산 · 학 · 연 전문가들의 기조강연과 플래너리 세션, 신진연구자 발표, 학생 참여 프로그램과 시상식 등을 통해 지식을 공유하고 세대 간 교류를 활성화하는 의미 있는 시간이 될 것으로 기대합니다. 본 학술대회가 단순한 발표의 자리를 넘어 새로운 협력과 융합 연구의 출발점이 되기를 바랍니다.

회원 여러분의 적극적인 참여와 활발한 학술 교류가 우리 학회의 지속적인 성장과 혁신을 이끄는 힘이 될 것입니다. 2026년 4월, 학술대회 현장에서 더 많은 회원 여러분을 직접 뵙고 뜻깊은 교류의 시간을 나누기를 기대합니다.

감사합니다.

2026. 4

(사)한국산업식품공학회 회장 **정 명 수**

CONTENTS

PROGRAM

2026. 04. 16 (목)

09:00-17:00	등 록		
	GC1	**GC2**	
10:00-11:30	**대학원생 우수논문 선발대회 (A)** 장소 그랜드볼룸 1 좌장 김우주 (서울과학기술대학교)	**대학원생 우수논문 선발대회 (B)** 장소 그랜드볼룸 2 좌장 김우기 (연세대학교)	
11:30-13:00	점심시간 / 포스터 심사 (11:30~12:30)		
13:00-13:10 (개회식)	개회사	정명수 (한국산업식품공학회 회장)	장소 그랜드볼룸 1
	축 사	백현동 (한국식품연구원 원장)	
	축 사	백무열 (한국식품과학회 회장)	
13:10-14:00	**기조강연 1**  **K-Food의 미래 경쟁력과 과학기술의 역할** 장해춘 (세계김치연구소) 장소 그랜드볼룸 1 좌장 최수진 (서울여자대학교)		
14:00-14:10	휴 식		
	S1	**S2**	
	지속가능한 김치 산업 시스템을 위한 글로벌 김치 표준 모델 후원 세계김치연구소 장소 그랜드볼룸 1 좌장 김수정 (전남대학교)	**개인맞춤형 기능성식품 산업화를 위한 바이오-공정-제품의 트리플 혁신 전략** 후원 한양대학교 기능성식품 계약학과 장소 그랜드볼룸 2 좌장 고광웅 (한양대학교)	
14:10-14:40	농식품 분야에서의 Multimodal-Language-Action 모델 기반 Physical AI 연구 손형일 (전남대학교)	Precision microbial control and identification of functional biomaterials using bacteriophages 김진실 (한양대학교)	14:10-14:40
14:40-15:10	글로벌 김치팩토리 표준 플랫폼 개발 정영배 (세계김치연구소)	Leveraging encapsulation technologies for health-promoting and sustainable future foods 정은우 (동아대학교)	14:40-15:10
15:10-15:40	김치, 스마트 Factory & 스마트 HACCP 정재환 (텔스타(주))	Development of an AI-driven personalized nutritional beverage dispenser integrating medical health screening data and lifestyle pattern analysis 고준성 ((주)파도타다)	15:10-15:40
15:40-15:50	휴 식		
	S3	**S4**	
	지속적인 밀 산업 육성을 위한 식품 산업 확장 전략 후원 국립식량과학원 장소 그랜드볼룸 1 좌장 이정희 (국립식량과학원)	**연구에서 산업까지: AI로 확장되는 식품시스템** 후원 한국식품연구원 장소 그랜드볼룸 2 좌장 김종훈 (한국식품연구원)	
15:50-16:10	밀 산업 육성을 위한 제 2차 기본계획 및 전략 서은희 (농림축산식품부)	식품 산업 및 연구 분야 AI 적용사례로 본 식품시스템 전망 오승일 (한국식품연구원)	15:50-16:20
16:10-16:30	수입밀과 비교한 국산밀 제분 특성과 가공 물성 최용석 (사조동아원)	식품 데이터 플랫폼과 R&D AI 에이전트 서혜인 (한국식품연구원)	16:20-16:50
16:30-16:55	국산 밀 품종에 따른 밀가루의 가공적성 및 전분 특성 이창주 (원광대학교)		
16:55-17:20	밀 부산물 활용 업사이클을 통한 지속가능 식품 산업 민명준 ((주)리하베스트)	글로벌 식품산업에 적용가능한 확장형 AI 솔루션 양선흥 ((주)팜킷)	16:50-17:20
17:20-17:30	휴 식		
17:30-18:10	랩 센스 챌린지 (Lab Sense Challenge) 이벤트		

2026. 04. 17(금)

09:00-16:00	등록 / 포스터 심사 (9:00~10:00)	
09:30-10:00	정기총회	
	S5	**S6**
	식품 제조 패러다임의 전환: 푸드테크 기반 공유공장 지원 및 규제 혁신 실증 후원 한국식품산업클러스터진흥원 장소 그랜드볼룸 1 좌장 배승현 (한국식품산업클러스터진흥원)	**K-나물 세계화를 위한 혁신전략** 후원 하늘농가(주) 장소 그랜드볼룸 2 좌장 목진홍 (동국대학교)
10:00-10:30	식품 제조혁신 공유플랫폼: 푸드테크 공유공장 지원 및 GMP 공유공장 운영 실증 박정섭 (한국식품산업클러스터진흥원)	K-나물 cube 간편식 개발을 위한 동결건조 공정 최적화 윤종영 (하늘농가(주)) 10:00-10:30
10:30-11:00	공유 인프라 기반의 성공 방정식: 공유공장 이용기업 우수 사례 윤서연 ((주)소이프트바이옴)	수확 후 농산물 비파괴 품질 판정 기술 연구 현황 이아영 (경희대학교) 10:30-10:50
11:00-11:30	규제 혁신으로 여는 미래: 공유 제조 플랫폼을 활용한 식품 및 건강기능식품 발전 전략 이철수 (한국식품산업협회)	Plantronics bridging Agri-Food technology and AI 김재준 (한국전자통신연구원) 10:50-11:10 Real-time ion sensing platform for next-generation smart farming 한상길 (인천대학교) 11:10-11:30
11:30-12:20	**기조강연 2**  **미래 식품산업 혁신방안 – AI 기반의 K-푸드, 미래산업으로의 전환 –** 김덕호 (한국식품산업클러스터진흥원) 장소 그랜드볼룸 1 좌장 민세철 (서울여자대학교)	
12:20-13:20	점심시간	
	S7	**S8**
	유전자에서 식탁까지: 효소와 개량 미생물이 여는 미래 식품 후원 한국식품연구원 장소 그랜드볼룸 1 좌장 이영경 (한국식품연구원)	**식품품질 향상을 위한 냉동 및 유리화 제어 전략** 공동개최 건국대학교 글로벌기초연구실(BRL), 강원대학교 강릉 RISE사업단 장소 그랜드볼룸 2 좌장 조연지 (강원대학교)
13:20-13:50	Mining nature with AI: Discovery of novel hydrolases for food waste valorization 최재웅 (한국식품연구원)	저장 조건에 따른 아이스크림 얼음입자 성장과 품질 저하 특성 김지연 ((주)풀무원) 13:20-13:50
13:50-14:20	Synthetic biology-driven microbial engineering for the design and production of bioactive compounds 황현규 (전북대학교)	단백질-당-지질 복합계의 유리화 특성 최미정 (건국대학교) 13:50-14:20
14:20-14:50	Smart microbial cell factories enabled by precision fermentation for sustainable food and biomaterials 김수정 (전남대학교)	저수분 환경에서의 유리화 특성과 미생물 생리활성 보존 전략 한민기 (건국대학교) 14:20-14:50
14:50-15:00	휴 식	
	S9	**S10**
	고부가가치 블루푸드 제품개발을 위한 융복합 기술 적용 전략 후원 국립부경대학교 블루푸드 융합기술연구소 장소 그랜드볼룸 1 좌장 유상묵 (경북대학교)	**지속가능 식품 시스템 전환을 위한 차세대 식품 기술** [신진연구자 발표] 장소 그랜드볼룸 2 좌장 이동훈 (가천대학교)
15:00-15:30	라만분광법을 활용한 수산식품의 비파괴 품질 · 안전성 신속 분석 기술 개발 남원일 (국립부경대학교)	From sea to soil: Valorization of blue food resources for the food industry 곽호정 (국립부경대학교) 15:00-15:20
15:30-16:00	시판 참치 및 대체 참치 제품의 풍미 및 품질 특성 평가 및 비교 연구 장혜원 (성신여자대학교)	Toward a new paradigm of sustainable alternative foods driven by technological innovation and convergence 이정수 (부산대학교) 15:20-15:40
16:00-16:30	덤블모자반 유래 meroterpenoid 성분의 안정성 최적화를 위한 저장 기술 개발 Cao Lei (국립부경대학교)	Cell-cultured milk production via milk tree construction 권혁철 (한국식품연구원) 15:40-16:00 Functional enhancement of plant protein through structural modification 최우열 (건국대학교) 16:00-16:20
16:30-17:00	시상식 및 폐회사 장소 그랜드볼룸 1	

2026. 04. 18(토)

09:00-16:00	패널토의

GC1

대학원생 우수논문 선발대회
(A)

장소 그랜드볼룸 1

좌장 김우주 (서울과학기술대학교)

10:00-10:15	**A novel quantitative analysis method for printability in 3D food printing for surimi** Sol Kim
10:15-10:30	**Predicting crystallinity of subcritical water-treated cellulose in pilot-scale production using hybrid RSM–GPR modeling** Soohyun Kim
10:30-10:45	**Morphological changes and rheological characteristics of $G_1/O/G_2$ emulsions as influenced by inner gel phase concentration** Si yeon Kim
10:45-11:00	**Characterization of granular cold-water swelling rice flour (GCWSRF) prepared by ethanol–heat treatment (EHT) at different ethanol concentrations** Hee-Chan An
11:00-11:15	**Elucidating phase behavior-driven network formation in pea protein-based meat analogues using seaweed-derived polysaccharides as starch alternatives** Heeseo Lee
11:15-11:30	**Effect of liquid-to-solid triacylglycerol ratio on the physicochemcial characteristics and gastrointestinal digestion fates of curcumin-loaded triacylglycerol nanoparticles** Jisu Choi

GC2

대학원생 우수논문 선발대회
(B)

장소 그랜드볼룸 2

좌장 김우기 (연세대학교)

10:00-10:15	**Effect of OSA esterification at different tages on physicochemical properties of short-chain glucan aggregates (SCGA)** Ji-Hyun Kwak
10:15-10:30	**Bitterness masking of potassium chloride by gellan gum through selective ionic interactions in NaCl/KCl systems** Yeongyeong Kim
10:30-10:45	**A hyaluronidase-responsive starch microparticle platform for selective colorimetric detection of *Staphylococcus aureus* in food** Tae-Hoon Kim
10:45-11:00	**Non-destructive quality assessment and shelf-life prediction of paprika via multimodal deep learning** Sumin Shin
11:00-11:15	***Weissella cibaria* GSKM06 postbiotics attenuate obesity by reducing adiposity and modulating gut microbial composition in high-fat diet-induced obese mice** Chaehyun Oh
11:15-11:30	**가수분해 펙틴 용액을 이용한 열전환(pyroconversion) 가루쌀분말의 특성** 장은정

기조강연 1

장소 그랜드볼룸 1

좌장 최수진 (서울여자대학교)

13:10-14:00	**K-Food의 미래 경쟁력과 과학기술의 역할** 장해춘 (세계김치연구소)

K-Food의 미래 경쟁력과 과학기술의 역할

CURRICULUM VITAE

장 해 춘

근무처
- 세계김치연구소

학력
- 서울대학교 식품공학 (식품미생물), 석·박사
- 서울여자대학교 식품과학, 학사

경력
- 세계김치연구소장
- 조선대학교 식품영양학과 교수, 김치연구센터장

주요활동
- 농림수산식품부 농림수산식품과학기술위원
- 식품의약품안전 (청)처 자체 규제 심사위원
- 국가과학기술연구회 기획평가위원 (생명복지분과)
- 보건복지부 건강기능식품 심의위원
- ㈜LG전자 식품과학연구소 기술자문위원
- 한국미생물생명공학회 부회장

수상
- 농림축산식품 과학기술대상 (대통령 표창)

기타
- 일본 동경대학교 응용생명공학과 UNESCO 장학생
- 교육과학기술부 NURI 사업「전통식품첨단화 인력양성 사업단」단장
- (논문) 139편, (특허) 34건, (기술 사업화) 김치냉장고 약 4조원 매출 창출

ABSTRACT

Amid the growing global popularity of Korean culture, the international demand for K-Food—such as kimchi, kimbap, and instant noodles—has significantly increased. Kimchi, in particular, has emerged as a flagship K-Food product, with exports reaching approximately USD 159.46 million between January and October 2025, according to the Korea Customs Service. Furthermore, recent U.S. dietary guidelines have recommended fermented foods, including kimchi, as beneficial for improving the gut microbiome, reflecting the accumulation of scientific evidence supporting its health-promoting properties.

In this context, K-Food is no longer merely a cultural asset but is increasingly recognized as a strategic industry with both economic and societal value. At the same time, the Korean government has identified twelve key strategic technologies to enhance national competitiveness and is actively promoting science and technology-driven policies. Against this backdrop, the integration of advanced science and technology into the K-Food sector presents a critical opportunity to secure future competitiveness.

This keynote lecture explores the role of science and technology in advancing the global competitiveness of K-Food. It highlights feasible research directions and practical applications, including the scientific validation of functional properties, innovations in fermentation and food processing, and the development of next-generation food technologies. Additionally, policy implications and strategic frameworks for fostering interdisciplinary research are discussed.

By presenting concrete examples and future-oriented perspectives, this lecture aims to provide insights into how K-Food can evolve into a sustainable and globally competitive industry, while simultaneously promoting Korea's cultural identity and technological excellence.

S1

지속가능한 김치 산업 시스템을 위한 글로벌 김치 표준 모델

후원 세계김치연구소

장소 그랜드볼룸 1

좌장 김수정 (전남대학교)

14:10-14:40	**농식품 분야에서의 Multimodal-Language-Action 모델 기반 Physical AI 연구** 손형일 (전남대학교)
14:40-15:10	**글로벌 김치팩토리 표준 플랫폼 개발** 정영배 (세계김치연구소)
15:10-15:40	**김치, 스마트 Factory & 스마트 HACCP** 정재환 (텔스타 (주))

농식품 분야에서의 Multimodal-Language-Action 모델 기반 Physical AI 연구

CURRICULUM VITAE

손 형 일

근무처
- 전남대학교

학력
- 2010. 카이스트 기계공학과, 공학박사
- 2000. 부산대학교 기계공학과, 공학석사

경력
- 2015~현재. 전남대학교, 정교수
- 2012~2015. 삼성중공업 중앙연구소, 수석연구원
- 2010~2012. Max Planck Institute of Biological Cybernetics, 박사후연구원
- 2010. The University of Tokyo, 박사후연구원
- 2005~2009. 삼성전자 ITD센터, 책임연구원
- 2003~2005. LG전자 생산기술원, 선임연구원

주요활동
- 전남대학교 그린바이오 혁신융합대학 사업단, 사업단장
- 전남대학교 바이오사이버네틱스 연구센터, 센터장
- IEEE Robotics and Automation Letters, Associate Editor
- Electronics, Associate Editor
- 한국로봇학회지, 편집위원
- 제어로봇시스템학회, 한국로봇학회, 한국농업기계학회, 한국산업융합학회 이사

수상
- 제어로봇시스템학회, 우광방 학술상
- ICRA 2023 Workshop, Best Paper Award
- ICCAS 2011, Outstanding Paper Award
- 제어로봇시스템학회, 한국농업기계학회, 한국양봉학회 등 우수 논문상 다수

ABSTRACT

본 발표는 비정형 환경과 복잡한 생물학적 객체를 다루는 농식품 분야에서 Multimodal-Language-Action (MLA) 모델 기반 Physical AI 연구현황과 계획을 소개한다. 먼저 1) Scene Graph Generation (SGG)-VLA 아키텍처를 활용한 과채류 수확·전정·적과용 양팔 로봇 시스템 연구, 2) Imitation-Reinforcement Learning 기반의 휴머노이드 정밀 농작업 제어 연구, 3) MLA 모델의 정밀도를 높이기 위한 Tactile 매니퓰레이션 연구, 마지막으로 4) 작물 채취를 위한 VLA 기반 샘플링 로봇 연구를 소개한다. 나아가 이러한 농업 분야의 핵심 기술을 식품 제조 공정으로 확장 적용하여, 1) 고도의 비정형 조작이 요구되는 김치 속넣기 작업을 수행하는 MLA 기반 휴머노이드 로봇 연구와 2) 김치 공정 내 물류 효율 극대화를 위한 군집 UGV (Unmanned Ground Vehicle) 제어 및 경로 최적화 연구를 소개한다. 결론적으로 본 연구는 농업 생산부터 식품 가공 및 물류에 이르는 'Farm-to-Table' 전 과정의 지능형 자동화를 위한 기술적 토대를 마련하고, 노동 집약적인 국내 농식품 산업의 디지털 전환과 글로벌 경쟁력 제고를 위한 Physical AI의 실질적인 활용 가능성을 시사한다.

글로벌 김치팩토리 표준 플랫폼 개발

CURRICULUM VITAE

정 영 배

근무처
• 세계김치연구소 (글로벌융합연구본부, 김치팩토리연구단, 단장)

학력
• Ph. D. 고려대학교 의생명융합과학
• MS. 고려대학교 식품가공학

경력
• 2011~현재. 세계김치연구소 책임연구원
• 2008~2011. 한국식품연구원 연구원

주요활동
• 2025~현재. 김치원료공급단지 구축사업 자문위원
• 2021. 고부가가치식품기술개발사업 과제기획위원

수상
• 2014. 국가과학기술연구회이사장상

기타
• 2024~현재. HMR 제조 공정 개선 기술 개발 과제 (연구책임자)
• 2011~현재. 국가 R&D 기반 김치 제조공정 자동화/표준화 기술 개발 연구

ABSTRACT

최근 김치 산업은 생산 공정의 비표준화, 품질 편차, 위생·안전 관리의 한계로 인해 글로벌 시장 확대에 어려움을 겪고 있으며, 이를 해결하기 위한 공정 표준화 및 디지털 기반 제조 혁신이 요구되고 있다.
김치연구소는 김치 산업이 직면한 문제를 해결하기 위해 김치 제조공정 (원료 입고–전처리–절임–양념–발효–포장)에 자동화 및 디지털 기술을 적용하여 표준화된 생산 체계를 구축하고자 하였으며, 센서 기반 공정 모니터링과 건염 절임 공법을 통해 공정 효율을 향상시키고, 자동화 설비를 통해 생산성 증대 및 작업 의존도 저감을 달성하였다.
또한, IoT 기반 네트워크를 활용하여 공정 데이터를 실시간으로 수집·관리하는 스마트 품질·위생 관리 시스템을 구현하였으며, 비파괴 머신비전 기술을 통해 원부재료 및 공정 품질을 실시간으로 평가하고 염도 및 숙성도 등 품질 지표를 정량적으로 예측하였다.
이러한 연구성과를 바탕으로 향후 디지털 트윈 기반의 “글로벌 김치 팩토리 표준 플랫폼 개발”을 추진하여, 김치 산업의 표준 정립과 글로벌 경쟁력 확보, 나아가 김치의 세계화에 기여하고자 한다.

김치, 스마트 Factory & 스마트 HACCP

CURRICULUM VITAE

정 재 환

근무처
• 텔스타(주)

학력
• 조선대학교 환경공학과

경력
• 2020.08~현재. 텔스타 (AI • Big Data 활용, 스마트 Factory)
• 2018.06~2020.08. ELT (신재생에너지)

주요활동
• [KOICA IBS] 동티모르 아따우로 섬 에너지 불평등 해소를 위한 청정에너지 접근성 향상 사업
• [한국식품안전관리인증원] 김치류 제조업체 스마트 해썹 선도모델 개발연구
• [한국식품안전관리인증원] 과자류 제조업체 스마트 해썹 선도모델 개발연구
• [한국식품안전관리인증원] 음료류 제조업체 스마트 해썹 선도모델 개발연구
• [세계김치연구소] 차세대 김치공장 시뮬레이션 용역수행
• [중소벤처기업진흥공단] 스마트 Factory 보급 • 확산 사업, 15건 등

수상
• 2013.09. 광주광역시북구청장 표창패
• 2008.12. 문화체육관광부장관 표창
• 2007.12. 광주광역시장 표창

ABSTRACT

본 발표는 김치 제조 산업에서 스마트 Factory와 스마트 HACCP 도입의 필요성과 구현 방법을 설명하고, 실제 현장 적용사례를 통해 식품 제조공정의 디지털 전환 방향을 제시한다. 특히 자동화 설비와 ICT 기술을 기반으로 한 스마트 Factory 구조와, CCP 관리 데이터를 디지털화한 스마트 HACCP 시스템의 운영방식을 중심으로 설명한다.

- 스마트 Factory는 IoT, AI, Big Data 등 ICT 기술을 활용하여 생산 공정을 실시간으로 모니터링하고 최적화하는 제조 시스템으로 정의된다. ERP, MES, LMS 등 생산관리 시스템과 연계하여 공정 데이터를 통합 관리하며, 이를 통해 품질 (Quality), 비용 (Cost), 납기 (Delivery), 생산성 (Productivity)을 동시에 개선할 수 있다.
- 스마트 HACCP은 기존의 수기 기록 기반 위생관리 방식에서 벗어나 CCP 데이터를 센서와 IoT 장비로 자동 수집하고 클라우드 시스템에서 관리하는 디지털 식품안전 관리 체계이다. 이를 통해 실시간 모니터링, 자동 기록 저장, 데이터 기반 의사결정이 가능하며 식품 안전 관리의 신뢰성을 향상시킨다.
- 본 자료에서는 금속검출 공정, 세척 공정, 가열 공정 등의 실제 스마트 HACCP 적용 사례를 설명하며, 센서 데이터와 공정 정보를 통해 CCP 모니터링을 자동화하는 방법을 소개한다. 또한 작업자 위생관리와 공정 출입 절차를 AI 기반 영상 인식 기술로 관리하는 디지털 위생관리 시스템 사례도 포함되어 있다.
- 결론적으로 스마트 Factory와 스마트 HACCP의 결합은 식품 제조 산업에서 공정 자동화, 데이터 기반 품질 관리, 위생 안전 확보를 동시에 실현하는 핵심 기술이며, 특히 김치 산업과 같은 발효식품 제조 공정에서 생산성과 식품 안전성을 동시에 강화할 수 있는 중요한 전략으로 평가된다.

S2

개인맞춤형 기능성식품 산업화를 위한 바이오-공정-제품의 트리플 혁신 전략

후원 한양대학교 기능성식품 계약학과

장소 그랜드볼룸 2

좌장 고광웅 (한양대학교)

14:10-14:40	Precision microbial control and identification of functional biomaterials using bacteriophages 김진실 (한양대학교)
14:40-15:10	Leveraging encapsulation technologies for health-promoting and sustainable future foods 정은우 (동아대학교)
15:10-15:40	Development of an AI-driven personalized nutritional beverage dispenser integrating medical health screening data and lifestyle pattern analysis 고준성 (주식회사 파도타다)

Precision microbial control and identification of functional biomaterials using bacteriophages

CURRICULUM VITAE

김 진 실

근무처
• 한양대학교 식품영양학과

학력
• 2021. 서울대학교 식품생명공학전공, 박사
• 2018. 서울대학교 농생명공학전공, 석사
• 2016. 서울대학교 식품생명공학전공, 학사

경력
• 2026.03~현재. 한양대학교 생활과학대학 식품영양학과 조교수
• 2023.01~2026.02. 미국 국립보건원 (NIH) Post-Doctoral Visiting Fellow
• 2022.07~2022.12. 세종대학교 탄수화물소재연구소 선임연구원
• 2021.03~2022.06. 서울대학교 식품바이오융합연구소 선임연구원

주요활동
• 식품 내 식중독균 분리 및 특성 분석 연구
• 식중독균의 병원성, 항생제내성, 스트레스 저항성 기전 연구
• 박테리오파지를 활용한 다제내성 식중독균 제어 연구
• 박테리오파지 유래 단백질 기반 숙주 반응 조절 기전 연구

수상
• 2022. 서울대학교 식품바이오융합연구소 우수 과학자 우수상

ABSTRACT

Bacteriophages (phages), the natural predators of bacteria, offer high specificity and efficiency in microbial management. Phages and their encoded proteins are increasingly recognized as programmable functional biomaterials. This study explored the dual potential of phages in achieving targeted microbial control and serving as a source of novel bio-derived materials. First, we focused on the precision control of Shiga toxin-producing *Escherichia coli* (STEC). Unlike toxin-inducing conventional treatments, the lytic phages effectively controlled this pathogen without inducing Shiga toxin expression. This highlighted the role of phages as safe, high-precision biocontrol agents that mitigated both bacterial growth and virulence. We also developed a phage cocktail to resolve the common issue of multi-drug-resistant (MDR) *E. coli* interference during the *Campylobacter* isolation process. By selectively reshaping the microbial composition using a phage cocktail during the enrichment process, this phage-based approach significantly enhanced the isolation efficiency of *Campylobacter* spp., identifying phage as a functional biomaterial for the selective isolation of bacteria. Finally, we investigated the functional identification of the early proteins derived from T4 phage. Our findings revealed that these proteins acted as molecular bio-modulators that hijacked the host's transcriptional machinery and heat-shock response. By investigating these host-takeover mechanisms, we identified these phage-derived proteins as potential biomaterials capable of reprogramming microbial metabolism for specific industrial or food-grade applications. Taken together, these findings confirm the potential of phages in both precision microbial modulation and the discovery of functional bio-substances for advancing food safety and microbial biotechnology.

Leveraging encapsulation technologies for health-promoting and sustainable future foods

CURRICULUM VITAE

정 은 우

근무처
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학력
- 2024.02. 한양대학교 식품영양학과, 석·박사
- 2019.02. 한양대학교 식품영양학과, 학사

경력
- 2025.09~현재. 동아대학교 식품영양학과 조교수
- 2024.02~2025.07. Cornell University, Dept. of Food Science 박사후연구원

주요활동
- 학술논문발표 24편: 국외 SCI (E) 23편, 국내 1편
- 특허기술발표 12건: 등록 8건, 출원 4건, 기술이전 2건

ABSTRACT

Encapsulation technologies have emerged as a promising platform for overcoming the limitations of functional ingredients, including poor solubility, instability, and low bioavailability. This study demonstrates the application of encapsulation technologies to improve bioactive delivery and address quality challenges in complex food systems. As a model of bioactive delivery, avenanthramides (AVNs) from oats were investigated. Germination increased AVN content and enhanced anti-diabetic activity in insulin-resistant HepG2 cells; however, the extracts exhibited limited solubility and bioavailability. To address these limitations, liposome- and bilosome-based delivery systems were developed. Bilosomes significantly improved AVN solubility (2.74-fold), significantly enhanced stability under acidic and thermal conditions, and increased bioaccessibility and cellular uptake compared to liposomes and non-encapsulated AVNs. As a model of food system application, encapsulation strategies were applied to plant-based meat analogs (PBMA) to address key challenges in premature flavor release and insufficient color transition during cooking. Thermoresponsive systems, including emulsion-filled calcium alginate gels and water-in-oleogel emulsions, enabled controlled flavor release upon heating and facilitated dynamic color transitions during thermal processing. Collectively, these findings highlight the potential of encapsulation as a core enabling platform for next-generation health-promoting and sustainable food systems.

Development of an AI-driven personalized nutritional beverage dispenser integrating medical health screening data and lifestyle pattern analysis

CURRICULUM VITAE

고 준 성

근무처
- 주식회사 파도타다

학력
- 한양대학교 식품영양학과 학사 졸업
- 한양대학교 식품영양학과 석사 1기 재학 중

경력
- 피트니스 센터 '더슈트' 운영 및 매각
- 샐러드 매장 '시드위드' 운영 및 매각

주요활동
- '주식회사 파도타다' 법인 설립
- 영양제 브랜드 '리틀모어' 운영
- 개인 맞춤 영양 음료 디스펜서 '비타크래프트' 운영
- 해외 5개국 (중국, 캐나다, 호주, 뉴질랜드, 러시아) 수출 진행
- CJ ENM 공동 마케팅 PoC 진행
- AC (엑셀러레이터) 지분 투자 유치

수상
- 한국식품과학회 학부생 아이디어 경진대회 우수상
- 국가 이공계 우수 장학생
- SBA 우수 창업 기업 표창장

기타
- 창업중심대학 예비창업자 최우수 기업 선정
- 청년창업사관학교 우수 기업 선정
- LIPS2 (혁신소상공인 투자연계지원) 선정

ABSTRACT

Background: Nutritional imbalances driven by sedentary lifestyles and individualized metabolic differences demand a precision-nutrition approach. Existing supplementation platforms rely on generalized dosing or self-reported surveys, limiting clinical relevance and user compliance.

Objective: This study presents VitaCraft, an AIoT-based personalized nutritional beverage dispenser that formulates real-time, customized nutrient beverages based on individual medical and behavioral data.

Methods: The AI recommendation engine fuses clinical biomarkers (blood glucose, cholesterol, hepatorenal indices) retrieved via the CODEF API with a 20-item reinforcement learning-guided lifestyle questionnaire. Optimal recipes comprising four liquid functional components — arginine, taurine, magnesium, and probiotics — are generated through a proprietary AI model (Korean Patent Application filed). A 4-channel liquid pump system with load cell-based gravimetric feedback achieves dispensing accuracy within ±3%.

Results: Prototype validation confirmed >95% dispensing accuracy. The full cycle from health data input to ready-to-drink (RTD) beverage production is completed within 30 seconds. Field trials are currently ongoing in commercial fitness center environments.

Conclusion: VitaCraft bridges food engineering, precision nutrition, and AIoT hardware into a single scalable platform. Its evidence-based, liquid-format delivery model offers a clinically meaningful advancement over existing capsule-based personalized nutrition systems.

S3

지속적인 밀 산업 육성을 위한 식품 산업 확장 전략

후원 국립식량과학원

장소 그랜드볼룸 1

좌장 이정희 (국립식량과학원)

15:50-16:10	**밀 산업 육성을 위한 기본계획 및 전략** 서은희 (농림축산식품부)
16:10-16:30	**수입밀과 비교한 국산밀 제분 특성과 가공 물성** 최용석 (사조동아원)
16:30-16:55	**국산 밀 품종에 따른 밀가루의 가공적성 및 전분 특성** 이창주 (원광대학교)
16:55-17:20	**밀 부산물 활용 업사이클을 통한 지속가능 식품 산업** 민명준 ((주)리하베스트)

밀 산업 육성을 위한 기본계획 및 전략

CURRICULUM VITAE

서 은 희

근무처
- 농림축산식품부 전략작물육성팀

학력
- 경희대학교 행정학과 졸

경력
- 2023~2025. 농림축산식품부 국제협력총괄과
- 2020~2022. 농림축산식품부 친환경농업과
- 2016~2018. 농림축산식품부 농업기반과
- 2008~2012. 농림축산식품부 식량정책과

주요활동
- 정부양곡 보관 및 유통 관리
- 농림축산식품부 소관 농업기반시설 유지 관리
- 친환경농업 육성 및 소비기반 조성
- 농림축산식품부 소관 제1차 국제농업협력(ODA) 종합계획(2025~2029) 수립

ABSTRACT

밀은 쌀 다음으로 소비가 많지만, 식량자급률(2024년)은 1.5%로 낮아 기후변화와 국제정세 등 대외 충격에 매우 취약할 수밖에 없다. 이에 밀 산업 기반을 조성하고 식량자급률을 향상시키기 위하여 「밀 산업육성법」이 제정되고 「제1차 밀 산업 육성 기본계획('21~'25)」을 수립하였다. 추진한 결과, 국내 밀 재배면적은 '20년 5.2천ha에서 '25년 9.1천ha로 1.7배 증가하여 밀 생산량은 17천톤에서 38천톤으로 2.2배 증가하였을 뿐만 아니라, 우수품종 보급과 관리로 단위면적당 생산량도 325 kg/10 a에서 418 kg/10 a로 증가되었다. 생산기반 확충 측면에서는 양적 성장은 이루어졌으나 소비자가 원하는 균일한 품질의 원맥 생산과 국산 밀 소비가 크게 증가하지는 못하였다.

「제2차 밀 산업육성 기본계획('26~'30)」의 기본방향은 수요자가 요구하는 균일한 품질의 밀 생산·유통 체계를 구축하여 고품질 국산 밀을 시장에 안정적으로 공급하고, 이를 통해 국산 밀의 수요를 창출하는 것이다. 소비자의 수요에 맞는 질적 성장을 통해 2030년까지 생산 면적은 5만ha, 생산량은 20만 톤까지 확대하여 밀 자급률을 8%까지 높이는 목표를 추진한다. 목표 달성을 위해 수요에 기반한 효율적 생산체계를 구축하고, 고품질 밀 유통을 활성화하고, 소비가 생산을 견인하는 선순환 체계 구축의 3대 전략을 수립하였다. 「제2차 밀 산업육성 기본계획」이 성공적으로 진행되어 지속가능한 밀 산업 기반이 조성되고, 국산 밀 산업이 성장 발전될 것으로 기대된다.

수입밀과 비교한 국산밀 제분 특성과 가공 물성

CURRICULUM VITAE

최 용 석

근무처
• 사조동아원

학력
• 전남대학교 식품영양학, 석사·박사
• 전남대학교 농화학과, 학사

경력
• 2023.01~현재. 사조동아원 생산본부장
• 2007.10~2022.12. 사조동아원 제분연구소장
• 1993.05~2007.09. 한국제분·동아원

주요활동
• 곡물을 이용한 가공 기능성 소재 개발 실무 및 총괄 연구: Low carb 제품 연구, High protein noodle, High TDF source
• 업계 최초 ISO22000/HACCP 도입 및 auditor로서 운영 시스템 구축
• 식품연구소장협의회 총무간사역 수행

수상
• 2022. 국무총리상

기타
• 2008.01~02. IKEDA Bakery 기술 연수
• 1997.01~06. American Institute of Baking 수료
• 1996. HACCP 전문가 과정 (보건산업진흥원)
• 1995. SPC/SQC 팀장 과정 수료

ABSTRACT

우리나라 밀 가공제품 중 소비량이 많은 제면·제빵용 밀을 1·2등급 국산밀과 수입밀을 비교하였다. 본 연구에 사용된 제면용 밀은 새금강과 호주산 ASW(Australian Standard White)를 사용하였고, 제빵용 밀은 금강밀과 미국산 HRS(Hard Red Winter, NS)를 사용하였다. 제면 실험 결과 새금강밀은 ASW에 비해 어두운 색상을 나타내며, 쫄깃한 식감이 부족하였으나, 시중에 판매하는 미국산 중력분(HRW, SW 혼합분)과 유사한 식감을 나타냈다. 제빵 실험 결과 금강밀은 NS와 비교하여 1급 밀은 반죽 탄력과 끈적임이 이 양호하였으나, 2등급 밀은 느린 수화와 탄력이 떨어졌으며, 완제품 관능평가 결과 국산밀 2등급은 낮은 단백질 함량으로 뭉치는 식감을 나타냈으며, 1등급은 대체로 양호한 식감을 나타냈으나 수입밀에 비해 수분 보유량이 낮아 퍼석한 식감을 나타냈다.

국산 밀 품종에 따른 밀가루의 가공적성 및 전분 특성

CURRICULUM VITAE

이 창 주

근무처
• 원광대학교 농식품융합대학 식품생명공학과

학력
• 2011. 서울대학교 농업생명과학대학 식품생명공학과 박사

경력
• 2015~현재. 원광대학교 식품생명공학과 교수
• 2011~2012. CJ제일제당 식품연구소, 연구원
• 2012~2015. Iowa State University, USA, Research Associate
• 2015~2015. University of Hawaii at Manoa, USA, Research Associate

주요활동
• 2024.01~현재. 한국푸드테크협의회 전북지회 부지회장
• 2023.09~현재. 농림축산식품부 정책자문위원
• 2022.08~현재. 농림축산식품부 쌀가루 산업 발전협의체 위원
• 2021.01~현재. 국립식량과학원 현장명예연구관

수상
• 2024.07. 한국과학기술단체총연합회 과학기술우수논문상
• 2023.12. 농림축산식품부장관 표창장

기타
• (사)한국산업식품공학회 운영위원

ABSTRACT

우리나라의 1인당 밀가루 소비량은 2014년 32.9 kg에서 2023년 35.7 kg으로 지속적으로 증가하고 있다. 밀가루의 주요 사용 용도는 면류 (38.5%), 빵류 (16.4%), 분말 제품 (8.9%) 순으로 나타나며, 특히 면류의 소비 비중이 가장 높은 것으로 보고되었다. 그러나 국내 밀가루 소비는 대부분 수입밀에 의존하고 있어 국산 밀의 자급률은 약 2% 수준에 불과하다. 이는 국산밀이 수입밀 대비 2–3배 높은 가격과 품질 균일성 부족 등의 한계를 가지기 때문이다.
최근에는 이러한 문제를 해결하기 위해 용도별로 적합한 고품질 국산 밀 품종 개발이 활발히 이루어지고 있다. 면용 품종으로는 새금강 (Saekeumkang), 한면 (Hanmyeon), 빵용 품종으로는 백강 (Baekgang), 조경 (Jokyung), 금강 (Geumgang), 황금알 (Hwanggeumal) 등이 보급되고 있다. 본 연구에서는 다양한 국산 밀 품종의 밀가루를 이용하여 국수를 제조하고, 면류의 물리적 및 조리 특성을 평가하였다. 또한 품질의 균일성을 확보하기 위해 품종 간 블렌딩을 적용하여 그 특성을 비교 분석하였다. 그 결과, 새금강 단일 품종으로 제조한 면은 시판 면에 비해 상대적으로 낮은 강도를 나타냈다. 반면, 새금강과 황금알을 블렌딩한 면의 강도는 증가하였으며, 용출량은 0.417에서 0.333으로 감소하여 품질이 개선되었다. 한면 품종으로 제조한 국수는 새금강보다 높은 경도를 나타냈으며, 용출량은 0.274로 가장 낮아 스파게티와 같은 건면 제품에 적용 가능성이 있는 것으로 판단된다. 따라서 국산 밀가루의 품종별 블렌딩은 면류 제품의 품질을 개선하고 산업적 활용성을 높일 수 있는 효과적인 전략이 될 것으로 기대된다.

밀 부산물 활용 업사이클을 통한 지속가능 식품 산업

CURRICULUM VITAE

민알렉산더명준

근무처
• ㈜리하베스트, 대표이사

학력
• 서울대학교 푸드테크 FTCXO 프로그램 수료
• 서울대학교 경영전문대학원 Global MBA
• Pepperdine 대학교, 회계학 학사 (미국)

경력
• 콴티파이인큐베이터: 전략 고문 및 자문
• Shokunin (미국): Founding Member
• PwC (삼일회계법인): 전략 컨설팅, M&A, 신사업, Deal Structuring Specialist
• Amgen Inc. (미국 본사): 해외 M&A Specialist
• IMT Capital: 재무 실사, 투자 검토 및 관리 (부동산, 대체투자)

주요활동
• 국내 최초 푸드업사이클 컨셉/개념 도입
• 국내 최초 푸드업사이클 생태계 수립 (수거-제조-유통)
• 인도네시아 최초 푸드업사이클 사례 도출 (P4G, PT. Bintang 협업)

수상
• 2023. 인도네시아 혁신 사례 수상 (Inovatif Peduli Gizi)
• 2023. 베트남 과학기술부 (MOST) NATEC 수상
• 2022. 국가식품산업클러스터 농림축산식품부장관상 수상
• 2019. 제2회 경기 업사이클 공모전 대상, 경기도 지사상

기타
• Future Food Asia Advisory: 푸드업사이클 현황 및 발전 방안 (2024~2025)
• 동남아 최초 푸드업사이클 사례 도출 적극 기여: 인도네시아, 베트남

ABSTRACT

최근 글로벌 식량 위기 및 환경 문제의 대안으로 푸드 업사이클링이 주목받고 있다. 본 발표는 산업 간 경계를 허물고 미활용 자원을 고부가가치 신소재로 재설계하는 '변환경제(Cross Economy)'의 일환으로서 푸드 업사이클링을 조명하며, 이를 단순한 폐기물 재활용(Recycling)을 넘어서는 혁신적 패러다임으로 제시하고자 한다. 특히 저부가가치로 버려지던 밀 부산물 (밀기울)의 잠재력에 주목하며, 이를 고영양·고기능성 원료로 전환하기 위한 공정 고도화 (수분 제어, 미생물 억제 등)의 기술적 한계와 소비자 수용성 확보라는 산업적 도전 과제를 고찰하고자 한다.

이러한 과제를 극복하고 산업의 성공적인 안착을 도모하기 위해, 산학연 협력을 통한 공정 효율화, 대형 F&B 기업과의 파트너십을 통한 시장 검증, 그리고 B2C 브랜드 (어글리바이츠클럽 등) 전개를 통한 가치 소비 확산 전략을 제시한다. 나아가, 법적 규격 마련 및 정책적 지원의 필요성을 역설하고, 향후 푸드 업사이클 산업이 첨단 신소재 개발 등 이종 산업으로 융복합되는 미래 비전을 모색한다. 이를 통해 국내 성공 모델의 글로벌 진출 및 전 세계 식량 불평등 해소에 기여하고자 한다.

S4

연구에서 산업까지: AI로 확장되는 식품시스템

후원 한국식품연구원

장소 그랜드볼룸 2

좌장 김종훈 (한국식품연구원)

15:50-16:20	**식품 산업 및 연구 분야 AI 적용사례로 본 식품시스템 전망** 오승일 (한국식품연구원)
16:20-16:50	**식품 데이터 플랫폼과 R&D AI 에이전트** 서혜인 (한국식품연구원)
16:50-17:20	**Taste Intelligence for hyper-personalization of food commerce** 양선흥 ((주)팜킷)

식품 산업 및 연구 분야 AI 적용사례로 본 식품시스템 전망

CURRICULUM VITAE

오 승 일

근무처
- 한국식품연구원

학력
- 성균관대학교 생명공학과 AI의공학전공, 박사
- 성균관대학교 바이오메카트로닉스학과, 석사
- 성균관대학교 바이오메카트로닉스/정보통신공학, 학사

경력
- 2015~현재. 한국식품연구원 식품융합연구본부 안전유통연구단 선임연구원
- 2013~현재. 성균관대학교 생명공학대학 바이오메카트로닉스학과 겸임교수
- 2021~현재. 한국식품연구원 전략기획본부 AI정보실 겸직

주요활동
- 다변량 데이터 실시간 동적모델링 및 XAI 기반 데이터 시각화/큐레이팅 연구
- IoE 기반 식품 초연결사회 구현기술 확보를 위한 인공지능 플랫폼 연구
- 스마트센서 및 IoT 기반 블록체인 스마트푸드시스템 구축기술 연구
- 생체데이터 로봇-장비 연계 융합형 스마트 매뉴팩처링 모델 구현 연구

수상
- Top cited articles published in the *Journal of Biomechanics* in 2013
- The best paper award in *International Journal of Precision Engineering and Manufacturing & The Korean Society of Manufacturing Process Engineers*

ABSTRACT

The food industry and food research are undergoing a fundamental transformation due to the rapid progress of data and artificial intelligence (AI) technology. Data-driven decision-making, predictive quality management, and process optimization throughout the food value chain have been made possible by the growing availability of sensor, IoT, distribution, and consumer data. Concurrently, the paradigm of food research is changing from experiment-centered methods to data-centric study design as it moves toward structured, standardized, and integrated data environments.

Through AI application scenarios in both industry and research settings, this presentation examines the developing structure of next-generation food systems. It demonstrates how data-driven approaches improve productivity, dependability, and sustainability in food systems by looking at the entire data pipeline, from data collection and preprocessing to analysis and modeling. The importance of data infrastructure, standards, and system integration in facilitating scalable AI applications is also covered in the session.

In the end, this presentation describes potential paths for industry and research in creating intelligent, data-driven food ecosystems and offers insights into how the convergence of data and AI is changing food systems.

식품 데이터 플랫폼과 R&D AI 에이전트

CURRICULUM VITAE

서 혜 인

근무처
• 한국식품연구원

학력
• 2020. KAIST 전기 및 전자공학 박사
• 2014. KAIST 전기 및 전자공학 석사
• 2010. 경북대학교 전자공학 학사

경력
• 2021~현재. 한국식품연구원 AI정보실 연구원

주요활동
• 2022~현재. 식품 데이터 플랫폼 구축 사업 참여연구원
• 2021~현재. 비대면 맞춤식품 건강관리 AI 융합 솔루션 개발 참여연구원
• 2024~2025. 기계학습 기반 식품 특이적 데이터 생성 모델 개발 연구책임자

수상
• 2025. 과학기술정보통신부 데이터 기반 활성화 유공

ABSTRACT

디지털 전환과 인공지능 기술의 발전에 따라 식품 R&D는 데이터 중심 패러다임으로 전환되었으며, 연구 전주기에 걸친 데이터의 체계적 관리와 고도화된 활용 역량이 핵심 요소로 부상하고 있다. 특히 가공, 유통, 안전, 제조, 식이, 기능성 등 다양한 식품 연구에서 생성되는 실험, 분석, 문헌 및 특허 등의 이질적인 데이터는 표준화와 연계를 통한 활용이 연구의 재현성과 산업 적용 가능성 확보에 중요하다. 이에 따라 데이터 관리계획 (Data Management Plan, DMP)을 기반으로 한 표준화된 연구데이터 관리와 이를 효과적으로 지원하는 디지털 인프라 및 AI 기반 지능형 도구의 필요성이 증가하고 있다.

본 발표에서는 한국식품연구원의 DMP 기반 연구데이터 관리체계를 소개하고, 연구데이터의 수집, 저장, 표준화, 공유 및 재사용을 지원하는 관리 프로세스와 데이터 거버넌스 구조를 설명한다. 또한, 식품 데이터 플랫폼 구축 사업을 통해 개발·운영 중인 핵심 인프라인 식품 데이터 플랫폼을 소개한다. 해당 플랫폼은 분산된 식품 연구데이터를 통합 관리하고, 메타데이터 표준화, 데이터 연계 및 검색, 분석 지원 기능을 제공함으로써 연구 자원의 축적과 활용도를 극대화하고 협력 연구 및 기술 확산을 촉진한다.

또한 AI 에이전트를 활용한 연구데이터 관리 및 활용 방안을 제시한다. AI 에이전트는 자연어 기반으로 연구자의 의도를 이해하고, 데이터 탐색, 메타데이터 생성, 품질 점검, 데이터 정제 및 분석 지원 등 연구데이터 관리 전반을 자동화·지능화한다. 나아가 데이터 간 관계를 학습하여 지식화함으로써, 단순 관리 도구를 넘어 연구 의사결정 지원 및 인사이트 도출까지 기능을 확장할 수 있다. 그 중 하나로 AI 에이전트 기반 DMP 작성 지원 기술을 소개한다. 해당 기술은 연구 계획을 바탕으로 생산 예정인 데이터 유형을 유추하고, 데이터 명세, 생산 및 관리 계획, 표준 및 공유 전략 등을 DMP 구조에 맞게 자동 생성한다. 이를 통해 연구자의 DMP 작성 부담을 경감하고, 데이터 관리의 일관성과 품질을 확보할 수 있으며, 연구 초기 단계부터 데이터 중심 연구 설계를 유도함으로써 기관 차원의 데이터 거버넌스 체계를 강화할 수 있다.

본 발표는 식품 데이터 플랫폼과 AI 에이전트의 결합이 연구데이터 관리 고도화를 넘어, 연구 성과의 산업적 확산과 가치 창출로 이어지는 AI 기반 식품시스템 전환의 핵심 인프라가 될 수 있음을 제시한다.

Taste Intelligence for hyper-personalization of food commerce

CURRICULUM VITAE

양 선 흥

근무처
- ㈜팜킷

학력
- 서울대학교 푸드테크 최고책임자과정
- 미네소타주립대 경영학 석사 (MBA, 미국)
- 연세대학교 전기전자공학부 학사

경력
- ㈜팜킷 | CEO & Co-Founder
- 현대자동차그룹 | AI 신규사업전략 담당
- 한화에어로스페이스 | 로봇사업 전략기획
- 삼성테크윈 | 전사 전략마케팅 담당
- 한국오라클 | 솔루션 기술영업

주요활동
- 팁스 (TIPS) 프로그램 창업기업 선정
- Microsoft for Startup 프로그램 선정
- CES 2025 유레카파크 참가
- 2025년 초격차 스타트업 1000+ 프로젝트 AI 스타트업 LLM 챌린지 선정
- TechCrunch Disrupt 2025 참가

수상
- 웰컴투팁스 우수상 중소벤처기업부장관 수상 (2025)
- 식의약 데이터 활용 경진대회 (식약처) 최우수상 2건 수상 (2023)
- 농림축산식품부 농식품 분야 우수 벤처창업 기업 선정 (A-벤처스 68호)

기타
- 특허 (등록): US 1건, KR 8건

ABSTRACT

The consumption of food and beverages through online platforms has become increasingly mainstream, with many consumers purchasing from e-commerce marketplaces or ordering delivery via mobile applications. According to The Business Research Company, the global food and beverage e-commerce market is valued at approximately $752 billion USD and is projected to grow rapidly with a CAGR of 18.5%. In response to this growth, food commerce companies are leveraging data collected from digital shopping and ordering environments to enhance conversion rates and revenue through targeted marketing and personalized customer experiences.

Farmkit offers a cutting-edge solution for food commerce businesses by utilizing its proprietary AI-powered Taste Intelligence technology. This system analyzes consumer food preferences, purchase intentions, and nutritional needs to deliver personalized product recommendations and automatically generate customized meal plans. By integrating advanced AI technologies such as Natural Language Processing (NLP), machine learning (M/L), and large language models (LLMs), Farmkit enables the automatic analysis of consumer taste profiles and processed food characteristics, driving hyper-personalized recommendations and transforming the food commerce landscape.

S5

식품 제조 패러다임의 전환: 푸드테크 기반 공유공장 지원 및 규제 혁신 실증

후원 한국식품산업클러스터진흥원

장소 그랜드볼룸 1

좌장 배승현 (한국식품산업클러스터진흥원)

10:00-10:30	**식품 제조혁신 공유플랫폼: 푸드테크 공유공장 지원 및 GMP 공유공장 운영 실증** 박정섭 (한국식품산업클러스터진흥원)
10:30-11:00	**공유 인프라 기반 식품제조 패러다임 전환 사례: 업사이클 콩 발효소재를 활용한 기능성 크림소스 상용화** 윤서연 ((주)소이프트바이옴)
11:00-11:30	**규제 혁신으로 여는 미래: 공유 제조 플랫폼을 활용한 식품 및 건강기능식품 발전 전략** 이철수 (한국식품산업협회)

식품 제조혁신 공유플랫폼: 푸드테크 공유공장 지원 및 GMP 공유공장 운영 실증

CURRICULUM VITAE

박 정 섭

근무처
• 한국식품산업클러스터진흥원

학력
• 2007.07~2010.08. 전북대학교 (화학공학과, 박사
• 2002.08~2004.02. 우석대학교 (생명공학과), 석사

경력
• 2017.07~현재. 한국식품산업클러스터진흥원 (실증지원부 차장)
• 2014.09~2017.07. 대두식품 품질관리 팀장 (식품개발 및 공정개선)
• 2013.03~2014.09. 한국농업경영기술연구원 책임연구원 (농식품 교육 및 사업발굴)

주요활동
• 강의 경력
  – 2024.03~2025.12. 전북대학교 푸드테크학과 (HMR, 대체식품 등)
  – 2015.03~2015.12. 군장대학교 식품공학과 (식품가공학의 이해)
  – 2014.03~2014.12. 전북대학교 한약자원학과 (한방화장품학의 이해)
• 기타 활동
  – 2025. 식품진흥원 공유주방 운영 총괄
  – 2024. 푸드테크 연구지원센터 수주
    (수요조사, 계획서 작성, 운영방안 수립 등)
  – 2023. 소상공인시장진흥공단과 소상공인 지원 협력
    (소상공인 및 로컬푸드 활성화를 위한 HMR 식품 제조 지원)

수상
• 2025.12. 농식품부장관상
• 2019.12. 전북도지사상
• 2012.12. 전북도지사상

ABSTRACT

푸드테크 산업은 디지털 기술과 식품산업의 융합을 기반으로 빠르게 성장하고 있으며, 이에 따라 식품 제조 및 외식 분야의 스타트업과 중소기업의 시장 진입이 활발해지고 있다. 그러나 초기 기업은 고가의 설비 투자, 위생 및 품질관리 기준 충족, 생산 역량 확보 등의 어려움으로 인해 사업화 과정에서 큰 제약을 받고 있다. 이러한 한계를 극복하기 위한 대안으로 공유형 인프라 기반의 지원 모델이 주목받고 있으며, 특히 공유공장 (주방)과 GMP (Good Manufacturing Practice) 기반 공유공장은 창업부터 제품 상용화까지 전주기 지원이 가능한 핵심 수단으로 평가된다.

한편 식품진흥원의 공유공장 (주방)은 식품제조를 위한 초기 창업자 및 소규모 기업을 대상으로 제품 개발, 시제품 제작, 시장 테스트가 가능하도록 지원하며, 창업 진입 장벽을 낮추는 역할을 수행하고 있다. 현재 파일럿플랜트 (원료소재, 고형제), 기능성식품제형센터 (액상), 소스산업화센터 (소스) 3개 기관에서 공유주방업을 운영하고 있으며, '25년 16개 기업이 공유공장 (주방) 사용계약을 체결·다양한 제품을 생산하고 있다.

그리고 GMP기반 공유공장 규제자유특구 사업은 "규제를 완화한 지역에서 여러 기업이 함께 사용·운영해보고, 푸드테크 산업에 적합한 새로운 제조 모델을 검증하는 정책 실증 사업"으로 2026~2028년 동안 한국식품산업클러스터진흥원을 주관기관으로 추진하고 있다.

이에 식품진흥원의 공유공장 (주방) 운영 사례 및 GMP기반 공유공장 추진 사항에 대해 설명하고자 한다.

공유 인프라 기반 식품제조 패러다임 전환 사례: 업사이클 콩 발효소재를 활용한 기능성 크림소스 상용화

CURRICULUM VITAE

윤 서 연

근무처
- ㈜소이프트바이옴 대표이사

학력
- 홍익대학교 대학원 광고홍보 전공 석사

경력
- 2021~현재. ㈜소이프트바이옴 대표이사
- 2013~202. ㈜네오팜 (건기식·화장품 임상 및 마케팅)
- 2011~2013. 인벤티스헬스 (화장품·의약품 임상/마케팅)
- 2010. 동국대학교병원 임상간호

주요활동
- 템페 발효 부산물 기반 기능성 소재 및 식물성 대체유제품·크림소스 상용화
- 저당·웰니스 브랜드 (JA:YU 등) 운영 및 온·오프라인 유통 채널 확장
- 국가식품클러스터 기능성제형센터 기반 제품 개발 및 생산 실증 수행
- 한국콩연구회 운영이사

수상
- 2024 농림축산식품부 장관상 표창

기타
- 특허: 필수아미노산을 보강한 식물성 발효단백질 및 그 제조방법 (공동 발명)
- 특허: 템페를 이용한 비건치즈 및 그 제조방법
- 특허: 병아리콩과 효모를 활용한 식물성단백 템페 제조방법
- 특허출원: 콩 발효 여액 기반 불포화지방산 함유 식용 오일 및 그 제조방법
- TIPS 기술개발지원사업 선정
- 벤처기업 인증 (혁신성장유형), ISO22000 인증

ABSTRACT

최근 식품산업은 푸드테크, 헬스, 지속가능성의 융합을 중심으로 빠르게 재편되고 있으며, 혁신 식품기술의 상용화를 위한 새로운 제조 생태계의 필요성이 커지고 있다. 특히 기능성 식품소재 분야에서는 초기 설비 투자, 인허가, 품질관리 체계 구축 등의 높은 진입장벽이 기술 사업화의 주요 제약 요인으로 작용해 왔다. 이러한 환경에서 공유 인프라 기반 제조 모델은 기술 기반 식품기업의 시장 진입과 확장을 가능하게 하는 대안으로 주목받고 있다.

본 발표에서는 콩 발효 기반 업사이클 단백질 소재인 아쿠아프로틴 (AquaProtein)을 활용하여 식물성 유크림 제형을 개발하고, 이를 실제 시장에 상용화한 사례를 중심으로 공유공장 기반 제조 모델의 산업적 의미를 제시한다. 해당 기술은 템페 제조 과정에서 발생하는 발효 부산물 (콩 발효추출물)을 활용하여, 기존 유제품 크림의 물성인 유화 안정성, 질감, 풍미를 대체 또는 보완할 수 있는 기능성 제형으로 개발되었다. 이는 국산 콩 기반 소재의 고부가가치화와 지속가능한 자원 활용 가능성을 동시에 보여주는 사례라 할 수 있다.

그러나 이러한 신규 제형의 사업화 과정에서는 생산 설비 구축, 제조업 허가 확보, 품질 인증 체계 정립 등에 상당한 시간과 비용이 요구되며, 이는 스타트업 및 기술 기반 기업에 큰 부담으로 작용한다. 이에 본 기업은 국가식품클러스터 내 기능성제형센터 및 공유공장 인프라를 활용하여 자체 설비 투자 없이 제조 허가와 생산 체계를 확보하고, 저당 식물성 크림소스의 상용화를 달성하였다. 이 과정은 공유 인프라가 단순 생산 지원을 넘어 시험생산, 공정 검증, 품질 안정화, 초기 시장 진입을 가능하게 하는 실증 플랫폼으로 기능할 수 있음을 보여준다.

또한 일부 제품은 실제 유통채널 및 B2B 시장에 진입함으로써, 공유형 제조 생태계가 혁신 식품의 시장 검증 속도를 단축시킬 수 있음을 확인하였다. 본 사례는 ① 공유 인프라를 통한 초기 진입장벽 완화, ② 기술 기반 식품소재의 신속한 시장 검증, ③ 설비 중심에서 기술·네트워크·공유공장 활용 중심으로의 제조 구조 전환이라는 측면에서 식품 제조 패러다임 변화의 가능성을 제시한다.

결론적으로, 공유공장 기반 생산 시스템은 단순한 비용 절감 수단을 넘어 신규 식품기술의 상용화를 가능하게 하는 핵심 인프라로 기능하며, 향후 기능성 식품을 넘어 화장품 및 바이오 소재 분야로의 확장 가능성 또한 기대된다.

규제 혁신으로 여는 미래: 공유 제조 플랫폼을 활용한 식품 및 건강기능식품 발전 전략

CURRICULUM VITAE

이 철 수

근무처
- 한국식품산업협회 부설 한국식품과학연구원

학력
- 건국대학교 미생물공학과 학사, 석사, 박사
- 서울대학교 푸드테크학과 최고경영자과정 수료

경력
- 전)한국보건산업진흥원 식품연구부 수석연구원
- 전)한국식품과학연구원 부원장
- 현)한국식품과학연구원 기업지원본부장

주요활동
- 식약처 식품안전기술위원회 위원
- 축산물위생심의 위원회 위원
- 식약처 자체평가 위원
- 식약처 식품의약품 규제과학혁신 위원회 위원

수상
- 보건복지부 장관상 (2005)
- 식약처장상 수상 (2019,2015,2013)

ABSTRACT

최근 식품 및 건강기능식품 산업은 소비자 맞춤형 제품 수요 증가, 기술 융합 가속화, 그리고 중소기업 중심의 시장 진입 확대 등 구조적 변화를 겪고 있다. 그러나 기존의 제조 인프라 중심 산업 구조와 규제 체계는 초기 투자 부담, 생산시설 확보의 어려움, 그리고 복잡한 인허가 절차로 인해 혁신적인 제품 개발과 시장 진입을 제약하는 요인으로 작용해 왔다. 이러한 한계를 극복하기 위한 대안으로 '공유 제조 플랫폼 (shared manufacturing platform)'이 주목받고 있다.

공유 제조 플랫폼은 생산설비, 품질관리 시스템, 전문 인력 등을 공동으로 활용할 수 있도록 지원하는 인프라로, 특히 식품 및 건강기능식품 산업에서 스타트업과 중소기업의 진입장벽을 낮추고 연구개발 성과의 사업화를 촉진하는 핵심 수단으로 평가된다. 공유제조 플랫폼의 활용을 높이기 위해서는 첫째, 국내외 공유 제조 플랫폼 운영 사례를 비교 분석하여 성공요인과 한계를 도출해야 하며 둘째, 현행 식품 및 건강기능식품 관련 규제 체계가 공유 제조 모델에 미치는 영향을 검토하여 규제 적용상의 문제점과 개선이 필요하다. 셋째, 산업 현장의 수요를 반영한 공유 제조 플랫폼 활성화 전략과 정책적 지원이 필요하다.

공유 제조 플랫폼은 설비 투자 비용 절감, 생산 유연성 확보, 품질관리 수준 향상 측면에서 긍정적인 효과를 가질 것으로 기대된다. 반면, 책임소재 불명확성, 위탁생산에 대한 규제 적용의 경직성, 시설 공동사용에 따른 위생 및 안전관리 기준의 불확실성 등은 개선이 필요한 부분이다. 이를 위해 규제 샌드박스 확대, 표준화된 운영 가이드라인 마련, 디지털 기반 품질관리 시스템 도입 등을 포함한 정책적 개선이 필요하다.

공유 제조 플랫폼은 규제혁신과 결합될 때 식품 및 건강기능식품 산업의 혁신 생태계를 구축하는 핵심 인프라로 기능할 수 있으며, 이를 통해 중소기업 경쟁력 강화와 산업 전반의 고부가가치 창출을 기대할 수 있을 것이다.

S6

K-나물 세계화를 위한 혁신전략

후원 하늘농가 (주)

장소 그랜드볼룸 2

좌장 목진홍 (동국대학교)

10:00-10:30	**K-나물 세계화를 위한 동결건조 간편식 CUBE 제품 개발** 윤종영 (하늘농가 (주))
10:30-10:50	**수확 후 농산물 비파괴 품질 판정 기술 연구 현황** 이아영 (경희대학교)
10:50-11:10	**Plantronics bridging Agri-Food technology and AI** 김재준 (한국전자통신연구원)
11:10-11:30	**Real-time ion sensing platform for next-generation smart farming** 한상길 (인천대학교)

K-나물 세계화를 위한 동결건조 간편식 CUBE 제품 개발

CURRICULUM VITAE

윤 종 영

근무처
- 농업회사법인 하늘농가㈜

학력
- 서울대학교 농생물학과 학사
- 연세대학교 식품생물공학과 석사
- 공주대학교 식품공학과 박사

경력
- ㈜풀무원 R&D, 마케팅
- ㈜동성식품 전문경영인
- ㈜닥터페퍼 오너경영인

주요활동
- 경인지방식품의약품안전청 HACCP 기술지도위원
- 중기부/농림부/산자부/특허개발원 식품·바이오 분야 정부지원사업 평가위원
- 국가직무능력표준 (NCS) 개발위원 (건강기능식품 학습모듈 개발 총괄 PM 등)
- 방위사업청 기술분야 자문위원
- aT 급식관리단 및 농협 협력업체 위생심사 위원

수상
- 경인지방식품의약품안전청장 표창
- 중소기업중앙회장 표창

기타
- 식품기술사
- MENSA international 정회원
- 한국식품과학회지 등 논문 10편 투고
- 트랜스글루타미나제를 활용한 글루텐프리면 등 특허 11건 출원 및 등록

ABSTRACT

1. 동결건조 (Freeze-drying, Lyophilization)는 재료를 급속 냉동한 뒤 진공 상태에서 얼음을 직접 수증기로 승화시켜 수분을 제거하는 기술로, 영양소와 구조를 최대한 보존하면서 장기 저장이 가능하다는 장점이 있습니다. 최근에는 식품·바이오 의약품·우주식품 등 다양한 산업에서 활용이 확대되고 있으며, 특히 아시아 시장에서 급성장 중입니다.

2. 동결건조 기술 정의

1) 원리: 물질을 영하 40℃ 이하로 급속 냉동 → 진공 상태에서 얼음을 직접 수증기로 승화 → 잔존 수분 제거.
2) 특징 – 열에 민감한 성분 (비타민, 효소, 향미 등) 손실 최소화
– 조직 수축이 적어 복원성이 뛰어남
– 최종 수분 함량 1~4%까지 낮출 수 있어 장기 보존 가능

3. 최근 산업 동향 (2025~2026 기준)

1) 식품 산업 – 나물·즉석식품 등 간편식에 적용, 뜨거운 물만 부어도 3분 내 복원되는 제품 출시
– 영양소 95% 이상 보존, 유통기한 수년 연장 가능
2) 바이오 의약품 – 단백질 의약품 안정화에 핵심 기술로 자리잡음
– 글로벌 바이오 의약품 시장은 2025년 기준 약 5,800억$ 규모, 연평균 12% 성장 중
3) 항공우주·군수 분야 – 우주식품, 응급구호식품, 군용 비상식량에 활용
4) 지역별 성장 – 아시아 시장에서 특히 높은 성장률 기록, 한국에서도 연구·상용화 활발

4. 동결건조 vs 일반건조 비교

구분	동결건조	일반 열건조
온도 조건	저온 (냉동 후 진공 승화)	고온 (열풍, 드럼 등)
영양소 보존율	90~95% 이상	50~70% 수준
복원성	원형에 가까움	조직 손상, 변형 많음
비용	고가 (설비·에너지 소모 큼)	상대적으로 저렴
적용 분야	의약품, 고급식품, 우주식품	일반 건조식품, 대량 생산품

5. 향후 전망과 과제

1) 전망 – 고부가가치 식품 및 의약품 중심으로 시장 확대
– 맞춤형 간편식, 기능성 식품, 백신 안정화 등에서 핵심 기술로 자리잡을 가능성 큼
2) 과제 – 높은 비용과 에너지 소모→ 효율적인 장비 개발 필요
– 대량 생산 시 경제성 확보가 관건

수확 후 농산물 비파괴 품질 판정 기술 연구 현황

CURRICULUM VITAE

이 아 영

근무처
- 경희대학교 스마트팜과학과

학력
- 2023.02. 서울대학교 바이오시스템공학과 공학박사
- 2019.08. 서울대학교 바이오시스템공학과 공학석사
- 2017.08. 서울대학교 바이오시스템공학과 공학사

경력
- 2026.03~현재. 경희대학교 스마트팜과학과 조교수
- 2018.09~2026.02. 국립농업과학원 농업공학부 수확후관리공학과 농업연구사

주요활동
- 주요 농산물 수확후 품질 판정 인공지능 모델 개발
- K-food 제조 공정 내 AI 적용, 초지능화 시스템 기술 개발
- 고품질 농산물 생산을 위한 선별 저장 기계 기술 연구
- 스마트 양잠 영농 자동화 기반 기술 개발
- 신선편이 가공시설의 안전성 유해요소 검사를 위한 휴대용 검사기술 연구
- 빅데이터를 활용한 과일 당도 선별 시스템의 성능 개선 연구

수상
- 2025. 스마트농업MBA교육과정 최우수상 (농촌진흥청 농촌인적자원개발센터)
- 2021. 연구노트 우수상 (농촌진흥청 국립농업과학원)
- 2018. Excellent Presentation Award (ISMAB)

기타
- 2024. 농업기계기사 필기 공동저자 (HJ골든벨타임)

ABSTRACT

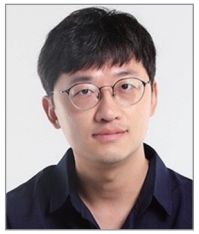
최근 식품 산업에서는 농산물 품질에 대한 소비자의 요구 수준이 비약적으로 높아짐에 따라, 수확후 처리 과정에서의 정밀 선별 기술이 핵심적인 산업 경쟁력으로 부상하고 있다. 전통적인 선별 방식은 주로 작업자의 육안에 의존하거나 단순 중량 및 크기 계측에 머물러 있었으나, 인건비 상승과 객관적 품질 지표 수립의 필요성이 커짐에 따라 자동화 및 고도화된 선별 시스템의 수요가 급증하고 있다. 특히 농산물의 상품성을 훼손하지 않으면서도 내·외부 품질을 신속하고 정확하게 예측할 수 있는 비파괴 분석 기술은 스마트 유통 및 가공 산업의 필수 기술로 주목받고 있다.

본 발표에서는 딥러닝 알고리즘과 첨단 센싱 기술을 결합하여 농산물의 외부 형상과 내부 결함을 정밀하게 판정하는 최신 연구 현황을 소개하고자 한다. 외부 품질 판정 측면에서는 다중 깊이 센서를 활용한 3차원 영상 복원 기술을 통해 전 표면 데이터를 확보함으로써, 단순 투영 면적보다 정확한 체적 및 밀도 예측과 기형과 검출이 가능하다. 특히 참외의 경우, 예측한 밀도값을 기반으로 내부 결함인 물찬과 (발효과)를 효과적으로 선별해낼 수 있음을 확인하였다. 또한 영상 분석에 인공지능 기반 딥러닝 모델을 적용하여 미세한 외관 결함을 실시간으로 판별하며, 육안 식별이 어려운 초기 멍이나 무름 현상을 근적외선 (NIR) 및 초분광 영상과 결합하여 검출 효율을 극대화하고 있다. 내부 품질 판정의 구체적인 사례로, 근적외선 분광 분석법을 도입하여 배 (신고)의 일소과나 내부 갈변을 비파괴적으로 식별하는 모델을 구축하였으며, 형광 초분광 영상을 활용하여 감귤의 초기 무름 현상을 성공적으로 검출해냈다.

이와 더불어 최근에는 단일 센서의 한계를 극복하기 위해 RGB 이미지는 물론 초분광, X-ray 등 여러 센서를 융합하여 데이터를 복합 분석하는 연구를 시도하고 있다. 이러한 시도는 식품 제조 과정에서 발생할 수 있는 이물과 부적합품을 실시간으로 추적 선별함으로써 식품 사고를 미연에 방지하고 소비자 신뢰를 확보하는 기반 기술로 자리매김할 것으로 기대된다. 비파괴 품질 판정 기술의 고도화는 생산자에게는 선별 비용 절감과 부가가치 창출을, 소비자에게는 균일한 고품질 농산물의 안정적 공급을 보장한다. 본 연구들을 통해 개발될 기술들은 단순한 선별 자동화를 넘어 수확후 관리 전반의 데이터 기반 의사결정을 지원하는 스마트 유통 생태계의 핵심 동력이 될 것이며, 궁극적으로 소비자가 안심하고 고품질 농산물을 구매할 수 있는 지능형 스마트팜 환경 조성에 기여하고자 한다.

Plantronics bridging agri-food technology and AI

CURRICULUM VITAE



김 재 준

근무처
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학력
- 2015. KAIST 원자력 및 양자공학과, 박사
- 2011. KAIST 원자력 및 양자공학과, 석사
- 2009. KAIST 물리학과, 학사

경력
- 2022~현재. 한국전자통신연구원 선임연구원
- 2020~2022. The University of Tokyo 전자공학과 (Post-Doc)
- 2015~2020. University of Massachusetts Amherst 고분자/화학과 (Post-Doc)

주요활동
- 기술이전 “식물일체형 전극과 바이오임피던스 분광법 기반 식물건강모니터링 기술” ㈜디지탈코리아, Korea
- 대표논문 “Embeddable Arrows for Electrical Monitoring of Plant Organs Using Gelatin Methacryloyl”, Device (2025)
- 대표논문 “On-Site Identification of Ozone Damage in Fruiting Plants Using Vapor-Deposited Conducting Polymer Tattoos”, Science Advances (2020)

수상
- 국가연구 개발 우수성과 100선 (과학기술정보통신부) (2024)
- JSPS Postdoctoral Fellowship for Research by Japan Society for the Promotion of Science, Japan
- 글로벌 박사 펠로우쉽, 과학기술부, Korea

ABSTRACT

최근 환경오염과 기후변화는 식물의 생육뿐만 아니라 이를 기반으로 생산되는 식품의 품질과 기능성에도 큰 영향을 미치고 있다. 특히 식물에서 생성되는 2차 대사산물은 항산화 물질과 향미 성분 등 식품의 품질과 기능성을 결정하는 핵심 요소이며, 이러한 물질의 생성은 식물이 받는 다양한 스트레스 반응과 밀접하게 연관되어 있다. 따라서 식물의 스트레스 상태를 정확하게 이해하고 관리하는 기술은 기능성 식품 원료 생산과 식품 품질 향상을 위해 매우 중요하다.

본 발표에서는 식물 표면에 부착되는 식물 일체형 전자소자를 이용하여 식물의 생리 반응을 전기 신호로 변환하고 실시간으로 측정하는 기술을 소개한다. 특히 생체 임피던스 측정 기술을 식물에 적용함으로써 식물의 스트레스 반응과 생리적 변화를 비파괴적으로 지속적으로 관찰할 수 있으며, 이를 통해 식물의 상태를 정량적인 전기 신호 형태로 수집할 수 있다. 이러한 방식은 식물 내부의 생리 정보를 센서 기반 전기 데이터로 변환한다는 점에서 기존의 광학적 또는 생화학적 분석 방법과 차별화된다.

특히 이러한 전기 신호 기반 접근은 인공지능 (AI) 분석과의 연계 측면에서 중요한 의미를 갖는다. AI는 기본적으로 전기적·디지털 데이터 형태의 정보를 학습하고 해석하기 때문에, 식물의 생리 정보를 효과적으로 활용하기 위해서는 이를 전기 신호 형태의 데이터로 변환하는 과정이 필수적이다. 본 연구는 식물의 생리 반응을 AI가 이해할 수 있는 전기 신호 데이터의 형태로 생성하고 분석하는 기술적 기반을 제시하며, 이를 통해 식물의 스트레스 상태와 대사 반응을 정밀하게 해석할 수 있다. 이러한 접근은 궁극적으로 식물 스트레스 관리와 대사 반응 조절을 가능하게 하여 2차 대사산물 생성 조절 및 식품 품질 향상에 기여할 것으로 기대된다.

Real-time ion sensing platform for next-generation smart farming

CURRICULUM VITAE

한 상 길

근무처
• 인천대학교 나노바이오공학전공

학력
• 2018. PhD, University of Cambridge
• 2013. 공학석사, 서울대학교
• 2011. 공학사, 동국대학교

경력
• 2023.03~현재. 조교수, 인천대학교
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• 2018.11~2023.02. Postdoc, University of Cambridge
• 2013. 선임연구원, SK하이닉스

주요활동
• 2026. 심사위원, 삼성휴먼테크논문대상

수상
• 우수강의상, 인천대학교 (2023-2학기, 2024-1학기, 2024-2학기)

기타
• 최근 3년간 정부 지원사업 14억 원 이상 수주
• 특허 출원 2건

ABSTRACT

This work presents a real-time multi-ion sensing platform for next-generation smart farming, enabling precise monitoring and control of crop growth environments. The proposed system simultaneously measures key ions, including nitrate (NO_3^-), potassium (K^+), and sodium (Na^+), in hydroponic solutions, providing continuous insight into plant nutrient status and salinity stress. Unlike conventional electrical conductivity (EC) sensors that measure only total ion concentration, the platform enables selective, real-time ion analysis, facilitating data-driven optimization of fertigation strategies.

The system integrates multi-ion sensors with wireless PCB modules and a mobile application for real-time data visualization and analysis. Based on ion concentration data, it supports automated decision-making for nutrient supply, anomaly detection, and growth condition optimization. The sensing mechanism leverages organic electrochemical transistor (OECT)-based technology to enhance sensitivity, selectivity, and stability.

This work contributes to the advancement of precision agriculture by introducing an integrated IoT-based ion sensing solution, paving the way for autonomous and data-driven smart farming systems.

기조강연 2

장소 그랜드볼룸 1

좌장 민세철 (서울여자대학교)

11:30-12:20	**미래 식품산업 혁신방안** **– AI 기반의 K-푸드, 미래산업으로의 전환** 김덕호 (한국식품산업클러스터진흥원)

미래 식품산업의 혁신방안
– AI 기반의 K-푸드, 미래산업으로의 전환

CURRICULUM VITAE

김 덕 호

근무처
- 한국식품산업클러스터진흥원

학력
- 2003.05. 미국 일리노이대 경제학 석사
- 1991.02. 서울대 사회복지학 학사

경력
- 2020.01~2022.01. 농식품공무원교육원장
- 2017.10~2019.06. 농식품부 식품산업정책관

주요활동
- 농촌진흥청 농산물안전성부장
- 농식품부 농업정책국장
- 한국농촌경제연구원 초빙연구원
- 농식품부 국제협력국장
- 대통령실 농수산비서관실 행정관
- 균형발전위원회 지역개발과장

ABSTRACT

1. 배경 및 목적

글로벌 식품시장은 현재 '기술, 문화, 지속가능성' 중심으로 급격하게 재편되고 있다. 특히 K-컬처의 확산으로 K-푸드의 위상은 강화되었으나, 국내 식품산업은 내수 시장 한계, 글로벌 공급망 위기, 인구 고령화 및 지역 소멸이라는 대내외적 위기에 직면해 있다. 본 발표는 이러한 위기를 극복하기 위해 식품산업을 단순 제조업에서 '기술·창의형 전략산업'으로 전환하기 위한 3대 혁신 전략과 구체적인 AI 기술 적용 방안을 제시하는 데 그 목적이 있다.

2. 내용 및 방법 (3대 혁신 전략과 AI 기술 적용)

본 정책 방안은 식품산업의 체질 개선을 위해 다음과 같은 세 가지 핵심 혁신 전략과 AI 기반의 기술 전환을 제안한다.

전략 1. K-푸드 민간기획사 육성: 식품을 단순 상품이 아닌 문화 콘텐츠로 접근하여, 글로벌 팬덤을 전략적으로 공략하고 유통을 전담할 '민간 에이전시 (기획사)' 모델의 도입하여 글로벌 팬덤을 공략한다.

전략 2. 푸드테크 중심의 식품저작권 제도화: 기존 지식재산권으로 보호받기 어려운 식품 레시피와 창의적 기술을 '식품저작권'으로 제도화하여 창작자의 권리를 보호하고, 이를 기반으로 한 수익화 및 기술 거래 생태계를 조성하여 푸드테크 중심의 고부가가치 구조로 개편한다.

전략 3. 공유공장 기반의 지역 클러스터 활성화: 지역 소멸 위기 지역을 대상으로 '공장 없는 제조'가 가능한 공유공장을 구축하여 지역의 창업 생태계를 활성화하고, 교육·정주·문화 인프라가 결합된 식품 복합타운 (약 5천 명 규모) 조성 모델을 제시하여 지역 소멸 위기에 대응한다.

혁신 전략의 실현과 글로벌 경쟁력 강화를 위해 건강, 식문화, 소비 트렌드에 대응할 식품 특화 AI 기술을 제안한다.

개인맞춤식습관 AI 엔진: 개인의 건강 데이터, 식선호도, 생애주기별 영양 상태를 분석하여 최적의 식단을 추천하고 맞춤형 식품 제조를 지원하는 지능형 엔진 구축

음식문화 AI 엔진: 글로벌 트렌드, 지역별 식문화 특성, SNS 데이터 등을 분석하여 K-푸드의 글로벌 현지화 전략과 새로운 음식 문화 콘텐츠를 생성하는 창의적 엔진 개발

AI 데이터 연계 플랫폼: 두 AI 엔진이 원활히 작동할 수 있도록 원료-제조-유통-소비 전 과정의 데이터를 통합 관리하고, 산·학·연·관이 공동 활용할 수 있는 표준화된 데이터 연계 플랫폼 구축

3. 결과 및 분석

제안된 전략들은 다음과 같은 산업적 변화를 이끌어낼 것으로 기대된다.

산업 구조의 고도화: 푸드테크 및 지식기반 산업으로의 전환을 통해 현재 대기업과 영세기업으로 양극화된 산업 구조를 '허리층 기업'이 탄탄한 건강한 생태계로 개편할 수 있다.

AI 기술의 현장 적용: 식품 특화 AI 기술을 제조 공정과 트렌드 분석에 적용함으로써, 소비자 맞춤형 건강 식문화 중심의 기술 전환이 가속화될 것으로 분석된다.

지역 경제 활성화: 공유공장 및 클러스터링을 통해 청년 창업가들이 지역으로 유입되는 창업 생태계가 구축되어 지역 소멸 문제를 해결하는 실질적인 대안이 될 수 있음

4. 결론 및 제언

미래 식품산업은 AI 기술력을 바탕으로 한 '기술·창의형 전략산업'으로 거듭나야 한다. K-푸드의 지속 가능한 성장을 위해서는 민간기획사를 통한 콘텐츠화, 식품저작권 도입을 통한 기술 보호, 그리고 지역 클러스터를 통한 상생 모델이 필수적이다. 본 정책 방안에서 제시한 혁신 전략은 향후 정부의 식품산업 정책 수립 및 기업의 글로벌 진출 전략 수립에 중요한 기초 자료로 활용될 수 있음

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유전자에서 식탁까지:
효소와 개량 미생물이 여는 미래 식품

후원 한국식품연구원

장소 그랜드볼룸 1

좌장 이영경 (한국식품연구원)

13:20-13:50	Mining nature with AI: Discovery of novel hydrolases for food waste valorization 최재웅 (한국식품연구원)
13:50-14:20	Synthetic biology – driven microbial engineering for the design and production of bioactive compounds 황현규 (전북대학교)
14:20-14:50	Smart microbial cell factories enabled by precision fermentation for sustainable food and biomaterials 김수정 (전남대학교)

Mining nature with AI: Discovery of novel hydrolases for food waste valorization

CURRICULUM VITAE

최 재 웅

근무처
- 한국식품연구원
- 전통식품연구부 / 한국인삼연구사업단

학력
- 2013~2018. KAIST 공학박사 (화학및바이오분자공학)
- 2009~2013. 건국대학교 학사 (생명과학및생명공학)

경력
- 2018.07~현재. 한국식품연구원 위촉연구원
- 유전자변형 미생물 승인 2건 (BD001, BD002)

주요활동
- SCI(E) 논문 19편 (제1저자/교신저자 포함)
- 국내 등록특허 6건, 출원 1건
- 학술대회 발표: 국제 3건, 국내 12건
- C. glutamicum 대사공학 및 분비생산 시스템 (10년+)
- 적응실험실진화 (ALE), AI 기반 효소 발굴
- Peer Review: Food Sci. Biotechnol. (2023~2024)

수상
- 해당 사항 없음

기타
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- ORCID: 0000-0001-9436-6369
- 이메일: choijw@kfri.re.kr

ABSTRACT

Food waste represents one of the most complex and underutilized organic resources globally. In South Korea, approximately 5.57 million tons of organic waste are generated annually, and upcoming regulatory mandates require mandatory biogas production from food waste by 2025–2026. However, the efficiency of anaerobic digestion remains constrained by the hydrolysis step, which is rate-limiting due to the recalcitrant nature of food waste components including cellulose, pectin, and lipids.

To overcome this bottleneck, we developed an AI-driven enzyme discovery platform capable of processing large-scale protein sequence databases. The pipeline integrates sequence crawling from public repositories, amino acid alignment-based clustering for structural diversity sampling, and protein language model (PLM)-based prediction of catalytic efficiency (kcat, Km) and solubility. This workflow enables efficient prioritization of high-performance enzyme candidates while significantly reducing computational cost and sequence redundancy.

Three classes of hydrolases were targeted — a cellulase, a polygalacturonase, and a lipase — each selected based on substrate specificity relevant to the major recalcitrant fractions in food waste. Candidate enzymes were cloned, heterologously expressed in *E. coli*, and screened for enzymatic activity against standard substrates. Top-performing candidates demonstrated substantially superior activity compared to commercially available reference enzymes, with up to a 3-fold improvement in polygalacturonase activity and nearly 10-fold in lipase activity.

These results demonstrate that nature-guided, AI-accelerated enzyme mining is a viable strategy for discovering industrially relevant hydrolases, with direct application to improving food waste bioconversion efficiency and supporting circular bioeconomy goals.

Synthetic biology–driven microbial engineering for the design and production of bioactive compounds

CURRICULUM VITAE

황 현 규

근무처
• 전북대학교 식품공학과

학력
• 2021. 공학박사, 포항공과대학교 시스템생명공학부
• 2015. 이학사, 한동대학교 생명과학부

경력
• 2025.09~현재. 전북대학교 식품공학과 조교수
• 2023.02~2025.08. 미국 코넬대학교 박사후연구원
• 2021.08~2023.02. 포항공과대학교 박사후연구원

주요활동
• Young Asian Biological Engineer's Community, iBioX Community, Metabolic Engineering conference 등 국제학회 Oral Presentation
• 미국 국방부 DARPA 과제: PTM 미생물 플랫폼 개발
• 코넬대학교 및 덴마크 바이오텍 기업과의 국제 공동연구: 영유아 조제식용 신규 기능성 소재 개발
• 대사공학, 효소공학, 합성생물학 분야 관련 국내 및 미국 특허 출원
• Metabolic Engineering, Molecular Catalysis, Biotechnology and Bioprocess Engineering 등 국제 학술지 리뷰어 활동

수상
• 2025. American Cancer Society (ACS) Postdoctoral Fellowship Award Selection
• 2020,2018,2017,2016. 한국공업화학회 우수논문발표상
• 2020,2018. 한국생물공학회 우수논문발표상
• 2018. 한국화학공학회 우수논문발표상
• 2018. i-BioN international symposium 우수논문발표상

ABSTRACT

Bioactive compounds, ranging from small molecules such as flavonoids to post-translationally modified (PTM) proteins and peptides, play key roles in nutrition and therapeutics. To explore their microbial production, we developed a synthetic biology–driven platform that enables multi-level pathway optimization. For flavonoid biosynthesis, combinatorial libraries of pathway variants were screened using a riboswitch-guided high-throughput approach, enabling rapid identification of high-performing strains and substantial improvements in production. In addition, we developed microbial platforms incorporating engineered PTM pathways to enable the production of functional biomolecules with defined modification patterns. This approach overcomes limitations of conventional eukaryotic systems in scalability and controllability. Overall, this work highlights an integrated microbial engineering strategy for producing diverse bioactive compounds, providing a versatile platform for applications in food, nutraceuticals, and biomedicine.

Smart microbial cell factories enabled by precision fermentation for sustainable food and biomaterials

CURRICULUM VITAE

김 수 정

근무처
- 전남대학교 식품공학과

학력
- 2009~2014. 서울대학교 농생명공학부 박사
- 2003~2005. 서울대학교 농생명공학부 석사
- 1999~2003. 동국대학교 식물자원학과 (식품공학과)

경력
- 2019~현재. 전남대학교 식품공학과 교수
- 2018~2019. 한국생명공학연구원 합성생물학전문연구단, 연수연구원
- 2017~2018. 미국 Washington University in St. Louis, Postdoctoral researcher

주요활동
- 한국미생물생명공학회 Microbiology and Biotechnology Letters 부편집장
- 국립식량과학원 바이오에너지작물연구소 현장명예연구관
- 한국미생물·생명공학회, 한국생물공학회, 한국식품과학회 정회원

수상
- 학술장려상 (한국미생물생명공학회, 2024)
- 우수신임교수상 (전남대학교)

기타 (연구분야)
- 정밀발효를 이용한 고부가가치 식품, 화장품, 의약품 소재 생산
- 식품 내 위해요소 검출용 바이오센서 개발
- GRAS 미생물의 유전자 도구 및 유전자 회로 개발

ABSTRACT

As the demand for sustainable food and high-value biomaterials increases, the development of smart microbial cell factories has become a pivotal strategy in precision fermentation. This study explores the robust production of shinorine and porphyra-334, which are high-value mycosporine-like amino acids (MAAs) known for their potent UV-protective and antioxidant properties using metabolically engineered *Saccharomyces cerevisiae*.

To establish an efficient production platform, we engineered "smart" genetic circuits to precisely modulate carbon flux toward the pentose phosphate pathway and shikimate pathway, minimizing byproduct formation and maximizing target metabolite titers. These engineered strains were integrated into a precision fermentation process optimized for the upcycling of agro-food wastes, such as rice straw, barley straw, and corn steep liquor.

Our results demonstrate that the synergy between advanced metabolic engineering and optimized fermentation parameters enables the scalable conversion of lignocellulosic biomass into functional biomaterials. This approach not only enhances the economic viability of MAA production but also underscores the role of precision fermentation as a cornerstone for a sustainable bio-economy, providing eco-friendly alternatives for the food and cosmeceutical industries.

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식품품질 향상을 위한 냉동 및 유리화 제어 전략

후원 건국대학교 글로벌기초연구실 (BRL),
강원대학교 강릉 RISE사업단

장소 그랜드볼룸 2

좌장 조연지 (강원대학교)

13:20-13:50	**저장 조건에 따른 아이스크림 얼음입자 성장과 품질 저하 특성** 김지연 (풀무원기술원)
13:50-14:20	**단백질–당–지질 복합체의 유리화 특성** 최미정 (건국대학교)
14:20-14:50	**Impact of freezing–induced glass and crystal states on probiotic viability and storage stability** 한민기 (건국대학교)

저장 조건에 따른 아이스크림 얼음입자 성장과 품질 저하 특성

CURRICULUM VITAE

김 지 연

근무처
- 풀무원기술원

학력
- 2007.02. 건국대학교, 축산식품생물공학과 생물공학, 석사
- 2005.02. 건국대학교, 축산식품생명과학부 축산가공학, 학사

경력
- 2007.01~2012.04. BR코리아 / R&D
- 2012.05~현재. ㈜풀무원 / 풀무원기술원

주요활동
- Dairy / Non-dairy Ice-Cream, 아이스크림 응용 디저트 제품/기술 개발
- 비가열 냉장 과채주스, 상온음료, 얼음, 냉동 디저트 제품/기술 개발
- 떠먹는 식물성 아이스크림 '코코젤라또', '플랜또' 출시 ('23~25년)
- 오버런을 증가시킨 식물성 아이스크림 제조 방법 및 그 제조방법에 의해 제조된 식물성 아이스크림 개발 ('23년 특허출원)

수상
- '식물성 지구식단 코코젤라또 초코' _ Continues IC Freezing 공정 & 냉해동 품질 안정화로 차별화된 Texture와 원물의 맛과 영양을 담은 Plant based 아이스크림 ('23 대한민국푸드앤테크_일반식품 부문 대상 수상)
- 2 Free 1 Add '풀무원지구식단 플랜또 딸기라즈베리' ('24년 대한민국푸드앤테크_Food Tech. 부문 대상 수상)

기타
- 냉장·냉동 식품의 생산·가공·유통 전 과정의 효율을 개선하는 연구개발 전문가
- 특정 소재의 기능적 가능성을 새로운 영역에 확장 적용·재해석하고, 그 효과를 예측하여 생산·가공·유통 전 과정의 기술 구현으로 연결하는 연구개발자

ABSTRACT

본 발표에서는 국내외 아이스크림 연구의 최근 동향을 고찰하고, 저장 조건 변화에 따른 품질 저하 인자를 예측하여 재결정화에 의해 상품성에 큰 영향을 미치는 주요 메커니즘을 분석함으로써 산업적 적용 과정에서 발생하는 한계를 해결하기 위한 기초 자료를 제시하고자 하였다. 아이스크림은 공기, 얼음결정, 비동결상으로 구성된 복합적인 3상 구조 (Air, Ice, Serum phase)를 가지며, 저장 중 얼음결정의 재결정화는 조직감 저하와 품질 열화를 유발하는 핵심 요인으로 알려져 있다. 이에 본 연구에서는 오버런을 주입한 식물성 아이스크림의 구조적 특성에 주목하고, 연속식 아이스크림 제조 공정을 적용하여 오버런 수준에 따른 품질 및 관능 특성을 평가하였다. 그 결과 오버런이 약 45~50% 수준일 때 아이스크림의 조직감과 부드러운 맛에 대한 관능 만족도가 가장 높은 것으로 나타났다. 또한 식물성 아이스크림의 구조 안정화를 위해 고분자 탄수화물인 식이섬유 함량을 식품 100 g당 6 g 이상 포함하도록 배합을 설계할 경우 저장 안정성이 향상되는 경향을 확인하였다. 이는 식이섬유가 비동결상의 점도와 수분 결합 능력을 증가시켜 자유수의 이동을 제한하고 얼음결정의 성장 및 재결정화를 억제하는 구조적 역할을 수행하기 때문으로 판단된다. 이상의 결과를 종합하면, 변화하는 냉동 유통 환경에서 아이스크림의 품질과 관능 특성을 안정적으로 유지하기 위해서는 비동결상의 동결점 제어와 함께 수분 이동성을 억제하고 구조 안정성을 확보하는 배합 및 공정 설계가 중요한 기술적 접근임을 확인하였다.

단백질–당–지질 복합체의 유리화 특성

CURRICULUM VITAE

최 미 정

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- 건국대학교 축산가공학과 농학석사
- Claude Bernard Université de Lyon 1 나노식품공학 이학박사

경력
- 2025.03~현재. 건국대학교 산학협력단 부단장
- 2020.09~현재. 건국대학교 식품과학전공 정교수
- 2018.07~2019.07. 과학기술정보통신부 연구산업진흥과 과장

주요활동
- 2026.02~현재. 한국연구산업협회 이사
- 2025.09~현재. ICoMST2026 조직위원회 위원
- 2025.06~현재. 국가과학기술자문회 심의 기계소재전문위원회 전문위원
- 2025.01~25.12. (사)한국산업식품공학회 학술위원
- 2024.09~현재. 농림식품기술기획평가원 농식품 연구개발사업 공동기획단 위원

수상
- 2023. 농림축산식품부 장관상
- 2021. 과학기술정보통신부 장관상
- 2020. 국가과학기술 우수성과 100선 선정
- 2016. 국립농업과학위원장 공로상

ABSTRACT

Amorphous matrices are widely used as delivery systems for protecting and transporting bioactive compounds because of their high solubility, dispersibility, and rehydration capacity. The glass transition temperature (Tg) is a key parameter governing the physical stability of amorphous structures. Below Tg, the matrix remains in a stable glassy state with low molecular mobility, whereas above Tg, increased molecular mobility promotes stickiness, crystallization, and other quality-deteriorating changes. Therefore, understanding the glassy-state properties of amorphous materials is essential for the design of stable formulations and the establishment of appropriate storage conditions.

In this study, the glassy-state characteristics of major food components, including proteins, saccharides, and lipids, were considered. Carbohydrate is the most common glass-forming material in foods. However, their glass transition behavior is highly dependent on moisture content because of the plasticizing effect of water. Protein is also highly relevant in this context, as increased molecular mobility can lead to irreversible structural changes such as denaturation and aggregation, making their glassy-state behavior important for stability. In contrast, lipid forms oil droplets and interfacial regions within amorphous matrices, and factors such as droplet size and distribution may influence the thermal properties of the system.

Among these food components, starch is a representative carbohydrate that undergoes various phase transitions during food processing, including gelatinization, retrogradation, and glass transition. In particular, its glass transition behavior is closely associated with structural rearrangement and quality changes. Accordingly, this study aimed to investigate the effects of low-molecular-weight saccharides on the formation and moisture-dependent stability of corn starch matrices. The rheological behavior, glass transition temperature, and water sorption properties of gelatinized starch-saccharide systems were examined and further evaluated using the Guggenheim-Anderson-de Boer and Gordon-Taylor models.

The findings are expected to contribute to a broader understanding of glass transition behavior in food composite systems and to provide fundamental information for predicting storage stability and designing food processing conditions.

Impact of freezing-induced glass and crystal states on probiotic viability and storage stability

CURRICULUM VITAE

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- 건국대학교 줄기세포재생공학과 이학박사

경력
- 건국대학교 첨단바이오공학부 박사후연구원

주요활동
- Han MG, Lee R, Sim HW, Lee WY, Park YB, Lee SH, Park JH. Effects of Bacillus licheniformis and Bacillus subtilis on Growth Performance, Gut Health, and Immunity in Pigs. J. Anim. Sci. Technol. (2026)
- Han MG, Lee WY, Park JH. Protective effects of Mitoquinone (MitoQ) supplementation on the quality of boar semen stored at 4℃ for artificial insemination. J Anim Reprod Biotechnol. 40 (4): 180-188. (2025)
- Han MG, Lee R, Park HJ, Lee KH, Song H. Effect of replacement feed ingredients of Micropterus salmoides in exotic species. J Anim Reprod Biotechnol. 38:225-235. (2023).

수상
- 2025. 한국동물생명공학회 구두발표 우수상
- 2021. 한국동물생명공학회 구두발표 장려상

기타
- 2025. European testis workshop 발표 선정

ABSTRACT

Increased glass transition temperatures (Tg) are essential for enhancing microbiological stability since they decrease molecular mobility in dried matrices. This study investigated the effects of amorphous and crystalline physical states generated by controlled freezing protocols on the survival of *Leuconostoc mesenteroides* during freezing, freeze-drying, and storage. Using lactose or inulin as carbohydrate components, whey protein isolate (WPI) served as a protein matrix. Before freeze-drying, formulations containing *L. mesenteroides* were either rapidly frozen in one step at -100°C to create amorphous states or in two steps at -5°C and -100°C to promote crystallization. Structural and thermal properties were characterized by X-ray diffraction (XRD), and Fourier-transform infrared spectroscopy (FTIR) and differential scanning calorimetry (DSC). Moisture sorption behavior and Tg-moisture relationships were analyzed using the Guggenheim–Anderson–de Boer (GAB) model and Gordon–Taylor (GT) equation. Rapid freezing produced amorphous matrices with higher Tg values and increased molecular disorder compared to crystalline matrices. GAB and GT analyses demonstrated that moisture interactions and glass transition behavior were dependent on carbohydrate type, with amorphous matrices providing enhanced stability compared to crystalline samples. After 30 days of storage, amorphous matrices retained higher probiotic viability than crystalline samples (p<0.05). In particular, the amorphous inulin system showed the highest survival (85.88%), whereas crystallization resulted in a pronounced decrease in viability (53.39%). These results demonstrate that controlling freezing-induced physical state and moisture interactions is essential for enhancing probiotic stability.

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고부가가치 블루푸드 제품개발을 위한 융복합 기술 적용 전략

후원 국립부경대학교 블루푸드 융합기술연구소

장소 그랜드볼룸 1

좌장 유상묵 (경북대학교)

15:00-15:30	**라만분광법을 활용한 수산식품의 비파괴 품질 · 안전성 신속 분석 기술 개발** 남원일 (국립부경대학교)
15:30-16:00	Enhancing volatile profiles and sensory attributes of edible insect oils through optimized extraction and roasting strategies 장혜원 (성신여자대학교)
16:00-16:30	Kinetics and mechanisms of sargahydroquinoic acid degradation: effects of acidification and extract matrix on stabilization Cao Lei (국립부경대학교)

라만분광법을 활용한 수산식품의 비파괴 품질 · 안전성 신속 분석 기술 개발

CURRICULUM VITAE

남 원 일

근무처
- 국립부경대학교 전자공학

학력
- 부산대학교, 전자공학 학사
- Virginia Tech, Electrical and Computer Engineering 박사

경력
- Harvard Medical School

기타
- ScholarGPS 라만분광학 분야 세계 상위 0.5% 연구자

ABSTRACT

라만분광법을 활용하여 수산식품의 품질 및 안전성을 비파괴적으로 신속 분석하기 위한 기술 개발 내용임. 본 연구에서는 대표 수산가공식품인 김을 대상으로 라만 스펙트럼 데이터를 수집하고, 이를 기반으로 품질 특성 지표를 판별할 수 있는 분석 가능성을 평가하고자 함. 특히 복잡한 전처리 없이도 시료 고유의 분자 지문 정보를 신속하게 확보하고, 라만 피크 및 스펙트럼 패턴 해석을 통해 품질 저하와 이상 징후를 효과적으로 구분할 수 있는 분석 체계를 확립하고자 함. 나아가 김 유래 데이터의 축적과 AI 기반 판별 모델 고도화를 통해 현장 적용성이 높은 수산식품 품질·안전성 평가 플랫폼 구축의 기초자료 확보를 목표로 함.

Enhancing volatile profiles and sensory attributes of edible insect oils through optimized extraction and roasting strategies

CURRICULUM VITAE

장 혜 원

근무처
- 성신여자대학교 바이오식품공학과

학력
- University of California, Davis, Agricultural and Environmental Chemistry 박사
- 동국대학교 식품공학 학사/석사

경력
- 한국식품연구원 가공공정연구단, 선임연구원

주요활동
- 식품의약품안전처, 식품위생심의위원회
- 특허청, 특허 및 실용신안등록출원 심사자문위원
- 한국식품영양과학회 운영위원 (학술)
- 한국분석과학회 이사 (식품/농화학), 편집위원
- 한국식품과학회 국문지 편집자
- 한국응용생명화학회 운영위원 (섭외), 식품생명분과 위원

수상
- 농림축산식품부장관상 (2023)
- KIAST-이대운 학술상 (2025)
- 성신여자대학교 표창장 (우수 연구성과)
- LECO 젊은 분석과학자상 (2019, 2025)
- 국가과학기술연구회 우수신진연구자상 (2018)

ABSTRACT

Edible insects are emerging as sustainable lipid resources, yet their unique off-flavors remain a significant barrier to consumer acceptance. This study investigated a comprehensive processing strategy to refine the flavor quality of insect oils by integrating optimized extraction and roasting techniques while evaluating their fatty acid profiles.

Initially, the volatile and fatty acid compositions of oils obtained via supercritical fluid extraction (SFE) and ultrasound-assisted extraction (UAE) were compared. SFE, optimized at 400 bar and 55℃, achieved higher total volatile concentrations and greater chemical diversity than UAE. Fatty acid analysis revealed that oleic, linoleic, and palmitic acids were predominant across species, with *Locusta migratoria* oil exhibiting particularly high levels of essential α-linolenic acid.

To address the sensory limitations, roasting was implemented as a value-added processing step. Optimized roasting at 150℃ for 30 min significantly modulated the volatile profiles, triggering the formation of favorable Maillard-derived compounds such as pyrazines and furans. These compounds imparted "nutty," "roasted," and "baked" notes, which successfully masked undesirable "fishy" and "ammonia-like" notes, leading to substantially higher consumer odor-liking scores.

Overall, the integration of optimized extraction and roasting is a pivotal strategy for enhancing the sensory appeal of edible insect oils while maintaining their high-quality fatty acid profiles. These findings provide a scalable approach to accelerate the incorporation of insect-derived lipids into the global food system.

Kinetics and mechanisms of sargahydroquinoic acid degradation: effects of acidification and extract matrix on stabilization

CURRICULUM VITAE

Cao Lei

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학력
- 2016.10. Mississippi State University, 박사
- 2012.08. University of Connecticut, 석사

경력
- 2023.04~2024.08. 국립부경대학교
- 2023.04~2024.08. 가천대학교
- 2019.06~2022.12. 국립부경대학교

주요활동
- 근육 수축력과 기능적 수행능력 평가를 기반으로 기능성 식품의 항근감소 효과를 규명하기 위한 organ-on-a-chip 플랫폼 개발
- 해양조류 유래 기능성 성분의 추출·분석 및 항산화·항염증 활성 연구
- SHQA 등 해양 유래 meroterpenoid의 안정성·분해기작 및 기능성 식품 응용 연구
- 세포·동물모델 기반 근감소증·대사질환 관련 기능성 소재 효능 및 작용기전 연구

ABSTRACT

Sargahydroquinoic acid (SHQA), an algal-derived meroterpenoid, exhibits potent antioxidant activity but poor chemical stability. This study systematically characterized its thermal degradation and explored proton-mediated and matrix-based stabilization strategies. LC-MS/MS and kinetic modeling demonstrated that SHQA sequentially converts into sargaquinoic acid and sargachromenol through oxidation and 6π-electrocyclization, resulting in a major decline in antioxidant capacity. DFT analysis showed that oxidation lowers the HOMO energy and increases the chemical reactivity of the degradation products. Weibull analysis indicated rapid initial degradation (β<1) that was suppressed under acidic conditions. Acidification remarkably extended the half-life at 37 °C from 1.28 h (control) to 119.4 h (1% acetic acid) and 3065 h (0.1% HCl). The crude extract matrix further enhanced stability (t1/2=182 h), with an additive effect only observed with 1% acetic acid. These findings elucidate SHQA's degradation mechanism and provide practical strategies for maintaining its bioactivity in marine-derived functional food applications.

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지속가능 식품 시스템 전환을 위한 차세대 식품 기술

| 신진연구자 발표 |

장소 그랜드볼룸 2

좌장 이동훈 (가천대학교)

15:00-15:20	From sea to soil: Valorization of blue food resources for the food industry 곽호정 (국립부경대학교)
15:20-15:40	Toward a new paradigm of sustainable alternative foods driven by technological innovation and convergence 이정수 (부산대학교)
15:40-16:00	Cell-cultured milk production via milk tree construction 권혁철 (한국식품연구원)
16:00-16:20	Functional enhancement of plant protein through structural modification 최우열 (건국대학교)

From sea to soil: Valorization of blue food resources for the food industry

CURRICULUM VITAE

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• 2017~2021. 서울대학교 바이오소재공학 (농학박사)

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연구분야
• 수산식품 부산물 기능성 성분 추출 및 고부가가치 자원화 연구
• 생분해성 고분자 및 천연고분자 기반 식품 응용기술 발굴
• 계산과학 및 유동해석 기반 구조·물성 정량화 및 현상 해석

기타 (대표실적 등)
• *Advanced Materials*, 37, 9, 2417266 (Co-first Author, 2025; IF 26.8)
• *Carbohydrate Polymers*, 360, 15, 123612 (First Author, 2025; IF 12.5)
• *Nature Materials*, 23, 3, 414-423 (Co-first Author, 2024; IF 38.5)
• *Advanced Science*, 10, 1, 2205554 (First Author, 2023; IF 15.1)
• *Carbohydrate Polymers*, 258, 15, 117688 (First Author, 2021; IF 12.5)

ABSTRACT

Blue food resources, including seaweeds, marine invertebrates, fishery by-products, and aquatic microorganisms, are increasingly recognized as sustainable biomass for the future food industry. Beyond their role as conventional food ingredients, these marine resources contain structurally diverse biopolymers and functional compounds that offer unique opportunities for food design, packaging, and environmentally friendly material development. In particular, marine-derived polysaccharides and related biomacromolecules exhibit distinctive physicochemical properties such as biodegradability, water-binding capacity, ionic responsiveness, and structural tunability, making them promising candidates for next-generation food applications.

A broad perspective is presented on the valorization of blue food resources from sea to soil, highlighting how marine biomass can be converted into value-added platforms for the food industry and beyond. The discussion begins with the structural characteristics and functional diversity of representative blue food-derived materials, with particular emphasis on polysaccharides obtained from algae, crustaceans, and marine microbial systems. It then turns to recent research examples demonstrating how these materials can be engineered into advanced hydrogels, degradable polymer systems, and functional matrices with potential relevance to food technology. Attention is finally given to future strategies for extending the use of blue food resources toward broader industrial applications, including smart food packaging, texture-controlled food manufacturing, and sustainable agricultural or environmental systems.

By bridging marine biomass utilization, material science, and food engineering, the broader perspective aims to position blue food resources not only as nutritional commodities, but also as versatile and sustainable building blocks for a circular bioeconomy. Such a perspective may help expand the role of marine resources in creating resilient, eco-friendly, and high-value solutions for the future food industry.

Toward a new paradigm of sustainable alternative foods driven by technological innovation and convergence

CURRICULUM VITAE

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- 고려대학교 생명공학과 (시스템식품생명공학 전공), 석사
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연구분야
- 다양한 가공 공정 (압출·3D 프린팅·동결-해동)을 활용한 식물성 대체육 개발
- 박테리아 셀룰로오스의 식품 포장 및 가공 분야에서의 다양한 활용 전략 개발
- 기타 (대표실적 등)

- Lee, J. S., Lyu, J. S., & Han, J. (2026). Engineering meat-like performance in plant-based burger patties: focusing on structural, cooking, and textural properties. Food Science and Biotechnology, 35 (2), 379-389.
- Lee, J. S., Jeong, Y. J., & Han, J. (2025). In-line salt solution injection as an ionic modulation strategy in high-moisture extursion of plant-based meat alternatives: Effects on fibrous structuring. Food Hydrocolloids, 112138.
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ABSTRACT

Meat alternatives are defined as food products designed to replace or mimic conventional meat without depending on traditional livestock production systems. They are produced using non-livestock-derived resources, including plants, seaweeds, fish, insects, and animal cell culture technologies, with the aim of replicating the appearance, texture, flavor, nutritional composition, and cooking characteristics of meat, or functionally substituting for it.

At present, extrusion-based structuring is the most widely employed processing technology in the global meat alternative industry. Most fibrous plant-protein products are manufactured by extrusion, and this technology has become a cornerstone of meat-alternative production owing to its capacity for continuous processing and strong potential for industrial-scale application.

Nevertheless, extrusion processing presents clear limitations from a sustainability perspective. Because it relies on high-temperature, high-pressure, and high-shear conditions, it is inherently energy-intensive. Moreover, extrusion systems require costly industrial equipment, leading to high capital investment and considerable operational and maintenance expenses. These characteristics are fundamentally inconsistent with the low-carbon, low-energy, and environmentally sustainable protein production systems that meat alternatives aspire to realize, thereby constraining their long-term technological, economic, and environmental sustainability.

Accordingly, both industry and academia must move beyond the current overdependence on extrusion as the dominant processing platform. In other words, rather than adhering to the conventional assumption that extrusion is the only viable solution, there is a pressing need to develop next-generation low-energy processing strategies. Such efforts will be essential to enhancing the sustainability and industrial competitiveness of future meat-alternative technologies.

Cell-cultured milk production via milk tree construction

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연구분야
- 배양우유 생산을 위한 배양기법 및 시스템 개발 연구
- 배양우유 생산을 위한 젖소 유선세포주 확립 및 배양액 최적화 연구
- 유제품 유래 소재 활용 품질 및 기능성 개선을 통한 고부가가치화 연구
- 식물성 소재 활용 대체우유 개발 및 품질특성 평가 연구
- 기능성 소재 첨가를 통한 발효 유제품의 건강 기능성 평가 연구

기타 (대표실적 등)

- Kwon, H. C., Jung, H. S., Kim, D. H., Han, J. H., Han, S. G. (2025). Cellular characteristics and milk component productivity of primary bovine mammary cells for cell-cultured milk component production. Journal of Animal Science and Technology, 67 (1), 236.
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ABSTRACT

The Fourth Industrial Revolution and the advancements in food technology are driving the development of cell-cultured food production techniques within cellular agriculture. Cellular agriculture is an innovative field that produces components of animal-derived foods such as meat, milk, eggs, and seafood through the cultivation of animal cells or microorganisms. Specifically, cell-cultured milk can be produced through the cultivation of mammary epithelial cells. However, the establishment of mammary epithelial cells (MECs), optimization of culture media composition, implementation of 3D cell culture systems, and development of downstream processing still remain major challenges for the commercially viable production of cell-cultured milk components. Our previous studies demonstrated that the optimization of hormones and amino acids enhanced the proliferation of immortalized bovine MECs (MAC-T), thereby suggesting a potential increase in milk component production. Furthermore, progesterone can effectively substitute for the highly expensive prolactin, which is essential for inducing MEC differentiation and milk component synthesis. Despite the optimizations in MAC-T cells, applying these conditions to primary bovine MECs revealed limitations due to the cellular instability arising from their finite lifespan. Therefore, this presentation will outline the plans to establish a novel MEC line by immortalizing primary MECs and inducing their prolactin overexpression. Furthermore, the proposed strategies for optimizing the culture media for milk protein production and constructing a ‘milk tree’ using plant-derived decellularized scaffold will be discussed. Ultimately, these plans aim to secure fundamental technologies for commercial cell-culture milk production.

Functional enhancement of plant protein through structural modification

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- 식품 3D프린팅
- 탄수화물 가공 및 소화능 관계 규명
- 단백질과 탄수화물의 상호작용

기타 (대표실적 등)

- Choe, U., Osorno, J. M., Ohm, J., Chen, B., Rao, J. 2021. Modification of physicochemical, functional properties, and digestibility of macronutrients in common bean (Phaseolus vulgaris L.) flours by different thermally treated whole seeds. Food Chemistry, 382, 132570.
- Choe, U., Lan, Y., Chen, B., Rao, J. 2022. Structural, and Functional Properties of Phosphorylated Pea Protein Isolate by Simplified Co-Spray Drying Process. Food Chemistry, 393, 133441.
- Choe, U., Chang, L., Ohm, J, Chen, B., Rao, J. 2022. Structure modification, functionality and interfacial properties of kidney bean (Phaseolus vulgaris L.) protein concentrate as affected by post-extraction treatments. Food hydrocolloids, 133, 108000.

ABSTRACT

Due to global population growth and climate change, plant-based proteins are gaining attention as important alternatives that can complement animal-derived proteins. However, compared to animal proteins, plant proteins have several limitations, one of which is their functionality. Functional properties of plant proteins such as solubility, emulsifying capacity, and foaming ability are significantly lower than those of commonly used animal proteins like eggs and milk. This is largely related to their structural characteristics. Therefore, this presentation aims to introduce various methods to improve the functionality of plant proteins through structural modification, as well as to discuss the current limitations in research.

POSTER
SESSION

Enhancing 3D printing performance via conjugation of soy protein isolate and high-methoxyl pectin

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Extrusion-based 3D food printing requires inks that shear-thin for smooth extrusion and rapidly rebuild a self-supporting structure after deposition. Soy protein isolate (SPI) is a promising plant-protein base, but SPI-only inks often show a narrow printability window due to unstable high-shear flow at high solids and insufficient shape fidelity at lower solids. Here, SPI–high methoxyl pectin (HMP) conjugates were produced via a wet-heating Maillard-type reaction (pH 7.5, 90°C, 2 h) and compared with native SPI, heat-treated SPI, and a physical SPI–HMP mixture. Conjugation was supported by increased UV–Vis browning indices (A304 and A420) and FT-IR band-shape changes in the carbohydrate fingerprint region, accompanied by improved pH-dependent solubility. Rheological tests of inks (15–25% solids) showed elastic-dominant behavior (G′>G″) and shear-thinning for all samples; however, native SPI and the physical mixture exhibited abrupt viscosity drops at high shear rates, suggesting macroscopic flow instabilities, whereas the conjugate maintained a smooth, continuous viscosity decay and faster post-shear structural recovery. Printing trials using cylindrical and lattice constructs confirmed the highest shape fidelity for the conjugate at 25% solids, while 15% solids were below the buildable threshold for all formulations. Overall, SPI–HMP conjugation offers a clean-label route to tune structure–rheology–printability relationships and expand the printing window of protein-rich SPI inks.

Interfacial behavior of defatted brown rice protein in a rice bran oil/water system

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Brown rice protein has attracted attention as a plant-based emulsifier. However, its interfacial characteristics have not been quantitatively characterized in detail. In this study, defatted brown rice protein (dBRP) was prepared to investigate its composition, solubility, and apparent HLB-equivalent value in a rice bran oil (RBO)/water system. Defatting markedly decreased the crude fat content from 22.7% to 5.5% and increased the protein content from 68.0% to 88.9%. In addition, dBRP exhibited improved solubility across a wide pH range (2–12) compared to non-defatted BRP. The interfacial tension at the RBO/water interface was measured at 25°C using the Wilhelmy plate method. To estimate the apparent HLB-equivalent value, a regression curve was established using standard surfactant mixtures (0.1%, w/w) with HLB values between 4.3 to 14.0. The interfacial tension of dBRP (0.1%) was measured as 9.16±0.02 mN/m, corresponding to an apparent HLB-equivalent value of approximately 10.2 based on the regression analysis. These results indicate that dBRP possesses amphiphilic properties suitable for stabilizing oil-in-water emulsion in the RBO/water system. Nevertheless, further investigation, including determination of the required HLB, is needed to more fully elucidate its interfacial functionality.

Controlled self-assembly of flower-like starch microparticles for plasmonic SERS sensing

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Herein, we demonstrate that kinetic regulation of ethanol-driven antisolvent precipitation enables the controlled self-assembly of enzymatically debranched short-chain glucans (SCGs) into uniform flower-like starch particles. The addition of hyaluronic acid slows early-stage SCG association, allowing petaloid clusters to reorganize into radially integrated flower-like architectures. Residual pullulanase influences nucleation behavior, while modulation of enzyme dosage during hydrolysis enables systematic tuning of particle diameter across the micrometer scale with narrow size distributions. The petal-rich surfaces provide abundant hydroxyl groups that facilitate adsorption of Au(III) ions, and subsequent mild reduction yields densely and uniformly distributed gold nanoparticles on the flower surfaces. The hierarchical inter-petal gaps and nanoparticle junctions generate a high density of electromagnetic hotspots, producing strong surface-enhanced Raman scattering (SERS) signals. Using 4-mercaptobenzoic acid (4-MBA) as a model probe, the gold-decorated flower-like particles enable reliable and quantitative SERS detection at very low concentrations with excellent signal reproducibility. These flower-like glucan particles therefore provide a clean-label, size-tunable scaffold that supports facile plasmonic functionalization and offers a robust platform for sensitive chemical sensing and SERS-based bio-tracking.

Comparative predictive modeling of psychrotolerant and mesophilic *Bacillus cereus* group growth in fried rice with genomic characterization

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Bacillus cereus group (BCG) is a foodborne pathogen capable of causing emetic and diarrheal illnesses, with distinct psychrotolerant (PBCG) and mesophilic (MBCG) strains differing in their growth behavior across temperatures. This study aimed to compare the growth characteristics of PBCG and MBCG, develop predictive models describing growth kinetics in vacuum-packed fried rice, and investigate the genomic characteristics of these strains using whole-genome sequencing (WGS). Growth of PBCG and MBCG strains was examined in food stored at temperatures of 5–37°C. Primary and secondary models were used to estimate lag time and maximum specific growth rate, and model validation under fluctuating temperature conditions showed high accuracy (ASZ 82–100%, RMSE 0.16–0.31). PBCG strains were capable of growth even at 5°C, whereas MBCG strains grew only above 13°C. Above 20°C, growth parameters did not differ significantly between groups. WGS of PBCG strains, including food-derived isolates, revealed species diversity (*B. toyonensis, B. mycoides,* and *B. cereus*) and showed that the strongly psychrotolerant isolate BCG9 is closely related to *B. weihenstephanensis* ATCC 12826, sharing cold-adaptation markers such as 16S rRNA variants and *cspA*. All PBCG strains harbored the enterotoxin genes *nheABC* and *hblABCD*. These findings improve the understanding of PBCG and support microbial risk assessment in ready-to-eat foods such as fried rice.

Evaluation of probiotic potential of lactic acid bacteria isolated from *Styela clava* jeotgal

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Fermented foods contain various lactic acid bacteria (LAB), which exhibit functional properties such as antioxidant activity and gut health improvement. LAB isolated from traditional fermented foods have attracted attention as potential probiotic candidates. However, studies on LAB derived from *Styela clava* jeotgal remain limited. In this study, LAB were isolated from *Styela clava* jeotgal and identified by PCR analysis. The isolates were classified into five species: *Lactobacillus plantarum, Lactobacillus reuteri, Pediococcus pentosaceus, Leuconostoc mesenteroides*, and *Lactobacillus brevis*, comprising a total of ten strains. Antioxidant activities were evaluated using ABTS and DPPH radical scavenging assays, and all isolates exhibited considerable antioxidant activity. The survival of LAB under simulated gastric and bile conditions was assessed, and several strains maintained viable cell counts under these conditions. In addition, certain strains showed relatively high cell surface hydrophobicity and auto-aggregation ability, suggesting their potential for intestinal adhesion. In conclusion, LAB isolated from *Styela clava* jeotgal demonstrated functional properties including antioxidant activity and tolerance to gastrointestinal conditions, indicating their potential as probiotic candidates.

Inhibition of cheese late blowing defect (LBD) by using *Lactococcus lactis* KFOM 0478 isolated from bovine milk for starter culture

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Gouda cheese is a semi-hard cheese produced from bovine milk and undergoes a long ripening period, during which late blowing defect (LBD) may occur, causing internal cracks and gas formation. LBD is mainly caused by the growth of *Clostridium tyrobutyricum*, resulting in economic losses in cheese manufacturing. Therefore, controlling clostridial growth during cheese production and ripening is important in industrial cheese processing. In this study, a novel *Lactococcus lactis* KFOM 0478 strain with anti-clostridial activity and milk fermentation ability was developed and applied as a starter adjunct culture, and experimental Gouda cheeses were manufactured using two types of raw milk. Microbial community changes during cheese ripening were analyzed using amplicon sequencing based on ONT MinION MK1B, and physicochemical properties were monitored. When only a commercial starter culture was used, *C. tyrobutyricum* was detected and LBD was observed during ripening. In contrast, in cheeses manufactured with the developed *L. lactis* KFOM 0478, *C. tyrobutyricum* was not detected and LBD did not occur. Whole genome sequencing revealed a genome size of 2,678,659 bp with 2,723 CDSs, and the strain possessed the lantibiotic gene cluster encoding lacticin 481 associated with anti-clostridial activity. These results suggest that the developed *L. lactis* KFOM 0478 can be used as a starter or protective culture to prevent LBD and improve process stability in Gouda cheese production.

Effect of OSA esterification at different stages on physicochemical properties of short-chain glucan aggregates (SCGA)

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This study investigated how the sequence of octenyl succinic anhydride (OSA) introduction during short-chain glucan aggregates (SCGA) formation affects the structural and functional properties of the resulting particles. OSA was applied at different stages of SCGA formation to obtain SCGA-OS, SCG-OS-A, and OS-SCGA, with DS values of 0.0106, 0.0094, and 0.0117, respectively. FT-IR and Raman spectroscopy confirmed the introduction of OSA groups into the samples. All OSA-modified samples exhibited more negative zeta-potential values (-23.3 to -27.1 mV) than SCGA (-11.5 mV), with SCGA-OS showing the largest change. XRD analysis showed that all samples retained a typical B-type crystalline structure, while relative crystallinity decreased from 19.0% in SCGA to 14.6% in SCG-OS-A and 11.0% in OS-SCGA. These samples also showed lower gelatinization temperature and enthalpy, indicating reduced structural order. In-vitro digestion revealed that SCGA-OS had higher resistant starch (RS, 52.0%) than SCGA (48.1%), whereas SCG-OS-A and OS-SCGA showed much lower RS values (30.6% and 11.9%). This suggests that OSA treatment prior to SCGA formation interfered with self-assembly, resulting in less ordered structures and greater digestibility. All OSA-modified samples formed smaller and more stable droplets than SCGA in Pickering emulsions. Overall, the stage of OSA introduction governed the structure, digestibility, and emulsifying functionality of SCGA.

Quality characteristics of dried noodles prepared with blended Korean wheat flours from different cultivars

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Korean wheat shows considerable variation in quality depending on the production region and year, which can be mitigated through blending techniques. In this study, dried noodles were prepared using Korean wheat cultivars Saekeumkang, Hwangeumal, and Hanmyeon, and their quality characteristics were evaluated. The samples included CJ-Saekeumkang, Saekeumkang (SAE), Hanmyeon (HA), and SAL (66.7% Saekeumkang+33.3% Hwangeumal) milled by small and large enterprises. For uncooked noodles, lightness (L*) ranged from 79.1 to 80.9, hardness from 38.7 to 57.1 N, and extensibility from 40.2 to 69.5 mm. Cooking characteristics showed cooked weight of 68.2–76.6 g, volume of 211–221 mL, and water absorption of 173–206%. Compared to single cultivars, SAL exhibited an increase in hardness from 42.1 to 51.5 N and in extensibility from 46.7 to 65.8 mm. During cooking, SAL showed a decrease in turbidity, indicating reduced solid leaching, and improved overall noodle quality. Therefore, blending technology can effectively compensate for quality variation in Korean wheat and improve product quality, providing useful basic data for future wheat blending applications.

Effects of ultrasound-assisted plasma-activated water on microbial inactivation and quality preservation of fresh-cut bok choy

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This study investigated the effects of ultrasound (US)-assisted plasma-activated water (PAW) treatment (UP treatment) on the inactivation of indigenous aerobic bacteria and *Escherichia coli* O157:H7 in bok choy, as well as on the microbial growth and the quality properties of bok choy during storage at 4 and 14°C. For UP treatment, bok choy leaves and stems were immersed in PAW, generated by treating distilled water with cold plasma using a dielectric barrier discharge system (90 W, 2 h), and treated with ultrasound (700 W, 19.8 kHz) for 10 min. UP treatment inactivated indigenous bacteria and *E. coli* O157:H7 by approximately 2 and 1 log CFU/g, respectively. During storage at 4°C for 14 days, bacterial counts in UP-treated samples remained at 4.1–5.4 log CFU/g, lower than those in NaClO-treated samples (5.5–6.3 log CFU/g). The longest microbial shelf life (32 days at 4°C) was estimated with UP-treated samples. No significant differences were observed in color, firmness, ascorbic acid content, or CO_2 generation during storage (p>0.05), whereas chlorophyll content and antioxidant activity were more maintained in UP-treated samples than in NaClO-treated samples. UP treatment also mitigated volume loss in leaves and stems, with no significant differences in sensory evaluation (p>0.05). These results demonstrate the potential of UP treatment as a novel washing technology and a promising alternative to chlorine-based sanitizer washing in fresh vegetable processing.

Drying and moisture plasticization control hydration and emulsion functionality of lactose–WPI Systems

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Bioactive compounds and beneficial microorganisms are susceptible to functional degradation during processing and storage, requiring formulation strategies to enhance stability. In this study, a protein–carbohydrate-based glassy system composed of lactose and whey protein isolate (WPI) was used to evaluate the functional properties of powders prepared under different drying and storage conditions. A protein–carbohydrate mixture of WPI and lactose (2:3) was prepared in pH 7 phosphate buffer (20% solids), and mixtures were produced under different drying and storage conditions. The powders were then dispersed in the aqueous phase to prepare oil-in-water (O/W) emulsions (1:9, w/w) using palm oil (LMF) or MCT oil. SEM analysis revealed irregular plate-like structures in freeze-dried powders, whereas spray-dried powders exhibited uniform spherical particles. Drying and storage conditions affected powder microstructure and stability through moisture-induced plasticization and structural rearrangement. Emulsion analysis showed that larger droplets were observed in palm oil-based emulsions, whereas smaller droplets were formed in MCT oil-based emulsions. These results suggest that drying-induced microstructural differences influence hydration behavior and emulsion stability, providing fundamental data for lactose–WPI-based glassy systems.

Development of mayonnaise-like characteristics in plant-based systems through hydrocolloid and oil optimization

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With growing demand for healthier options and increasing interest in plant-based alternatives, plant-based mayonnaise (PBM) has attracted considerable attention. To mimic the characteristics of conventional mayonnaise, rheological, textural, and sensory properties should be carefully considered. In this study, gum composition and oil ratio were optimized to develop PBM, and structural changes after oral digestion were also evaluated. Xanthan gum and guar gum were used to prepare gum complexes, and a ratio of 2:8 was selected due to its high viscosity and stable dispersion. As the oil ratio increased, elasticity and recovery rate increased, indicating enhanced thixotropic behavior. Regarding on textural properties, increasing oil ratio resulted in a softer texture, as indicated by reduced firmness and other texture parameters. Microstructural observations revealed that formulations containing 60 and 70% oil showed small and dense oil droplet distribution. After oral digestion, 60% oil ratio exhibited flocculated droplet structures, which may contribute to creamy texture perception in the oral phase. Taken together, a 60% oil ratio was considered optimal for PBM formulation and may serve as a fundamental model for further PBM development.

Structural characterization and 3D food printing suitability of soy protein isolate–xanthan gum based emulsion gels

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This study aimed to develop a structured emulsion gel system based on soybean isolate (SPI) and xanthan gum (XG) and to evaluate its structural characteristics, stability, and printability for potential food structuring applications. Emulsion gels were prepared with different XG concentrations (Control, XG0.05, XG0.10) and their microstructures were examined using polarized light microscopy and confocal laser scanning microscopy (CLSM). Textural properties were evaluated by measuring hardness, where the XG-containing samples exhibited higher hardness values compared to the control, with values of 0.23 N, 0.37 N, and 0.54 N for control, XG0.05, and XG0.10, respectively. Freezing-thawing stability analysis showed that the addition of XG improved structural integrity of the emulsion gels, resulting in reduced phase separation and enhanced resistance to repeated thermal stress. Printing stability tests further demonstrated that the SPI-XG emulsion gels exhibited continuous extrusion and shape retention during the printing process. In addition, the developed systems successfully formed well-defined three-dimensional structures during 3D printing. These findings suggest that SPI-XG based emulsion gels possess improved structural stability and mechanical properties, indicating their potential as structured soft materials for 3D printing applications.

국내산 봄나물의 카로티노이드 성분 분석

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HPLC를 이용하여 국내산 봄나물의 7가지 주요 카로티노이드(루테인, 제아잔틴, β-크립토잔틴, 13-z-β-카로틴, α-카로틴, β-카로틴, 9-z-β-카로틴) 함량을 분석하였다. 달래(*Allium monanthum* Maxim.), 봄동(*Brassica rapa* subsp. *pekinensis* (Lour.) Hanelt), 돌나물(*Sedum sarmentosum* Bunge), 개비름(*Amaranthus lividus* L.), 씀바귀(*Ixeridium dentatum* (Thunb.) Tzvelev), 방풍나물(*Peucedanum japonicum* Thunb.), 고들빼기(*Crepidiastrum sonchifolium* (Maxim.) Pak & Kawano), 물미나리(*Oenanthe javanica* (Blume) DC.), 돌미나리(*Oenanthe javanica* (Blume) DC.) 등 9종 봄나물의 카로티노이드 성분 분석 결과, 봄나물에 따라 카로티노이드 함량의 차이를 보였다. 총 카로티노이드 함량은 개비름(1005.32 μg/g)에서 가장 높았으며, 다음으로 방풍나물, 참나물, 돌나물 순으로 높았다. 개별 성분별로 살펴보면, 루테인은 씀바귀를 제외한 모든 봄나물에서 검출되었고, 개비름(684.78 μg/g), 방풍나물(618.22 μg/g), 돌나물(612.44 μg/g)에서 상대적으로 높은 함량을 보였다. 제아잔틴은 돌나물과 개비름 외에는 검출되지 않았다. β-크립토잔틴 함량은 방풍나물(74.86 μg/g)에서 가장 높았고, 개비름(59.69 μg/g)이 뒤를 이었고, 고들빼기(22.16 μg/g), 돌미나리(35.39 μg/g)에서 미량 검출되었으나, 나머지 봄나물에서는 검출되지 않았다. β-카로틴은 씀바귀를 제외한 모든 봄나물에서 검출되었으며, 방풍나물(210.05 μg/g)에서 가장 함량이 높았고, 돌나물(173.95 μg/g), 개비름(165.20 μg/g)에서도 높은 함량을 나타냈다. α-카로틴(3.59 μg/g)은 개비름에서만 미량 검출되었으며, 나머지 봄나물에서는 검출되지 않았다. 9-z-β-카로틴은 씀바귀를 제외한 모든 봄나물에서 검출되었으며, 개비름(35.04 μg/g), 방풍나물(33.67 μg/g), 봄동(28.05 μg/g), 돌나물(27.17 μg/g) 순으로 함량이 높았다. 13-z-β-카로틴은 봄동과 씀바귀를 제외한 모든 봄나물에서 검출되었으며, 방풍나물(60.08 μg/g), 개비름(45.84 μg/g) 순으로 함량이 높았다. 본 연구를 통해 국내산 봄나물의 카로티노이드 성분 데이터베이스 구축에 기여하고, 봄나물 카로티노이드 함량 정보를 제공하여 효과적인 카로티노이드 섭취와 봄나물 소비 증진에 도움을 줄 것으로 기대된다.

Solvent retention capacity of various rice flours and its relationship with quality attributes of cookies

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Solvent retention capacity (SRC) is a standardized method used to evaluate wheat flour functionality and predict baking performance. Recently, it has been applied to various cereal flours due to its simplicity. Therefore, this study aimed to apply SRC to characterize rice flour and examine its relationship with cookie quality. While the overall tendencies of the SRC values showed similar patterns to those of wheat flours, the retention capacity of ethanol was comparatively higher than that of wheat flour. Compared to wheat flour, rice flour exhibited significantly higher SRC values in water, sodium carbonate, sucrose, and MBS solvents, possibly indicating greater starch-dominated hydration behavior. When the rice flours were applied to cookies, Geumgang1, Hanareum4, and Saeilmi positively affected the spreadability of the cookies. Furthermore, slightly lower L* values were observed in cookies made with these rice flours, indicating that they exhibited more brownish colors compared to other samples. Several SRC values showed slight relationships with the quality attributes. These findings indicate that SRC can provide valuable insights into the hydration behavior of rice flours and their impact on cookie quality.

Ultra-high pressure-assisted fabrication of short chain glucan aggregates: accelerating recrystallization via pressure-driven nucleation

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Short chain glucan (SCG) self-assembles into crystalline short chain glucan aggregates (SCGA). Under ambient pressure (0.1 MPa), SCGA formation is governed by diffusion-limited growth and typically requires more than 24 h for substantial crystallization. This study investigated ultra-high pressure (UHP) to accelerate SCGA fabrication by promoting double-helix formation via volume contraction. SCG solution (9 wt%) was recrystallized at 0.1 MPa for 1–48 h and 200–600 MPa for 0.2–3 h. Recrystallization behavior was evaluated using yield, melting enthalpy (ΔH), and Avrami kinetic. SCGA formed under all conditions, with yields ranging from 2.83% to 40.80% and melting enthalpy values from 12.71 to 25.73 J/g. For 0.1–400 MPa, rate constants for yield (0.1398–3.5364 min^{-n}) and ΔH (0.8025–4.8373 min^{-n}) increased substantially, demonstrating elevated pressure accelerates diffusion-controlled growth. However, 600 MPa exhibited distinct kinetics; structural formation peaked within 0.2 h. While macroscopic yield maintained its level, ΔH subsequently declined. This indicates that while 600 MPa rapidly drives self-assembly, prolonged exposure induces the dissociation of the internal double-helical structures. Furthermore, the yield-derived negative activation volume ($\Delta V^{\ddagger}$=−31.59 cm^3/mol) confirmed UHP significantly lowers the nucleation barrier. These results demonstrate UHP facilitates rapid, pressure-driven SCGA fabrication, though excessive pressure compromises crystalline integrity.

Texturization of plant proteins using shear cell technology: effect of processing time

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The demand for plant-based meat analogs is increasing due to growing concerns regarding sustainability and health. Plant protein should essentially be texturized to mimic the structure and texture of raw meat. Varied processing methods such as thermoplastic and high-moisture extrusion, 3D printing, and shear cell technology have been developed. The shear cell processing has recently gained attention to form fibrous and layered structures. In this study, the effect of processing time on plant protein texturization was investigated using a semi-pilot shear cell equipment. A mixture of soy protein concentrate (SPC) and soy protein isolate (SPI) (1:1, 70% moisture) was processed at 110°C under rotation speeds of 25–50 Hz, with processing times ranging from 30 to 60 min. Fibrous structures were formed under specific conditions, with texturization index values ranging from 0.9 to 1.4 At low shear conditions (25–30 Hz), longer processing times (30–45 min) were required to achieve sufficient fibrous structure formation. In contrast, at high shear conditions (40–50 Hz), excessive processing time (>30 min) resulted in structural disruption, which limits fibrous structure formation. These results indicate that processing time plays a critical role in fiber formation and must be optimized in relation to shear intensity.

Audio-based identification of eating sounds using artificial intelligence

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Artificial intelligence (AI) technologies have been increasingly applied in the food science field, but research on AI-based food sound classification remains limited. This study presents a systematic comparative approach for identifying eating sounds using a publicly available Kaggle dataset. Each eating sound waveform was preprocessed using root mean square energy, and the resulting segments were converted into Mel-frequency cepstral coefficients (MFCCs) features and Mel-spectrograms, which were used as input datasets for machine learning and deep learning models. All machine learning models exhibited overfitting and limited generalization, whereas the convolutional neural network (CNN) model demonstrated significantly higher accuracy and better generalization. Furthermore, the results confirmed that utilizing MFCCs rather than Mel-spectrograms improved performance across all models. These findings suggest that CNN-based classification of food eating sounds using MFCCs offers strong potential as a foundation for objective and automated sensory evaluation in the food industry, though further validation with larger and more diverse datasets is necessary.

Estrogen receptor-mediated estrogen-like activity of *Lespedeza cuneata* extract as a functional material for menopausal symptom relief

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This study evaluated the estrogen-like activity of *Lespedeza cuneata* extract as a potential functional material for alleviating menopausal symptoms at the cellular level. Menopause is characterized by a decline in ovarian function and reduced estrogen levels, leading to various physiological and psychological changes. Although hormone replacement therapy is effective, its long-term use has been associated with adverse effects, highlighting the need for safer alternatives. Cytotoxicity was first assessed using an MTT assay in MCF-7 cells. Cell viability remained above approximately 80% at concentrations up to 200 μg/mL, indicating no significant cytotoxicity. Based on these results, concentrations up to 200 μg/mL were used for subsequent experiments. Estrogen-like activity was evaluated using an E-screen assay in ER-positive MCF-7 cells, where the extract induced a concentration-dependent increase in cell proliferation. In contrast, no significant changes were observed in ER-negative MDA-MB-231 cells, suggesting that the proliferative effect is mediated through estrogen receptor–dependent mechanisms. Furthermore, co-treatment with an estrogen receptor antagonist attenuated the proliferative response, supporting the involvement of ER-mediated signaling pathways. In addition, Oil Red O staining in 3T3-L1 cells showed no significant difference in lipid accumulation between the extract-treated and control groups. Taken together, these findings indicate that *Lespedeza cuneata* extract exhibits estrogen receptor–dependent estrogen-like activity without promoting adipocyte differentiation. Therefore, it may serve as a plant-derived functional material for alleviating menopausal symptoms, warranting further validation through *in vivo* and clinical studies.

압출 및 효소 처리를 이용한 밀 제분 부산물의 이화학적 특성

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본 연구에서는 밀 제분 과정에서 발생하는 부산물인 등외품 밀가루와 밀기울의 식품 소재로서 활용 가능성을 평가하기 위하여 압출 처리 및 효소 처리를 적용하고, 개질된 부산물의 이화학적 특성 변화를 분석하였다. 일반성분 분석 결과, 밀기울 시료가 식이섬유 함량이 높고 등외품 밀가루는 총전분 함량이 높은 특성을 나타냈다. 수화 특성 분석에서 보수력은 압출 처리 시료에서 높게 나타났으며, 팽윤력은 처리군 중에서 밀기울에 Celluclast BG 효소 처리를 적용한 후 등외품 밀가루와 혼합하여 압출한 시료에서 상대적으로 높은 값을 보였다. 용해도는 압출 처리 후 증가하는 경향을 나타냈다. RVA 분석 결과 압출 처리에 따라 전반적으로 점도가 감소하였으며 setback 값 또한 감소하는 경향을 나타냈다. 특히 밀기울에 효소 처리를 적용한 후 압출한 시료에서 상대적으로 낮은 setback 값을 보여 낮은 아밀로오스의 노화를 확인하였다. DSC 분석에서는 압출 처리 시료에서 호화 피크가 관찰되지 않아 압출 과정에서 결정성의 소실을 확인할 수 있었다. 또한 SEM 관찰 결과 압출 처리 시료에서 입자 구조의 파괴 및 불규칙한 표면 구조가 확인되었다. 종합하면, 압출 및 효소 처리를 통해 등외품 밀가루와 밀기울의 수화 특성 및 구조적 특성이 변화하는 것으로 나타났으며, 이러한 결과는 밀 제분 부산물의 식품 소재로서 활용 가능성을 제시하는 기초자료로 활용될 것으로 판단된다.

Safety and immunomodulatory potential of *Lactiplantibacillus plantarum* TMA126 based on phenotypic assays and whole genome analysis

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The present study aimed to evaluate the safety of *Lactiplantibacillus plantarum* TMA126 using phenotypic characterization and whole-genome sequence analysis, focusing on a strain with previously confirmed immunomodulatory activity. Phenotypic assays demonstrated that the strain exhibited no hemolytic activity (γ-hemolysis) and no cytotoxicity toward Caco-2 intestinal epithelial cells. In addition, the strain was susceptible to all tested antibiotics, with minimum inhibitory concentration values below the cut-off thresholds established by the European Food Safety Authority. Whole-genome analysis revealed that strain TMA126 possesses a complete genome assembled into 7 contigs, with a total size of 3,189,719 bp and a G+C content of 44.7%. A total of 3,051 coding DNA sequences, 16S rRNA genes, and 67 tRNA genes were identified, with an N50 value of 3,121,918 bp, indicating high assembly continuity. No acquired antibiotic resistance genes or virulence-associated factors were detected by ResFinder program. However, a vancomycin-related gene was identified through Blast KOALA analysis. This gene is likely associated with intrinsic resistance commonly observed in lactic acid bacteria and is unlikely to pose a safety concern. Furthermore, the strain has been previously demonstrated to possess immunomodulatory activity, supporting its potential as a functional probiotic. Collectively, these findings indicate that *L. plantarum* TMA126 satisfies key safety criteria and may serve as a safe and beneficial probiotic candidate for food and industrial applications.

Green synthesis of silver nanoparticles using edible insect extracts: effects of defatting on physicochemical stability and antibacterial activity

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The utilization of sustainable and eco-friendly materials for the green synthesis of nanoparticles is important for applications in the medical, environmental, and food industries. In this study, silver nanoparticles (AgNPs) were synthesized using extracts from defatted and non-defatted *Gryllus bimaculatus* (GB) and *Protaetia brevitarsis larvae* (PBL). Formation of AgNPs was confirmed by a color change from transparent to brown. The resulting AgNPs were further characterized by UV–vis spectroscopy, TEM, DLS, and zeta potential analysis. The AgNPs exhibited a spherical morphology, with maximum absorption wavelengths ranging from 400 to 420 nm and hydrodynamic sizes ranging from 88.8 to 109.0 nm. For both insect species, AgNPs synthesized using defatted extracts exhibited more negative zeta potentials than those synthesized using non-defatted extracts, suggesting improved colloidal stability. All AgNPs demonstrated antibacterial activity against both Gram-negative and Gram-positive bacteria, with comparable antibacterial efficacy regardless of the extraction method employed. These results suggest that defatted edible insect extracts are promising precursors for the green synthesis of AgNPs, yielding nanoparticles with improved colloidal stability while retaining antibacterial activity.

A novel quantitative analysis method for printability in 3D food printing for surimi

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Three-dimensional food printing (3DFP) has emerged as a promising technology for producing customized food structures; however printability evaluation remains a critical challenge. Conventional methods for assessing key printability indicators such as water holding capacity (WHC) and gel strength are destructive, time-consuming, and require specialized equipment, limiting real-time monitoring and automation. To address these limitations, this study developed a non-destructive computer vision-based approach combined with machine learning for rapid and automated evaluation of printability in surimi-based 3DFP. The framework extracts quantitative image features from printed structures and uses them as inputs for predictive models. Grayscale texture features from gray-level co-occurrence matrix (GLCM) analysis, combined with additive concentration data, were used for Random Forest (RF) models. Three models were constructed based on imaging perspectives: top view (TOP), side view (SIDE), and combined view (TS). The TOP model showed the highest performance for WHC (R^2=0.875, RMSE=0.831), while the TS model performed best for gel strength (R^2=0.691, RMSE=0.556). Texture features captured structural characteristics, with Contrast and Entropy contributing most to WHC and Energy and Contrast to gel strength. This approach provides a rapid and automation-compatible alternative for printability assessment in 3DFP.

Predicting crystallinity of subcritical water-treated cellulose in pilot-scale production using hybrid RSM–GPR modeling

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Nanocellulose (NC) is a promising sustainable material, but conventional production methods are limited by scalability and environmental concerns. Subcritical water treatment (SWT) offers a greener alternative, and pilot-scale SWT was applied to produce subcritical water-treated cellulose (SWT-C). The effects of temperature, pressure, and time on crystallinity were investigated, and SWT induced structural modification of cellulose through selective alteration of amorphous regions. Response surface methodology (RSM) was first employed for modeling, showing moderate predictive performance (R^2=0.863) but was limited in capturing nonlinear behavior. To address this, a hybrid RSM–GPR model was developed by combining RSM as a global trend with Gaussian Process Regression (GPR) for residual modeling. The hybrid model significantly improved prediction accuracy (R^2=0.997) and enabled uncertainty-aware optimization. Overall, this study demonstrates that the hybrid RSM–GPR framework provides an effective approach for modeling complex pilot-scale processes and supports robust optimization of SWT-C production.

가루쌀을 이용한 카스텔라의 품질 특성 및 소비자 기호도 분석

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본 연구에서는 근기능 개선 효과가 있는 가루쌀을 활용하여 제조한 3종의 카스텔라(가루쌀 100%, 흑미가루 첨가 제품, 새싹땅콩가루 첨가 제품)와 시판 제품을 비교하여 소비자의 기호도 및 품질 특성을 조사하였다. 20~50대 성인 50명을 대상으로 검사를 수행한 결과, 전체적인 기호도는 흑미가루 첨가 제품(4.86점)과 가루쌀 100% 제품(4.84점)이 새싹땅콩가루 첨가 제품(4.06점)에 비해 유의적으로 높게 평가되었다. 각 시료별 특성을 살펴보면, 가루쌀 100% 제품은 모든 기호도 항목에서 보통 이상의 평가를 받았으며, 특히 수분감(5.54점)과 식감(5.62점)에서 가장 부드럽고 촉촉한 특성을 나타내었다. 흑미가루 첨가 제품은 흑미가루 첨가로 인한 시각적 효과와 향의 기호도(4.80점)에서 가장 높은 평가를 받았으나, 두 제품 모두 공통적으로 단맛의 보완이 필요한 것으로 나타났다. 반면, 새싹땅콩가루 첨가 제품은 고소한 맛의 강점에도 불구하고 새싹땅콩가루 특유의 향과 이취(4.18점)때문에 기호도가 가장 낮게 평가되었다. 제품 정보 공개 후 선호도 변화를 분석한 결과, 가루쌀과 흑미가루를 첨가한 가루쌀 100% 제품과 흑미가루 첨가 제품은 건강 기능성 인식에 따라 선호도가 상승하였으나, 새싹땅콩가루 첨가 제품은 원료 공개 후 이취에 대한 부정적 인식과 알레르기 우려로 인해 선호도가 하락하였다. 이상의 결과를 종합할 때, 가루쌀 카스텔라 제조 과정에서 단맛을 보강하고 수분감을 개선한다면, 소비자 기호도가 향상된 제품 개발이 가능할 것으로 사료된다.

Morphological changes and rheological characteristics of $G_1/O/G_2$ emulsions as influenced by inner gel phase concentration

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This study investigated the effect of xanthan gum (XG) and locust bean gum (LBG) concentration in the inner gel phase (G_1) on the microstructure and rheological properties of gel-in-oil-in-gel ($G_1/O/G_2$) emulsions. The XG/LBG mixture (1:1) was incorporated into G_1 at 0, 0.3, 0.5, and 1.0%, while the outer gel phase was fixed at 0.5%. As G_1 concentration increased, the mean droplet size decreased significantly from 8.80±1.70 μm to 3.15±0.75 μm, corresponding to a 64% reduction. Encapsulation efficiency showed no significant difference between 0% and 0.3%, but increased at 0.5% and 1.0%, with an improvement of up to 30% compared to the control (p<0.05). All samples exhibited shear-thinning behavior, and apparent viscosity increased markedly at 0.5% and 1.0% compared to lower concentrations. Amplitude sweep results showed that the strain at which structural breakdown occurred increased with G_1 concentration, particularly at 0.5% and above. Frequency sweep analysis showed that G′ remained higher than G″ across the tested frequency range, and both values increased with G_1 concentration. Overall, increasing G_1 concentration reduced droplet size and improved encapsulation efficiency, viscosity, and mechanical strength. Collectively, these results demonstrate that precise control of the inner gel phase enables control of droplet stability and rheological properties, providing a useful approach for structured double emulsion systems.

Casein-based hydrogel films: fabrication of edible scaffolds for cultivated meat

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Driven by the need for more sustainable food systems, cultivated meat has emerged as an alternative to conventional animal-based products. A key challenge is the development of scaffolds that are both biocompatible and edible for safe integration into food applications. These structures are essential for supporting cell adhesion, proliferation, and differentiation during tissue formation. However, many existing materials still show limitations in mechanical stability, cell compatibility, and food applicability. In this study, casein-based hydrogel films were investigated as scaffold materials for cultivated meat. Casein was used to form hydrogel films, and their structural stability was enhanced through crosslinking with potassium sorbate, calcium chloride and transglutaminase. The resulting hydrogels were cast, dried, and processed into uniform circular samples. Physicochemical properties were characterized using various analytical methods. In addition, cell viability, proliferation, and differentiation were evaluated using C2C12 mouse myoblasts to assess scaffold performance. This study demonstrates a food-grade, biocompatible scaffold system with potential for cultivated meat applications. The use of safe, widely available materials and a simple fabrication process supports its feasibility for future scale-up.

Bitterness masking of potassium chloride by gellan gum through electrostatic interactions

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This study investigated a bitterness masking strategy using gellan gum (GG), which binds K^+ ions and regulates K^+ release responsible for KCl bitterness. Samples were prepared using 0.6% (w/v) KCl with GG (0.03—0.15% (w/v)) in solution and 5% (w/v) KCl with GG (0.1—0.5% (w/v)) in spraydried powder. In solution, sensory evaluation (9-point scale) showed that bitterness decreased from 6.67 to 2.33 and saltiness decreased from 6.43 to 4.17 with increasing GG concentration, while K^+ release rate decreased (p<0.05). In powder, field emission scanning electron microscopy revealed hollow particle structures in GG-containing samples, and particle size (Dx(50)) decreased from 48 μm in control (KCl) to 1.43—1.50 μm (p<0.05). Xray diffraction showed reduced crystallinity and a transition to an amorphous structure, suggesting interactions between GG and K^+. Fourier-transform infrared spectroscopy showed shifts in the COO^- stretching bands of GG, from 1601 to 1608–1612 cm^{-1} (asymmetric) and from 1400 to 1403–1420 cm^{-1} (symmetric), indicating ionic interactions between GG and K^+. The K^+ release rate decreased with increasing GG concentration (p<0.05). Sensory evaluation showed that bitterness decreased from 6.38 (KCl) to 4.38 (0.3% GG), while saltiness increased from 5.88 (KCl) to 6.29 (0.2% GG) and then decreased to 4.63 (0.5% GG)(p<0.05). These results suggest that GG–K^+ interactions regulate ion release and reduce KCl bitterness, enabling its application as a sodium substitute.

A study on minimizing the use of gluten in the production of plant-based meatballs with ohmic cooking

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In the plant-based meat analogue production, various additives such as gluten are used for meat-like texture however, their use causes digestive problems and conflicts with the growing demand for clean-label products. This study evaluated the potential of ohmic cooking with minimized gluten use in plant-based meatballs, one of the popular plant-based meat analogues. Ohmic cooking has the advantage of rapid and uniform heating through internal energy generation via electrical resistance heating. A lab-scale ohmic cooking system for producing plant-based meatballs was customized and compared with conventional boiling treatment. Ohmic cooking system was customized for electric current passage into irregular shape of meatballs. It consists of an isoelectrical solution container with two electrodes, K-type thermocouple, electric field supplier and data acquisition system. Meatballs with different gluten contents (0, 1.5, 3, 4.5, 6%) were immersed in isoelectrical solution and then an electric field of 15 V/cm was supplied. Ohmically cooked plant-based meatballs exhibited higher hardness and chewiness compared to boiling through electrochemical reaction. In addition, color analysis showed that ohmic cooking maintained redness. Ohmic cooking could produce plant-based meatballs with quality attributes more similar to those of actual meat products. This study demonstrated the potential of ohmic cooking to produce plant-based meatballs with minimized gluten use.

Development of a ROS2-based 6-DOF robotic arm system for food 3D printing applications

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Food 3D printing has emerged as a promising technology for customized food fabrication and automated food manufacturing. However, most existing implementations utilize dedicated gantry-type systems, and applications based on articulated robotic arms remain limited. This study presents a custom-built six-degree-of-freedom (6-DOF) robotic arm integrated with Robot Operating System 2 (ROS2) and ros2_control framework as a flexible alternative platform for food 3D printing applications. The system employs brushless motors communicating via Controller Area Network (CAN) protocol, enabling precise multi-joint coordination. An extrusion-type end-effector was designed and mounted for food material deposition. Layer-by-layer path planning was implemented by defining planar deposition trajectories executed sequentially with incremental Z-axis offsets, replicating the fundamental principle of additive manufacturing. Path execution consistency and layer uniformity were evaluated through preliminary physical deposition trials with a food-simulant material. Results confirmed successful multi-layer path execution, demonstrating system feasibility for structured food deposition tasks. This platform demonstrates the potential of articulated robotic arms as a flexible alternative to conventional food 3D printing systems, with potential applications in customized food fabrication and automated garnishing in food processing environments.

Starch-based internal phase improves stability and freeze–thaw survival of *Leuconostoc mesenteroides* in W1/O/W2 double emulsions

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This study aimed to improve the physical stability of double emulsions (W1/O/W2) and the freeze-thaw survival of *Leuconostoc mesenteroides* using a starch-based internal aqueous phase (W1). Emulsions were prepared by varying starch content (0% and 3%) in the internal phase and pectin (0.1% and 0.3%) and whey protein isolate (WPI; 0.5% and 1.0%) concentrations in the external phase (W2). Starch addition increased internal phase viscosity, which may have improved droplet stability and protected *L. mesenteroides*. Particle size analysis showed smaller and more uniform droplets in starch-containing samples, indicating improved dispersion stability. Zeta potential values increased with higher pectin and WPI concentrations, suggesting enhanced electrostatic repulsion that reduced droplet aggregation. In addition, the combined use of polysaccharide and protein improved interfacial stabilization. Encapsulation efficiency was higher in starch-containing samples with elevated pectin and WPI levels, attributed to restricted diffusion within the viscous internal phase. Furthermore, starch-containing samples maintained higher *L. mesenteroides* viability after freeze–thaw treatment. Overall, the combination of a starch-based internal phase and a polysaccharide–protein-stabilized external phase enhanced *L. mesenteroides* viability and emulsion stability, suggesting a promising strategy for beneficial bacterial delivery in low-temperature and fermented foods.

High-moisture meat analogues with *Tenebrio molitor, Protaetia brevitarsis*, and *Gryllus bimaculatus*: distinct effects of defatting on protein interactions and structure formation

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High moisture meat analogues (HMMA) are manufactured by extrusion of plant-derived carbohydrates and proteins at high temperature and high pressure to mimic the fibrous structure of muscle tissue. The nutritional and textural properties of HMMA are essential to achieve characteristics comparable to those of meat. Therefore, three edible insect species were used as functional protein additives, and the effects of defatting were evaluated. Addition of defatted *Tenebrio molitor* to HMMA increased essential amino acids content, protein-protein interactions, and protein digestibility compared with HMMA without insect (control) and HMMA containing non-defatted *T. molitor*. In contrast, defatting of *Protaetia brevitarsis* reduced thermal stability and structural anisotropy. HMMA containing *Gryllus bimaculatus* showed lower thermal stability and protein digestibility than the control, with no improvement in textural properties regardless of defatting. Therefore, the effects of defatting were species-dependent, and among the tested insects, defatted *T. molitor* had the greatest potential for improving HMMA quality.

쌀 도정 부산물을 이용한 식이섬유 강화 및 전분 노화지연 기능 업사이클링 식품 소재 제조 및 특성

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본 연구는 인산화 반응압출성형 공정을 적용하여 식이섬유를 강화하고 전분의 노화를 지연시킬 수 있는 쇄미와 미강 기반의 업사이클링 식품 소재를 개발하고자 하였다. 미강의 가용화를 위해 미강은 수침지(WI), 파보일링(PB), 및 가압조리(PV)를 한 후 셀룰로스 가수분해효소를 이용하여 효소적 가수분해하였다. 미강 가용화 방법 중 미강을 PV한 후 Celluclast BG와 Viscozyme L로 처리 하였을 때, 미강의 가수분해율이 가장 높았고, 이들은 각각 고분자(RBG) 및 저분자(RBV) 미강 가수분해물을 생산하였다. 선행연구에서 노화 지연 효과가 확인된 인산화 알파 쇄미가루(BRP)의 제조 조건을 바탕으로, 쇄미가루에 PV 전처리 미강 분산물(RBS) 또는 효소 처리된 미강 가수분해물(RBG, RBV)을 첨가하여 반응압출성형물을 제조하였다. 인산화 반응 압출성형에 의해 쇄미가루-미강 혼합물은 인산화 및 인산화 가교가 되었음을 확인하였다. 대조군과 RBS, RBG 및 RBV의 보수력과 팽윤력 및 용해도는 감소하였다. RBG 및 RBV의 호화엔탈피는 대조군보다 유의적으로 증가하였으나, 저온 저장에 따른 용융엔탈피의 유의적 변화가 없어 장기 노화가 지연됨을 확인하였다. RBS는 가장 낮은 setback 점도를 나타내어 단기 노화 지연에 효과적이었다. Temperature sweep test에 있어, RBG 및 RBV는 RBS보다 낮은 G′을 나타냈으며, 페이스트의 냉각 중에도 G′의 유의미한 증가가 관찰되지 않았다. Frequency sweep test에 있어, 주파수 증가에 따라 RBV의 G′ 값이 RBG보다 높은 상태를 유지하다가 이후 역전되는 양상이 관찰되었다. 모든 시료에서 주파수 증가에 따라 비교적 일정한 탄성 거동을 보여 구조적 안정성이 유지되었다. 결론적으로, 미강의 가용화 전처리와 인산염 기반 반응압출성형 공정을 적용함으로써 개발한 쇄미/미강 기반 업사이클링 식품 소재는 식이섬유 함량을 증가시키는 동시에 전분 분자의 재배열 및 결정화 속도를 지연시킬 수 있음을 확인하였다.

Machine learning-based prediction of root ginsenosides from leaf metabolites in *Panax ginseng*

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Ginseng (*Panax ginseng*) is a highly valued crop in which the root serves as the primary edible and medicinal part, and its quality is determined by the accumulation of bioactive compounds such as ginsenosides. However, evaluating these compounds during cultivation requires destructive root sampling, leading to the loss of its commercial value. Therefore, non-destructive approaches that utilize aboveground information to predict root metabolite content are needed.

In this study, we investigated whether leaf metabolomic profiles could predict root ginsenoside content in *P. ginseng*. A total of 60 plants, including cultivated and wild-simulated ginseng, were collected from Gangwon Province, Korea. Metabolomic profiling was conducted using LC–Orbitrap MS, in which more than 150 non-ginsenoside metabolites were relatively quantified, while 38 ginsenosides were quantified separately. Correlation analysis revealed that leaf-derived ginsenosides and metabolites were strongly associated with major root ginsenosides. Based on these relationships, a machine learning model was developed to predict the concentrations of 20(S)-Rh1 and Ra1 in roots.

These findings demonstrate that leaf metabolomic information can be used for the non-destructive prediction of root ginsenoside content, providing a practical strategy for cultivation management and quality assessment.

지속가능 단백질 식품 설계를 위한 시판 동물성 패티의 기준 조직감 데이터베이스 구축

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지속가능한 대체 단백질 식품 개발에서 기존 육류의 조직감을 정밀하게 재현하는 것은 중요한 과제이다. 이를 위해서는 실제 상용 육류 제품을 기반으로 한 정량적 조직감 기준 데이터의 구축이 필요하다. 그러나 현재까지 시판 패티의 조직 특성을 체계적으로 정리한 데이터는 제한적으로 보고되어 있다. 본 연구에서는 국내에서 유통되는 동물성 패티 15종을 대상으로 기계적 조직 특성을 분석하여 대체 패티 설계를 위한 기준 데이터를 구축하고자 하였다. 열처리 이전의 기본 물성 특성을 확인하기 위해 비가열 시료를 대상으로 Texture Profile Analysis (TPA)와 Warner–Bratzler Shear Force (WBSF) 시험을 수행하였으며, 모든 데이터는 일원 분산분석(one-way ANOVA)을 통해 통계적으로 검정하였다. 분석 결과, 패티의 조직 특성은 원료 조성과 제조 방식에 따라 유의적인 차이를 나타냈다($p<0.05$). 순 쇠고기 패티는 경도 2.0–6.0 N, 씹힘성 0.3–1.4 N 범위로 비교적 부드러운 조직 특성을 보였다. 반면 혼합육 또는 가공육 기반 패티는 경도 13.0–29.0 N, 씹힘성 4.7–14.0 N으로 유의적으로 높은 값을 나타냈으며, 이는 유화형 육제품에서 형성되는 치밀한 단백질–겔 네트워크 구조의 특성을 반영하는 것으로 해석된다. 전반적으로 경도와 씹힘성이 증가할수록 WBSF 값 또한 함께 증가하는 경향을 보였으나, 순쇠고기 패티에서는 근섬유 배열 및 결합조직의 영향으로 경도와 독립적으로 전단력이 증가하는 사례도 관찰되었다. 본 연구는 시판 동물성 패티의 조직 특성에 대한 정량적 범위를 제시함으로써, 대체육 제품의 구조 설계 시 참고할 수 있는 핵심 조직감 기준 데이터를 제공한다. 특히 순쇠고기 패티와 유화형 가공육 패티 간의 구조적 차이는 식물성 대체 단백질 식품의 조직 설계 전략 수립에 중요한 기초 정보를 제공할 것으로 기대된다.

Influence of saccharides chain lengths and water sorption on glass transition behavior of corn starch matrices

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This study investigated water sorption behavior and glass transition temperature (Tg) of corn starch matrices containing saccharides of different chain lengths (glucose, sucrose, raffinose, stachyose). Corn starch and saccharide (1:1, w/w) were dispersed in deionized water (5%, w/v), heated (95°C, 1 h), cooled (25°C), and freeze-dried. X-ray diffraction (XRD) confirmed amorphous structures. Fourier-transform infrared spectra varied with saccharide type, indicating saccharide-dependent differences in short-range molecular organization. Differential scanning calorimetry showed lower Tg in matrices containing shorter saccharides (p<0.05), enhancing molecular mobility. Water sorption isotherms and Tg-water relationships were fitted using the Guggenheim-Anderson-de Boer (GAB) model and the Gordon–Taylor equation, respectively. As saccharide chain length increased, monolayer water content decreased from 6.25 (glucose) to 3.70 (stachyose). The Guggenheim constant (C) was highest for stachyose, suggesting stronger monolayer water binding in the stachyose-containing matrix. The Gordon-Taylor k value increased from 2.61 in starch to 4.79—5.81 in saccharide-containing systems, where higher k values were associated with greater Tg depression. Along with XRD and scanning electron microscopy changes after storage at 23—85% relative humidity, these results show that saccharide chain length is a practical means for controlling the water sensitivity of freeze-dried starch powders.

Deep learning-based prediction of moisture and soluble solid content (°Brix) in dried persimmons using RGB Images

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The quality of dried persimmon (*Diospyros kaki* Thunb.) has traditionally been evaluated through destructive measurements of moisture content and soluble solids content (SSC, °Brix). Such approaches have limitations in representing overall product quality, restrict real-time monitoring, and lead to empirically determined drying endpoints, which may result in process inefficiencies and increased costs. Because drying conditions strongly influence product quality and consistency, non-destructive, data-driven quality monitoring is increasingly needed. Therefore, this study developed an RGB image-based deep learning model to non-destructively predict moisture content and SSC and perform real-time quality classification during the drying process. A total of 120 samples from Sangju, Haman, and Yeongdong were collected, and 12,000 images were acquired. Moisture content and SSC were measured for all samples and used as labels. During drying, visual changes such as white powder, wrinkles, and color variation may reflect internal quality. The model learns structural features, with SimMIM pre-training and contrastive learning applied for stable training with limited data. For validation, samples from unseen regions and lab-scale conditions were used. The results showed that the model can predict moisture content and SSC and classify product quality. This approach enables non-destructive quality evaluation and drying monitoring, improving process control and cost efficiency.

Glass transition behavior of freeze-dried lipid nanoparticles: effects of solid-to-liquid lipid ratios

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This study aimed to evaluate the physical and thermal stability of encapsulation matrices by investigating glass transition behavior as a function of lipid phase composition. Solid lipid nanoparticles (SLNs), nanostructured lipid carriers (NLCs) and nanoemulsions (NEs) were formulated with solid-to-liquid lipid ratios of 10:0, 5:5 and 0:10 (w/w), respectively. Lipid dispersions containing palm stearin and medium-chain triglyceride (MCT) oil were mixed with a lactose–whey protein isolate (WPI) matrix and freeze-dried. Particle size was measured by dynamic light scattering, while X-ray diffraction (XRD), scanning electron microscopy (SEM), and differential scanning calorimetry (DSC) characterized the powders. Particle size increased with solid lipid content, following the order of NEs (233.53 nm), NLCs (259.63 nm), and SLNs (283.80 nm) (p<0.05). XRD patterns confirmed an amorphous matrix with residual crystalline features varying by lipid composition. SEM revealed irregular amorphous and glassy morphologies. Thermal analysis showed that glass transition temperature (Tg) decreased with increasing residual moisture and followed the order NEs (90.0°C)>NLCs (83.1°C)>SLNs (82.8°C) (p<0.05), suggesting higher solid lipid ratios promoted crystallization-induced water entrapment and reduced moisture removal during freeze-drying. These findings show that lipid phase composition affects glass transition behavior and provide a basis for designing glassy-state lipid nanoparticles.

Physicochemical and morphological characteristics of rice cultivars in relation to *in vitro* starch digestibility and *in vivo* glycemic index

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The objective of this study was to investigate the relationship between the structural characteristics of rice cultivars, *in vitro* starch digestibility, and *in vivo* glycemic index (GI) using ten rice cultivars, including Japonica (Samgwang, Selenio, Dodam), Indica (Slowmi1, Slowmi2, IPS, USA basmati, India basmati), and Indica–Japonica hybrids (Shingil, Amimyeon). ‘Dodam’ exhibited longer amylopectin chain length and higher amylose content than the other cultivars. X-ray diffraction analysis showed that all cultivars displayed a typical A-type crystalline pattern, whereas ‘Dodam’ exhibited a B-type pattern. Differential scanning calorimetry revealed that ‘Dodam’ had a higher gelatinization peak temperature (Tp) than the other cultivars. In particle size distribution, ‘Dodam’ showed larger values for both D[3,2] μm and D[4,3] μm. Scanning electron microscopy images indicated that Japonica cultivars, except ‘Dodam’, exhibited central pores, while ‘Dodam’, ‘Amimyeon’, ‘Slowmi2’, and ‘IPS’ showed rod-like structures in the central region. *In vitro* starch digestibility was evaluated in cooked rice, and the estimated glycemic index (eGI) varied among cultivars. ‘Dodam’ exhibited the lowest eGI, followed by ‘Slowmi2’ and ‘IPS’. Cultivars with lower eGI tended to show similar trends with lower *in vivo* GI. These findings may contribute to the development of rice-based food products with improved physicochemical properties and reduced glycemic response.

Modulation of expansion and internal structure of extruded corn snacks by isolated soy protein incorporation

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This study evaluated the effects of isolated soy protein (ISP) incorporation on the physical quality characteristics of extruded corn snacks. Corn flour was used as the base material, and ISP was added at levels of 0, 5, 7.5, and 10%. Extrusion was conducted under the following conditions, a barrel temperature of 160°C, a screw speed of 200 rpm, and a moisture content of 22%. The expansion ratio decreased progressively from 1.94±0.26 to 1.32±0.12 as the ISP content increased from 0% to 10%, which can be attributed to increased melt viscosity and protein-starch interactions that reduced starch melt elasticity and limited bubble growth during expansion. In contrast, the longitudinal expansion index slightly increased from 13.05±0.51 to 14.47±0.19 cm/g with increasing ISP content, which may be explained by restricted radial expansion, resulting in relatively greater axial elongation. Piece density increased proportionally from 0.17±0.02 to 0.26±0.01 g/cm³, reflecting reduced porosity, smaller cell size, and thicker cell walls, indicating the formation of a more compact internal structure.

In conclusion, ISP incorporation increased protein content while significantly influencing expansion behavior and internal structure under the tested extrusion conditions. These findings provide useful insights into the role of protein in extrusion systems and offer practical guidance for optimizing texture and processing conditions in the development of protein-enriched snack products.

Effect of puffing on physicochemical characteristics and bioactivities of grapefruit (*Citrus paradisi*) peel

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This study investigated the effect of puffing on the physicochemical characteristics and bioactivities of grapefruit (*Citrus paradisi*) peel. The peels were subjected to puffing at 500–1300 kPa, followed by extraction and analysis. Puffing disrupted plant tissue and induced a porous structure resulting in increased extraction yield. HPLC analysis showed that the flavonoid glycosides naringin and narirutin decreased, while the aglycone naringenin increased; hesperidin also increased after puffing, possibly due to its conversion from bound to free forms. All three furanocoumarins decreased or were not detected at higher puffing pressures. Maillard reaction products (MRPs), total phenolic content (TPC), total flavonoid content (TFC), and antioxidant activities (DPPH, ABTS, and FRAP) increased with puffing pressure. Puffed grapefruit peel decreased nitric oxide (NO) production, whereas it did not significantly affect TNF-α and IL-6, suggesting selective suppression of iNOS expression. In contrast, the non-puffed sample increased CYP3A4 activity, while samples puffed at higher pressures inhibited the enzyme. These results suggest that constituents other than furanocoumarins may influence CYP3A4 activity. Overall, puffing enhanced the functional properties of grapefruit peel by improving extractability and inducing flavonoid transformation while reducing furanocoumarin content. However, the potential risk of drug metabolism inhibition by puffed grapefruit peel should be considered.

Vegetable oil treatment enhances resistant starch formation in cooked rice depending on cultivar and starch structure

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Rice is widely consumed as a staple food and is characterized by high starch digestibility. Various approaches have been explored to increase resistant starch (RS) content. In this study, cooked rice was treated with vegetable oil to enhance RS formation. Three Korean rice cultivars (*Samgwang, Dodam,* and *IPS*) were used to investigate the effects of starch structure and cultivar type on RS formation and *in vitro* starch digestibility.

Dodam exhibited higher amylose content and a greater proportion of long amylopectin chains (DP≥37), whereas *Samgwang* showed lower amylose content and shorter chains. X-ray diffraction revealed A-type crystallinity in *Samgwang* and *IPS* and a B-type pattern in *Dodam*.

Dodam showed lower peak and final viscosities and a higher gelatinization temperature, while *IPS* showed higher gelatinization enthalpy with greater setback viscosity.

RS content increased in the order *Dodam>IPS>Samgwang*. Vegetable oil treatment enhanced RS formation, particularly in *Dodam* and *IPS*, and coconut oil treatment resulted in the highest RS content in *Dodam*.

Oil-treated samples exhibited amylose–lipid complex formation, indicated by V-type diffraction peaks and increased relative crystallinity, with compact microstructures. These changes were associated with increased hardness and chewiness.

Overall, vegetable oil treatment enhanced RS formation and represents an effective strategy to improve the nutritional functionality of rice-based products.

Real-timeprediction of chicken breast spoilage using an AI-based digital twin system

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Quality deterioration of meat during storage is directly associated with food safety concerns and economic losses, yet conventional quality assessment methods are largely destructive and limited in real-time applicability. In this study, chicken breast was used as a model sample to develop an artificail intelligence (AI)-based regression framework integrating image-derived color information and ultrasound signals, inplemented within a cyber-physical system (CPS)-based digital twin (DT) enviroment.

CIELAB color data and ultrasound signals were employed to non-destructivelypredict lipid oxidation represented by thiobarbituric acid reactive substances(TBARS) and microbial proliferation reflected by total plate count (TPC). TheGradient Boosting Regressor achieved the best performance for TBARS (MSE:0.000825, R^2: 0.8188), while the Random Forest Regressor showed superioraccuracy for TPC (MSE: 0.9259, R^2: 0.8831). SHapley Additive exPlanations(SHAP) analysis identified distinct ultrasound-derived features associated witheach target variable, enhancing model interpretability. The models wereintegrated into a Unity-based CPS virtual refrigerator for real-time qualityvisualization within a digital twin system. External validation confirmedrobustness, with MSE of 0.0110 and RMSE of 0.0122 for TBARS, and MSE of 0.2365and RMSE of 0.2784 for TPC. This framework combines nondestructive predictionwith digital twin technology for real-time meat quality management.

A hyaluronidase-responsive starch microparticle platform for selective colorimetric detection of *staphylococcus aureus* in food

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Bacterial infections pose a significant threat to public health due to their high morbidity and mortality. In particular, *Staphylococcus aureus* is one of the most threatening foodborne pathogens. Current detection methods for *S. aureus* still suffer from limitations such as low specificity and low sensitivity. To address these issues, we proposed selective and sensitive colorimetric sensor for *S. aureus* detection in food, utilizing a starch-based hyaluronidase-responsive platform. Hyaluronidase, a key virulence factor of *S. aureus,* is an enzyme that breaks down hyaluronic acid (HA), a major component of host connective tissues. The sensor employs microparticles composed of debranched amylopectins that spontaneously self-assemble into a spherical morphology. During this process, HA (as a stabilizer) and 3,3',5,5'-tetramethylbenzidine (TMB) are encapsulated to form spherical starch-based microparticles. When *S. aureus* is present in a food matrix, hyaluronidase degrades the HA, which destabilizes the particle structure and triggers the release of TMB. Subsequently, the intrinsic peroxidase-like activity of polyethyleneimine (PEI)-coated starch magnetic particles (PEI@SMPs) catalyzes the oxidation of the relesed TMB into a blue product in the presence of hydrogen peroxide. The sensor's selectivity for *S. aureus* was confirmed using hyaluronidase-negative bacteria such as *E. coli* and K.pneumoniae. The detector exhibited a limit of detection(LOD) of approximately 940 CFU/mL in real food samples. The sensitivity was further improved with pre-conditioning of hyaluronidase, lowering the LOD to 485 CFU/mL after 2h and 78 CFU/mL after 3h. The highly selective and sensitive colorimetric sensor provides a potential way of detecting *S. aureus* in food safety applications.

A multi-faceted analysis of freeze-drying systems and development of optimized pre-treatment protocols using calcium lactate

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In the food industry, the freeze-drying process is increasingly being adopted due to its superior ability to preserve flavor, aroma, and nutrients without thermal damage, unlike conventional drying methods. Its high moisture evaporation rate of over 98% also ensures excellent long-term storage stability. However, the slow freezing typically employed in freeze-drying processes often leads to tissue softening and structural collapse of the raw materials, resulting in a degraded texture. Therefore, this study conducts a multifaceted analysis of the freeze-drying process and aims to design an optimized procedure for freeze-dried products. Specifically, we investigate a pre-treatment process involving calcium lactate substitution to optimize solubility and texture—key quality indicators for freeze-dried food.

Impact of roasting and enzymatic hydrolysis on the flavor profiles, amino acid composition, and physicochemical properties of beans

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Roasting is a pivotal thermal process that facilitates the development of desirable color, aroma, and taste-active compounds, while simultaneously enhancing antioxidant capacity. Although numerous studies have characterized the structural, physicochemical, and volatile profiles of vegetables during roasting, research on identifying optimal roasting conditions for maximizing product quality remains limited. Furthermore, to synergistically enhance flavor profiles—specifically through the liberation of free amino acids—it is essential to investigate enzymatic treatments, such as the application of pectin esterase and pectinase, to promote protein degradation and cell wall modification. Therefore, the objective of this study is to characterize the distinct impacts of processing conditions and raw material types by analyzing the evolution of flavor components and amino acid compositions in four leguminous species with relatively high protein content among plant-based sources(soybean, black soybean, kidney bean, and chickpea) subjected to roasting and enzymatic treatment.

Development of a plant-based meat flavor via maillard reaction and thiamine degradation for Improved sensory properties of plant proteins

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This study aimed to develop a plant-based meat flavor and optimize its production process using the Maillard reaction and thiamine thermal degradation for the generation of meat-like flavors in plant-based protein systems. Conventional plant-based protein products often exhibit sensory limitations due to inherent off-flavor characteristics and a lack of sulfur-containing volatile compounds. To overcome these limitations, a roasting extract derived from green onions, garlic, onions, and shiitake mushrooms was formulated with cysteine, methionine, and thiamine, followed by a multi-stage high-temperature short-time (HTST) process. Volatile compounds were analyzed using SPME-GC/MS, and changes in free amino acid composition and sensory attributes were evaluated. Aldehyde compounds, including hexanal, decreased, while meat-related compounds such as pyrazines, furans, and thiazoles increased via Strecker degradation and sulfur-mediated Maillard pathways. In particular, the increased formation of 2-methyl-3-furyl disulfide and 4-methyl-5-hydroxyethylthiazole enhanced roasted and savory notes. In addition, elevated levels of umami-related free amino acids improved the taste profile. Application of the developed plant-based meat flavor to tofu tenders improved meat-like aroma and overall acceptability while effectively reducing beany flavor. These findings demonstrate that the proposed approach effectively improves the sensory quality of plant-based protein foods.

Enhancement of alcohol content and flavor by suspension freeze concentration

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Increasing demand for high-quality alcoholic beverages has driven interest in processing technologies that enhance flavor and product stability without inducing thermal degradation. Conventional thermal concentration methods often lead to the loss of volatile compounds and undesirable changes in sensory properties. In this context, freeze concentration has emerged as a promising low-temperature alternative capable of preserving and selectively enriching key constituents.

In this study, suspension-freezing-based freeze concentration was applied to cheongju and soju to evaluate alcohol enrichment efficiency and component distribution. Samples (1 L) were frozen at −25°C for 1 h and separated into ice and concentrated liquid fractions by centrifugation (1300 rpm, 1 min). Alcohol, inorganic ions, and organic compounds were analyzed.

The alcohol content of cheongju increased from 13% to 17%, while soju (initially 16%) exceeded 40% after repeated cycles. ICP-OES showed that Ca increased 2.03-fold and K, Na, and Mg increased 1.44–1.48-fold in the concentrated fraction. LC-MS analysis of 53 compounds showed enrichment of citric acid, succinic acid, and trans-ferulic acid in the liquid fraction, whereas dehydroascorbic acid was retained in the ice phase.

These results indicate that suspension freeze concentration is an effective low-temperature technique for alcohol enrichment and modulation of flavor-related compounds, with potential to improve product quality and storage stability.

Differential inactivation responses of *Shigella sonnei* and *Bacillus subtilis* across light-emitting diode wavelengths.

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Wavelength-specific responses are vital for designing efficient microbial control systems. In this study, microbial inactivation behavior was evaluated across various light-emitting diode (LED) wavelengths using Gram-negative *Shigella sonnei* ATCC 29930 (*S. sonnei*) and Gram-positive, spore-forming *Bacillus subtilis* ATCC 6051 (*B. subtilis*). Cell suspensions were exposed to LED arrays spanning UVC (265 nm), UVB (308 nm), UVA (365 nm), visible light (405, 530, and 660 nm), and near-infrared light (850 and 940 nm). Viable cell counts were determined by plate counting on tryptic soy agar following incubation. The fluences required to achieve a 6–7 log reduction for *S. sonnei* and *B. subtilis* were 0.10 and 0.17 J/cm² (UVC), 0.90 and 1.18 J/cm² (UVB), and 177.61 and 254.19 J/cm² (UVA), indicating higher UV resistance of *B. subtilis* across the UV spectrum. At 405 nm, similar fluence levels were required for both strains. Under UVC, *S. sonnei* showed a rapid initial reduction, whereas *B. subtilis* exhibited a more gradual decline. Under UVA and 405 nm, *S. sonnei* exhibited linear or shoulder-type inactivation, while *B. subtilis* showed a tailing effect characterized by a reduced inactivation rate following an initial rapid decline. In the visible light (530 and 660 nm) and near-infrared (850 and 940 nm) regions, both strains showed less than a 1 log reduction. These results highlight the need for organism-specific LED disinfection strategies based on distinct inactivation behaviors.

Differential effects of pre- and post-extraction black tea powders on structure and antioxidant properties of low-moisture extruded meat analogs

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This study compared the physicochemical, textural, and antioxidant effects of pre-extraction black tea powder and post-extraction black tea by-product powder in low-moisture extruded meat analogs. The powders were incorporated at 0, 3, 6, and 9% into a base formulation of isolated soy protein and wheat gluten and extruded at 30% moisture and 140°C. DPPH radical scavenging activity increased in a dose-dependent manner for both powders, confirming enhanced antioxidant functionality. As powder concentration increased, lightness (L*) and yellowness (b*) decreased, while redness (a*) increased, with more pronounced color changes observed in the pre-extraction powder. Texture profile analysis showed that hardness and cohesiveness markedly decreased with increasing addition levels. Notably, water-soluble components in the pre-extraction powder more strongly interfered with protein cross-linking than the fiber-rich extraction by-products, leading to severe structural degradation at 9% addition. In contrast, the extraction residue effectively enhanced dietary fiber and antioxidant properties while minimizing structural disruption. These findings highlight its strong potential as a sustainable upcycling ingredient for plant-based meat analogs.

Upcycling sesame and perilla meal proteins: for pant-based clean-label emulsifiers

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In this study, sesame meal protein isolate (SMPI) and perilla meal protein isolate (PMPI) were enzymatically hydrolyzed with papain to investigate the effects of structural modifications on emulsifying properties and emulsion stability. Enzymatic hydrolysis reduced molecular weight, increased random coil content, enhanced solubility, and increased surface hydrophobicity, thereby improving interfacial properties. Moderate hydrolysis resulted in the highest surface hydrophobicity and the greatest reduction in interfacial tension, indicating optimal conditions for emulsification. Nanoemulsions stabilized by hydrolyzed SMPI and PMPI maintained constant droplet sizes (237–297 nm) during 28 days at 40°C. The creaming index ranged from 6.7% to 62%, showing markedly improved stability compared to untreated SMPI and PMPI. Notably, Moderate hydrolyzed samples exhibited smaller droplet sizes and lower creaming indices than whey protein isolate (WPI) emulsions (354 nm, 30.9%), demonstrating superior interfacial stability. SMPI showed higher emulsification performance than PMPI, associated with greater structural reorganization and more negative ζ-potential values, while both proteins exhibited improved emulsifying properties after hydrolysis. These findings suggest that controlled enzymatic hydrolysis of protein isolates can effectively enhance the emulsifying performance and emulsion stability and offer potential clean-label emulsifiers for cosmetic and food formulations.

Comprehensive evaluation of potential genotoxicity of food additives titanium dioxide and silicon dioxide in different human intestinal cell systems

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Titanium dioxide (TiO_2) and silicon dioxide (SiO_2) are widely used in the food industry as a white colorant and as an anti-caking agent, respectively. However, TiO_2 has been banned as a food additive in Europe due to concerns about its potential genotoxicity. Recent studies suggest that SiO_2 may induce inflammatory responses, raising the need for further safety evaluation of both food additives. In this study, the *in vitro* genotoxicity of food additives TiO_2 and SiO_2 was evaluated. Human intestinal epithelial cell lines (Caco-2 and HT-29) and three different human intestinal barrier models mimicking the intestinal wall were used to assess genotoxicity in the presence or absence of metabolic activation. The effects on DNA damage were assessed using the comet assay and quantification of 8-hydroxy-2′-deoxyguanosine. In addition, chromosomal damage was evaluated through chromosomal aberration and micronucleus assays. The results showed that SiO_2 did not induce genotoxicity. In contrast, TiO_2 caused DNA damage but did not lead to chromosomal aberrations or micronucleus formation. These findings provide important data for the safety assessment of the food additives TiO_2 and SiO_2.

Differential susceptibility to order effects based on product acceptance in alternative food testing

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The alternative food market has expanded substantially due to consumer concerns about health and environmental sustainability. Consumer acceptance is critical for predicting product success; however, the sequence of sample presentation can influence outcomes through order effects. While randomization and balanced serving orders are commonly used to minimize this bias, susceptibility to order effects may vary by product characteristics. This study examined order effects across alternative food categories, including plant-based beverages, plant-based meat alternatives, and products with different alternative sweeteners. Overall liking was measured using a 9-point hedonic scale, and sensory perceptions were evaluated using check-all-that-apply methods or intensity scales. Two-way ANOVA examined the effects of sample, serving order, and their interaction on liking scores. Serving order significantly influenced liking across all categories, with a consistent first-serving effect where initial samples received the highest scores. Significant interactions between sample and serving order were found for plant-based beverages and plant-based meat alternatives. Samples with higher liking showed stable scores across serving positions, whereas lower-liked samples exhibited greater variability. These findings suggest that acceptance levels may influence the order effect magnitude. Results emphasize the importance of careful experimental design when evaluating novel food categories.

Bioactive properties of the different lactic acid bacteria isolated from Filipino fermented foods: burong mustasa, burong isda, and tapuy

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The Philippines, due to its tropical climate, experiences prolonged sun exposure and relatively high temperatures and humidity throughout the year causing skin problems. In addition, rice serving as the staple food could cause health problems such as diabetes. Traditional fermented foods contain lactic acid bacteria (LAB) that produce metabolites that may have potential health benefits when consumed. Therefore, the study aims to isolate and identify LAB strains found in traditional fermented foods from the Philippines and further examine its bioactive properties. Among the 73 identified strains using Polymerase Chain Reaction (PCR), 15 strains belonging to the *Lactiplantibacillus plantarum*, *Levilactobacillus brevis*, *Leuconostoc mesenteroides*, *Pediococcus pentosaceus*, and *Weissella paramesenteroidesgroup* were chosen for further examination. The LAB strains exhibited excellent antioxidant activities in ABTS assay with values up to 95% and in DPPH assay with 84%. Moreover, the strains exhibited mild to good result in skin- and health-related bioactivity inhibitory assays such as collagenase, elastase, tyrosinase, α-glucosidase, and astringent effect with inhibition rates up to 70.17%, 52.16%, 53.50%, 70.38% and 17.21%, respectively. The results provided additional information regarding the LAB present in the said foods and further studies are recommended to standardize the present LAB and its potential application to skin care and health related products.

L-arginine supplementation in plasma-activated water (PAW) enhances the efficacy of PAW treatment for microbial inactivation and stability of grape tomatoes during storage

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Plasma-activated water (PAW) supplemented with L-arginine (Arg-PAW) treatment was investigated for its inactivation effects on *Escherichia coli* O157:H7 and *Listeria monocytogenes* inoculated onto grape tomatoes as well as its effects on microbial growth, microbiome, and storability of grape tomatoes. PAW and Arg-PAW were generated by treating 1 L of distilled water (DW) or L-arginine (L-Arg) solution (1 mg/mL) with atmospheric cold plasma at 51.5 W for 60 min. DW, L-Arg, PAW, and Arg-PAW treatments were made by immersing grape tomatoes in each solution for 5 min. Compared with PAW, Arg-PAW exhibited a higher pH and oxidation-reduction potential, reaching 2.9 and 610.5 mV, whereas its electrical conductivity decreased to 1066.2 μS/cm. L-Arg supplementation increased hydrogen peroxide, nitrite, and nitrate concentrations to 46.2, 59.2, and 1091.9 μM, while reducing the ozone concentration to 60.0 μM. Arg-PAW treatment inactivated *E. coli* O157:H7 and *L. monocytogenes* by 3.8 and 3.2 log CFU/g, respectively. Arg-PAW treatment altered the microbiome of grape tomatoes during 3-day storage at 4°C and inhibited the growth of indigenous mesophilic aerobic bacteria during for 14 days at 4°C, while maintaining color and pH, retarding the decrease in firmness and lycopene content, and increasing ascorbic acid content (p<0.05). These results demonstrate the potential of Arg-PAW treatment for microbial inactivation and improving the storability of grape tomatoes.

Effect of pressure-assisted thawing on the microstructural and textural formation of chicken-like fibrous structures from frozen tofu

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This study investigated the mechanisms of protein matrix restructuring and anisotropy formation in tofu under different pressure-assisted thawing (PAT) conditions. PAT treatment under diverse thermal history conditions resulted in a reduction in sample thickness and produced an anisotropic layered structure that consisted of a porous upper region and a compact lower region. The moisture content decreased to 63.5-70.2%, which indicated greater water expulsion than that observed in non-compressed samples. High-temperature thawing conditions (PAT3-PAT5) promoted structural densification, whereas annealing conditions (PAT6-PAT7) improved pore uniformity and structural alignment. At the molecular level, the balance of protein-protein interactions shifted. PAT5 showed increased disulfide bonding, which contributed to the formation of a rigid network, whereas PAT7 exhibited predominantly charge-based interactions. These structural changes were reflected in material properties. Hardness generally increased and reached the highest value in PAT5, while the texturization index (TI) increased in PAT7, which suggested enhanced structural alignment. Conventional thawing often causes microstructural damage and quality deterioration in tofu. A systematic understanding of process-structure-property relationships is therefore required to enable precise texture control in protein-based foods.

Evaluation of saltiness enhancement effects of SPI & Meju hydrolysates using sensory evaluation and electronic tongue

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The saltiness-enhancing effects of soy protein isolate hydrolysate (SPIH) and meju hydrolysate (MH) in both whole solution (*W*) and supernatant (*S*) forms were evaluated using sensory evaluation and electronic tongue (e-tongue) analysis. After preparing each sample (*W, S*) at concentrations of 0.1%, 1.0%, and 1.5%, the NaCl concentration of all samples was standardized to 30 mM to evaluate changes in saltiness intensity relative to the hydrolysate content. Both e-tongue and sensory evaluation results demonstrated that saltiness intensity significantly increased as the concentrations of SPIH and MH increased. In the e-tongue analysis, SPIH generally exhibited higher saltiness intensity than MH however, sensory evaluation revealed that MH provided a superior saltiness-enhancing effect, highlighting a discrepancy between instrumental analysis and human perception. Regarding sample forms, MH showed higher saltiness intensity in the *S* than in the *W* across both analytical methods. For SPIH at a 1.5% concentration, the e-tongue analysis revealed a higher saltiness intensity in W (54.22±1.60) than in S (45.68±0.96), whereas the sensory evaluation indicated a slightly higher saltiness in S (37.50±8.12) than in W (36.67±6.15). These results confirm that saltiness intensity increases proportionally with the addition of SPIH and MH even at a constant sodium level, suggesting that these hydrolysates have high potential as saltiness enhancers for reducing sodium intake.

Effects of drying and enzymatic treatment on antioxidant activity and saccharification characteristics of upcycled sweet potato by-products

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This study aimed to evaluate pre-treatment conditions for the development of antioxidant-enriched distilled spirits using sweet potato by-products. The byproducts were dried under different methods, including hot-air drying(HA) and nearinfrared drying(NI), at temperatures of 60, 70, and 80°C for 16 h. Physicochemical properties and antioxidant activities were subsequently analyzed. Based on the selected drying condition, enzymatic saccharification was performed using α-amylase (A), glucoamylase (G), protease (P), and cellulase (C), either individually or in combination, for 0, 24, and 48 h. NI drying resulted in lower reducing sugar and soluble solid contents compared to HA drying; however, it exhibited the highest antioxidant activity. Therefore, NI-dried samples were selected for further enzymatic saccharification. Among the enzyme treatments, the combination of α-amylase and glucoamylase (AG) showed the lowest viscosity and the highest levels of reducing sugars and soluble solids. In addition, AG treatment for 24 h resulted in high total polyphenol and flavonoid contents, as well as enhanced DPPH radical scavenging activity. These results suggest that NI drying combined with 24 h saccharification using α-amylase and glucoamylase is an effective pre-treatment strategy for improving both antioxidant functionality and saccharification efficiency of sweet potato by-products.

Effects of aging on the functional properties of shellac–cellulose nanofiber composite films

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Shellac (Sh) is a natural biopolymer with excellent film-forming capacity and gas barrier performance, but its brittleness increases during storage because of aging. Cellulose nanofiber (CNF), which has high mechanical strength and oxygen barrier properties, can be incorporated to improve film performance. This study investigated the combined effects of CNF incorporation and aging on the functional properties of Sh-based edible films. Composite films were prepared at Sh:CNF ratios of 100:0, 80:20, and 50:50, then aged at 40°C and 53% relative humidity for 7 days. Physicochemical, mechanical, and gas barrier properties were evaluated. Increasing CNF content reduced thickness, moisture content, and water solubility, while increasing tensile strength, yield stress, and stiffness, with a decrease in elongation at break. CNF also improved oxygen barrier performance but increased water vapor permeability. Aging further decreased thickness and moisture content, increased rigidity, and reduced flexibility. Marked yellowing occurred in pure Sh films after aging, whereas CNF incorporation mitigated this color change. Unlike the effect of CNF, aging increased oxygen permeability while decreasing water vapor permeability. Overall, both blending ratio and aging treatment strongly influenced the performance of Sh–CNF composite films, suggesting their potential for tailored use in sustainable food packaging systems.

Ultrasonication-induced structural changes of alternan in aqueous systems

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Alternan, a glucan composed of alternating α-1,6 and α-1,3 linkages, has potential as a functional texture enhancer with dietary fiber-like properties due significantly influence viscosity and texture, remains poorly understood. This study investigated the particle characteristics of alternan dispersions and their response to ultrasonication. Alternan dispersions (0.1-10%, w/w) were analyzed using dynamic light scattering, revealing concentration-dependent aggregation, with particle size increasing at higher concentrations. To evaluate structural disruption, a 1% (w/w) dispersion was subjected to ultrasonication (37 kHz) for up to 240 min. Initial ultrasonication reduced the dominant particle size from approximately 250 nm to 150–200 nm, indicating partial disaggregation. With prolonged treatment, size distributions became multimodal, showing the coexistence of smaller particles (10–60 nm) and larger aggregates (~400 nm), suggesting simultaneous fragmentation and reaggregation. These results demonstrate that ultrasonication can modulate alternan nanoparticle structures in water, while also inducing dynamic reorganization. Therefore, controlled processing conditions are required to achieve consistent functionality in aqueous food systems.

Impact of storage temperature on quality stability of fresh-cut carrots

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Fresh-cut carrots are prone to rapid quality deterioration due to tissue disruption during processing. This study investigated the effects of storage temperature (2, 7, and 20°C) on physicochemical properties, antioxidant activity, texture profile, pH, and microbial growth during 8 weeks of storage. Weight loss increased progressively with temperature, and samples stored at 20°C exhibited severe dehydration and visual darkening. Total aerobic counts increased markedly at elevated temperature, reaching 10.57 log CFU/g at 20°C, indicating rapid microbial spoilage under ambient conditions. Total carotenoid content and antioxidant activity gradually decreased during storage, with significantly faster reductions observed at 20°C compared to refrigerated conditions. These changes corresponded with declines in CIE L* and b* values, suggesting pigment degradation. Texture profile analysis revealed substantial decreases in hardness and chewiness at higher temperature, reflecting structural breakdown of carrot tissues. In contrast, samples stored at 2°C maintained relatively stable physicochemical characteristics and slower microbial growth throughout storage. Overall, storage temperature critically influenced oxidative, structural, and microbiological deterioration in fresh-cut carrots, highlighting the importance of strict temperature control for maintaining quality and extending shelf-life.

Effects of freezing-induced glass and crystal states on probiotic viability and storage stability

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This study investigated how freezing-induced amorphous and crystalline states affect the survival of *Leuconostoc mesenteroides* during freeze-drying and storage. Using lactose or inulin as the carbohydrate component, whey protein isolate served as the protein matrix. Before freeze-drying, formulations were either frozen at -100°C to create amorphous states or at -5°C then -100°C for crystallization. XRD, FTIR and DSC analyses confirmed that rapid freezing produced amorphous matrices with higher glass transition temperatures (Tg) and greater molecular disorder than crystalline matrices. Guggenheim-Anderson-de Boer and Gordon-Taylor analyses indicated that moisture sorption and Tg depression, related to molecular mobility, depended on carbohydrate type and matrix physical state. Inulin-based matrices exhibited higher moisture sorption but lower Tg sensitivity to water compared to lactose-based matrices. Glassy matrices showed lower sensitivity to water plasticization, limiting molecular mobility and enhancing probiotic stability. After 30 days of storage, amorphous matrices retained higher probiotic viability than the crystalline (p<0.05). The amorphous inulin system showed the highest survival rate (86%), whereas crystallization resulted in a decrease in survival rate (53%). These results demonstrate that amorphous formed by rapid freezing enhance probiotic stability, particularly in inulin-based systems, by maintaining higher Tg and reducing water-induced plasticization.

Dynamic modeling of *Pseudomonas fluorescens* growth in fresh flounder under fluctuating temperature conditions

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This study developed a predictive growth model for *Pseudomonas fluorescens* in fresh flounder under both isothermal and fluctuating temperature conditions. Fresh flounder samples inoculated with a three-strain cocktail of *P. fluorescens* were stored at 0, 4, 10, 20, and 30°C. Primary growth data were fitted to the Baranyi model to estimate the lag phase duration (LPD) and the maximum specific growth rate (μ_{max}), while a secondary model was built by fitting a second-order polynomial equation to describe the effect of temperature on μ_{max}. Both models showed excellent goodness of fit, with R^2 values of 0.98–1.00 and 0.99, respectively. External validation using independent data sets at 15 and 25°C confirmed high predictive accuracy, yielding a bias factor (B_f) of 0.985, an accuracy factor (A_f) of 1.044, and an RMSE of 0.015 log CFU/g. Notably, *P. fluorescens* entered the exponential phase within 24 h at 0°C, and reached the marginal quality range (6–7 log CFU/g) within 48 h (10°C) and 96 h (4°C), indicating rapid quality loss under refrigerated conditions (0–10°C). When validated under three fluctuating temperature scenarios, the model maintained robust performance, with RMSE values of 0.169–0.338 log CFU/g and acceptable simulation zone (ASZ) coverage of 85.7–100%. Thus, the developed model serves as a reliable tool for predicting quality deterioration and estimating the shelf life of flounder, particularly under dynamic refrigerated supply chain conditions.

Effect of tempering–roasting conditions on powder properties and dispersion stability of chickpea flour suspensions

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Chickpea flour suspensions for beverage-type systems often exhibit limited dispersion stability due to rapid sedimentation and phase separation during handling and storage. This study aimed to identify tempering–roasting conditions that improve dispersion stability and to elucidate stability changes in relation to powder structure and hydration properties. Chickpeas were tempered to 15% or 20% moisture and roasted at 180—240°C at 20°C intervals for 5 min, then milled and sieved (600 μm). Powder structure/hydration were characterized, and stability was quantified using Turbiscan profiles. Increasing roasting temperature reduced median particle size and increased span, while hydration shifted toward higher absorption and lower solubility; roasting temperature significantly affected water absorption index (WAI) and water solubility index (WSI) (p<0.05), with WAI increasing from 1.90 to 2.40 g/g and WSI decreasing from 24.40% to 15.62%. Turbiscan profiles showed temperature-dependent destabilization, including larger ΔBS fluctuations, widened clarification and sedimentation zones, and an earlier onset of separation. Among tested conditions, 20% tempering moisture with 180°C roasting showed the highest stability (TSI 6.4), whereas 240°C increased TSI to 9.8 with enhanced clarification and sedimentation. Overall, these findings provide a practical basis for designing stable chickpea flour suspensions with reduced separation for beverage-type systems within the tested range.

Effects of phase change materials and thermal property of package in frozen food cold chain

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This study aimed to identify candidate materials and select a suitable phase change material (PCM) for frozen food applications based on thermal properties. Salt solutions and alcohols were screened as PCM ingredients. Three solutions containing 19.5% KCl, 13.0% NaCl, or 16.5% EtOH in distilled water were prepared. In addition, four EtOH-based binary mixtures were prepared by mixing the EtOH solution with each salt solution (KCl or NaCl) at ratios of 1:2 and 2:1. A total of seven samples were analyzed. The results showed that all samples exhibited phase transition temperatures near −10°C, within the desired temperature range for frozen food storage. The latent heat values of the KCl, NaCl, and EtOH solutions were 246.9, 231.9, and 109.0 J/g, respectively, with the KCl solution showing the highest latent heat. The latent heat of EtOH mixtures decreased with increasing the proportion of the EtOH solution, indicating limited suitability for PCM applications. The thermal conductivities of the KCl, NaCl, and EtOH solutions were 0.528, 0.582, and 0.506 W/m·K. The thermal conductivity of EtOH mixtures increased with increasing the proportion of the salt solution. The KCl solution exhibited both higher latent heat and lower thermal conductivity than the NaCl solution. This study provides fundamental data for heat transfer modeling and cooling retention in insulated packaging, with the 19.5% KCl solution identified as the most suitable PCM for this application.

Effects of post-processing methods on the quality characteristics of twin-screw extruded fish cake-based snacks

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Fish cake-based snacks are gaining attention as high-protein processed foods, but their quality and storage stability vary depending on processing methods. This study evaluated the effects of different post-processing methods—puffing (RF), frying (P), and puffing followed by frying (PF)—on fish cake-based snacks produced by twin-screw extrusion at a fixed screw speed (100 rpm). Samples were prepared using each processing method, and their cross-sectional area, water activity (Aw), color (L*, a*, b*), texture, and microbial counts were evaluated. Processing methods clearly affected product characteristics. The PF treatment showed a higher cross-sectional area, indicating greater expansion. Water activity differed among treatments, suggesting variations in moisture retention and potential storage stability. Color and texture also varied depending on the processing method. Notable differences were observed in hardness, gumminess, and chewiness. Microbial counts also differed and appeared to be related to water activity. These findings indicate that even under identical extrusion conditions, post-processing methods play a key role in determining the structure, moisture behavior, and texture of fish cake-based snacks. The puffing–frying process (PF) may offer advantages in product characteristics, although further studies are needed to clarify the underlying mechanisms.

Surface sterilization of shelled and in-shell eggs using intense pulsed light treatment

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This study evaluated the sterilization efficacy and quality changes in eggs inoculated with *Salmonella enterica, Listeria innocua, and Escherichia coli* —the primary pathogens associated with egg-borne illnesses— following intense pulsed light (IPL) treatment. Experiments were conducted on both shelled (peeled) and in-shell eggs. The IPL parameters were set to a voltage of 2,000 V, a frequency of 10 Hz, a pulse width of 150 μs, and a distance of 16 cm between the xenon lamp and the sample. Treatment durations ranged from 0 to 5 s at 1-s intervals. The average energy density per pulse was 1.28×10^{-3} J/cm², with a spectral distribution of 38% UV-C, 34% UV-B, 4% UV-A, and 24% RAD. In shelled eggs, the population of *S. enterica* was reduced by a maximum of 3.19 log CFU/egg, while *L. innocua* and *E. coli* showed reductions of 2.65 and 2.61 log CFU/egg, respectively. The color difference (ΔE) ranged from 0.18 to 0.60. Over the 5-s treatment, the surface temperature increased by approximately 4°C (from 19.93°C to 24.00°C). For in-shell eggs, the maximum reductions for *S. enterica, L. innocua,* and *E. coli* were 2.46, 1.96, and 1.44 log CFU/egg, respectively. The ΔE for in-shell eggs ranged from 0.28 to 0.95. The surface temperature of in-shell eggs rose by approximately 13°C (from 24.53°C to 37.63°C) after 5 s of exposure.

강아지 분변에서 분리한 신규 젖산균의 항산화 능력 평가

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본 연구에서는 강아지 분변에서 분리한 신규 젖산균의 항산화 능력을 평가하였다. 젖산균은 MRS, LBS broth에 2%로 접종한 후 37℃로 24시간 배양하였으며, 2회 계대배양하였다. 배양 후에 phenol/chloroform 법을 이용하여 분리한 젖산균은 그람염색을 통해 그람양성의 간균과 구균으로 선별하였으며, 이후 polymerase chain reaction (PCR)으로 균주를 동정한 결과 *Lactobacillus reuteri, Lactobacillus salivarius, Lactobacillus paracasei*가 각각 2균주씩 분리되었다. 젖산균의 항산화 능력을 평가하기 위해서 각 균주의 젖산균 배양 상등액으로 ABTS, DPPH 라디칼 소거 활성 측정 실험을 진행하였다. 실험 결과 강아지 분변에서 분리한 젖산균의 항산화 능력이 유의미한 잠재력을 보여주고 있음을 확인할 수 있었다. positive control로 사용한 ascorbic acid와 비교하였을 때도 비슷한 소거능을 가지는 것으로 나타났다. 이러한 결과를 바탕으로 강아지 분변에서 분리한 젖산균은 천연 항산화제로서의 기능적 소재로 검토할 수 있을 것이다.

Effects of spent coffee ground (SCG) extracts combined with glycine and xylose on the enhancement of Robusta coffee flavor

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This study aimed to enhance the flavor of Robusta coffee using spent coffee ground (SCG) extracts in combination with glycine and xylose. To extract reducing sugars from SCG, water, citric acid, and sodium bicarbonate were used as extraction solvents, followed by autoclave treatment at 121°C. Among the treatments, SCG extracts pretreated with 0.2 M citric acid and autoclaved for 45 min exhibited the highest total sugar (12.391 g/L) and reducing sugar (1.57 g/L) contents. Subsequently, green Robusta coffee beans were soaked in SCG extracts supplemented with glycine or xylose. After drying, the coffee beans were roasted to induce the Maillard reaction. Flavor profiles were evaluated using gas chromatography-mass spectrometry and gas chromatography-time-of-flight mass spectrometry. The results revealed that coffee beans soaked in SCG extracts exhibited significantly reduced levels of pyridines and pyrazines (p<0.05), while showing an increasing trend in furan and pyrrole compounds, indicating an increased degree of the Maillard reaction. In particular, SCG extracts supplemented with glycine increased pyrrole compounds (p<0.05), whereas xylose supplementation increased pyrazine, furan, and pyrrole compounds (p<0.05). These findings suggest that SCG-derived sugar extracts, in combination with glycine and xylose, can be effectively utilized to valorize SCG and enhance the sensory quality of espresso coffee through Maillard-driven flavor development.

Non-destructive inspection of foreign materials leafy vegetables using terahertz imaging system

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Foreign material (FM) contamination in leafy vegetables poses significant food safety risks, particularly in minimally processed products. Conventional detection methods, including X-ray and metal detectors, are effective for hard contaminants but frequently fail to detect soft, low-density FMs such as insects. Terahertz (THz) imaging has emerged as a potential alternative, although its application to high-moisture foods remains limited due to strong water absorption. This study investigates a 200 GHz THz transmission imaging system for detecting hidden FMs in fresh leafy vegetables. The study utilized freeze-dried mealworms as model contaminants, and five vegetable types with varying moisture content and thickness were analyzed. The acquisition of images was facilitated by a large-area THz scanning system, and the contrast-to-noise ratio (CNR) was calculated to detectability. THz imaging demonstrated the capacity to detect FMs in high-moisture samples, particularly in thin and flat leaves such as perilla and lettuce, with higher CNR values. The performance of detection system was found to decrease in proportion to the thickness and leaf layering of the subject material. A comparative analysis of THz imaging with X-ray imaging reveals that, under certain conditions, THz imaging exhibits comparable or enhaced performance. The findings indicate that THz imaging is a viable non-destructive technique for detecting soft contaminants in leafy vegetables with high moisture content.

Physicochemical properties and *in vitro* starch digestibility of domestically cultivated long-grain rice

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This study aimed to characterize the physicochemical properties and *in vitro* starch digestibility of domestically cultivated long-grain rice and to elucidate the relationships between these factors. Rice samples, including Samgwang (Japonica type), Amimyeon (Tongil type), and Milyang 452, Milyang 454, and Milyang 455 (domestic long-grain cultivars), were analyzed. The results showed that Milyang 452 exhibited the highest amylose content. The total starch content was above 90% for all samples Rapid Visco Analyzer (RVA) analysis showed that Milyang 452 exhibited a high pasting temperature with a low breakdown, Milyang 455 showed high peak viscosity and breakdown, and Milyang 454 displayed a high setback value. Texture profile analysis (TPA) showed that hardness and chewiness generally followed the same pattern. In particular, Milyang 452 displayed lower springiness and adhesiveness, whereas Milyang 455 had the lowest cohesiveness. *In vitro* starch digestibility of cooked rice was assessed, and the estimated glycemic index (eGI) was lowest in Milyang 455. The physicochemical and textural characteristics of domestically cultivated long-grain rice highlight its potential for the development of rice products with low glycemic index.

The effect of solid - state fermentation (SSF) with soybean, dandelion root, and ogalpi seed using *Rhizopus oligosporus* KCCM 11948P on coffee alternative components and its biochemical properties

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Coffee substitutes offer low- or caffeine-free alternatives with improved digestibility and added health benefits, aligning with current trends in functional and plant-based foods. This study aimed to develop a novel coffee alternative using soybean, dandelion root, and ogalpi seeds, fermented with *Rhizopus oligosporus* KCCM 11948P via solid-state fermentation (SSF). Fermentation enhanced the nutritional profile by increasing L-carnitine production and elevating the contents of total polyphenols, flavonoids, and saponins by 1.4-, 1.5-, and 1.2-fold, respectively. Isoflavone composition was significantly modified, with reductions in glycoside forms and marked increases in aglycones, including genistein (4.41-fold increase) and glycitein (1.90-fold increase), along with the new formation of daidzein. Total phenolic compounds increased by 1.24-fold, driven by higher levels of caffeic acid, ferulic acid, and trigonelline. The product contained very low levels of caffeine (0.7 mg/kg DM), making it suitable for caffeine-sensitive individuals. Enhanced antioxidant capacity was observed, with ABTS, FRAP, and ORAC values increasing by 1.5-, 1.2-, and 1.2-fold, respectively. Additionally, α-glucosidase inhibitory activity improved significantly, indicating potential antidiabetic effects. These findings demonstrate that SSF effectively enhances the functional and nutritional properties of a novel coffee alternative.

Observation of changes in physicochemical and structural characteristics due to barley roasting

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This study investigated the changes in physicochemical and structural properties of barley during roasting. The appearance of barley was progressively darkened as the roasting intensity increased. The moisture content decreased continuously during roasting, which was attributed to moisture evaporation induced by thermal treatment. Texture analysis revealed changes in hardness and fracturability, indicating structural modifications in the internal matrix of barley. Thermal properties evaluated by thermogravimetric analysis (TGA) showed differences in thermal degradation behavior depending on roasting conditions. X-ray diffraction (XRD) analysis demonstrated alterations in crystalline structure, suggesting internal structural rearrangement during roasting. In addition, particle size distribution varied with roasting conditions, which is likely associated with changes in the structural integrity of barley. These results indicate that roasting significantly affects moisture content, texture, thermal stability, crystalline structure, and particle size distribution of barley, and plays an important role in determining its physicochemical properties.

Pressure annealing treatment of short-chain glucan aggregates (SCGA)

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Short-chain glucan (SCG), produced by debranching waxy corn starch, self-assembles into semi-crystalline short-chain glucan aggregates (SCGA). This study investigated the effect of pressure annealing treatment (PAT) on the physicochemical properties of SCGA. SCGA was subjected to pressure treatments at 400, 500, and 600 MPa for 30 min. To compare these effects with conventional heat annealing treatment (HAT), a separate group was annealed at 50°C for 72 h. The yields under all conditions remained above 80% compared to native SCGA. HAT significantly increased the onset temperature and double-helix melting enthalpy (ΔH) compared to native SCGA, confirming that HAT induced molecular rearrangement and increased the number of double helices within the SCGA structure. Regarding PAT, no significant differences were observed at 400 MPa, whereas an increasing tendency in double-helix melting enthalpy was noted at 500 MPa. Notably, the 500 MPa treatment resulted in a higher double-helix melting enthalpy than the conventional HAT, although the onset temperature remained at a level similar to that of native SCGA. These results demonstrate that short-term pressure treatment at 500 MPa can induce molecular rearrangement in SCGA, producing effects consistent with those of HAT. In contrast, at the higher pressure of 600 MPa, the double-helix melting enthalpy decreased, which is significant in terms of controlling crystallinity alongside partial gelatinization.

Ultra-high pressure processing for the inactivation of microbial changes in duck meat

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The effects of ultra-high pressure (UHP) treatment on microbial inactivation and oxidation characteristics during the storage period of duck breast meat were evaluated. The survival of *Listeria monocytogenes, Salmonella Typhimurium*, *Escherichia coli, Staphylococcus aureus,* and *Bacillus cereus* decreased significantly with increasing pressure and holding time, with marked reducions at ≥300 MPa for 15 min. Gram-negative bacteria were more pressure-sensitive than gram-positive bacteria. Among the tested strains, *S. aureus* showed the greatest pressure resistance, whereas *S. Typhimurium* was the most sensitve. Thiobarbituric acid reactive substances increased with pressure and storage time, whereas volatile basic nitrogen content significantly decreased in UHP-treated samples, indicating that protein spoilage was inhibited. Overall, UHP effectively reduced pathogens in duck meat while inhibiting protein spoilage. Treatments at ≥300 MPa demonstrate potential as a non-thermal approach to enhance microbial safety in raw duck meat.

Rechargeable *N*-halamine antimicrobial coating on harvesting knives using sesame protein isolate for reducing cross-contamination of fresh produce

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Cross-contamination via food contact surfaces is a critical food safety concern during fresh produce harvesting. Conventional chlorine-based sanitizers are limited by rapid loss of activity in the presence of organic matter and lack of sustained antimicrobial function. This study developed rechargeable *N*-halamine antimicrobial coating applied to stainless-steel harvesting knives using sesame protein isolate (SPI) derived from sesame meal as a food industry by-product. SPI was formulated with cellulose nanocrystals and tannic acid, applied by brushing and chlorinated with NaOCl to form *N*-halamine structures confirmed by FTIR analysis. The coated surface contained 2.38 μmol/cm² of active chlorine after 10 min of chlorination. The coating retained approximately 2 μmol/cm² of active chlorine over five recharge cycles and fully recovered to initial levels following organic stress and solar irradiation. The coated surface achieved more than 3 log reduction of *E. coli* O6 (ATCC 25922) within 1 min and complete inactivation of *L. innocua* (ATCC 33090) within 30 min. In cross-contamination tests secondary bacterial transfer to uncontaminated lettuce was reduced to near the detection limit with 3-4 log reduction compared to uncoated surfaces. Overall, the results demonstrate the potential of SPI-based *N*-halamine coatings as a sustainable and rechargeable strategy for controlling microbial cross-contamination in fresh produce harvesting.

Integrating instrumental analytical techniques with machine learning for the discrimination of Korean wheat flour

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The consumption of wheat-based foods in Korea has been steadily increasing, while the domestic wheat self-sufficiency rate remains low. In order to promote the use of Korean wheat flour, reliable approaches for evaluating and predicting its processing performance are required. In this study, the physicochemical characteristics of Korean wheat cultivars were analyzed using various instrumental analytical techniques - Rapid Visco Analyzer (RVA), Fourier-transform infrared spectroscopy (FTIR), Texture Analyzer (TA), and GlutoPeak. The analytical data were used as datasets for machine learning models, and feature-selected datasets were constructed to evaluate the contribution of different instrumental techniques to predictive performance. The machine learning models trained with RVA parameters alone achieved improved performance with an accuracy of 0.95. The addition of key Texture Analyzer parameters, particularly R_{max} and extensibility, further improved model performance. Under this condition, K-nearest neighbors and support vector machine models achieved accuracies up to 0.995, while ensemble models including Random Forest and CatBoost achieved perfect classification accuracy. Overall, this study demonstrates that instrumental analytical techniques coupled with machine learning analysis can be utilized as a rapid and objective screening tool for the quality standardization of Korean wheat flour.

Multi-stress tolerance and biofilm formation of food-derived *Listeria monocytogenes* under food-processing–relevant conditions

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This study investigated the multi-stress tolerance, biofilm formation, and disinfectant susceptibility of *Listeria monocytogenes* strains from food and reference collections under food-processing–relevant conditions. A total of 29 were examined under combined stresses: 1°C+5% NaCl+pH 3(adjusted with HCl or lactic acid). Cell viability was monitored for up to 96 h, and biofilm formation was evaluated at 37°C, 4°C, and 1°C. Under HCl-adjusted conditions, 62.1% and 41.4% of strains remained viable above 1 log CFU/mL after 48 h and 96 h, whereas lactic acid caused greater inactivation, with 41.4% and 13.8% surviving after 24 h and 48 h. After 96 h under HCl multi-stress, 55% of food isolates survived above 1 log CFU/mL, compared with only 11.1% of reference strains. Similarly, under lactic acid multi-stress, all reference strains were inactivated within 24 h, while 60% of food isolates remained viable. All strains except *L. innocua* ATCC 33090 formed at least weak biofilms at 37°C, and eleven food isolates produced biofilms even at 1°C after 8 weeks. Minimum inhibitory concentration tests against four disinfectants, including sodium hypochlorite, showed no marked differences among strains. These results demonstrate that certain food-derived *L. monocytogenes* strains persist under multiple stresses and low temperatures, indicating their potential for survival in food-processing environments and the need for genetic studies on stress resistance mechanisms.

Influence of protein-starch ratios on rheological behavior and fibrous structure formation in high-moisture meat analogs

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Developing a meat-like fibrous texture is essential for high-moisture meat analogs (HMMA), but the influence of formulation ratios on the physical properties of their base mixtures remains unclear. Therefore, this study investigated the effects of isolated soy protein (ISP), wheat gluten (WG), and corn starch (CS) ratios on the rheological and pasting properties of plant-based meat analog blends. The study was conducted with six formulations from 7:2:1 to 4:4:2, and their pasting and rheological properties were evaluated using a Rapid Visco Analyzer (RVA) and a rheometer, respectively. The results indicated that storage modulus (G') and complex viscosity (η*) significantly increased as the ISP concentration increased, with the ratio of 7:2:1 exhibiting the highest values due to the formation of a firm protein-driven gel network. The loss factor (tan δ) remained stable between 0.28 and 0.30 regardless of the formulations, indicating a consistently elastic-dominant viscoelastic behavior. Furthermore, pasting viscosities measured by RVA were found to increase with increasing CS concentration (from 10% to 20%), which was attributed to extensive starch gelatinization. However, at 20% CS concentration, the sharp increase in pasting viscosity relative to G' resulted in an excessively viscous, paste-like structure. Conversely, the 6:3:1 ratio showed an optimal balance between high G' and moderate pasting viscosity, providing sufficient network strength to ensure structural integrity and fibrous formation. Therefore, it was concluded that the ratio of ISP, WG, and CS is a key factor in determining the rheological and pasting properties of high-moisture meat analogs.

Proposal of quality control (QC) parameters based on rheological characterization and extrusion usability of commercial sauce products

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This study aimed to investigate a quantitative framework for quality control (QC) of commercial sauces (23 samples) by integrating rheological characterization with extrusion-based consumer usability assessment. Apparent viscosity was measured at shear rates of 1, 10, and 50 s^{-1} using a rotational viscometer to define practical QC indicators associated with storage stability and perceived flow behavior during handling and dispensing. Flow behavior was characterized using a rheometer and fitted to the Herschel–Bulkley model to quantify yield stress and shear-thinning behavior. Viscoelastic properties were evaluated through amplitude sweep tests to determine the linear viscoelastic region (LVER) and to measure storage modulus (G') and loss modulus (G"). Frequency sweep tests were conducted at 4, 25, and 60°C to assess structural stability and temperature-dependent behavior, while a three-interval thixotropy test (3ITT) was performed to evaluate structural breakdown and recovery kinetics under simulated processing conditions. Extrusion behavior was analyzed using a texture analyzer through compression–extrusion tests, where peak force, work done, and consistency index were used to quantify extrusion resistance and consumer-perceived usability. The proposed approach provides an integrated set of QC parameters linking processing behavior, structural stability, and consumer handling characteristics.

Utilization of stearyl alcohol–stearic acid binary oleogels as solid fat replacers in food systems

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Recently, oleogels prepared with a single component oleogelator have shown limitations in fully replacing the functionality of conventional solid fats in food systems, leading to increasing interest in combinations of oleogelators. In this study, binary oleogels were prepared using various ratios of stearyl alcohol and stearic acid, and their potential as shortening substitutes in cookies was evaluated. The stearyl alcohol (70): stearic acid (30) oleogel based on flaxseed oil exhibited the highest hardness and the lowest melting point, indicating a new eutectic oleogel system. In addition, binary oleogels showed higher hardness than single gelator systems, and these results were consistent with their solid fat content and oiling-off behavior. Cookies prepared with the stearyl alcohol (70): stearic acid (30) oleogel as a shortening substitute showed higher spreadability than those prepared with conventional shortening, which was consistent with the temperature-dependent viscoelastic properties of the dough. Furthermore, the saturated fatty acid content of the oleogel cookies decreased from 30% to 15%, suggesting an improved nutritional profile.

Efficient and green extraction of antioxidant compounds from peanut hulls by subcritical water extraction

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Peanut hulls are promising agricultural byproducts for functional ingredient development. To identify an efficient process for extracting their antioxidant compounds, subcritical water extraction (SWE; 120-200°C, 5-20 min) was compared with microwave-assisted extraction (MAE; 400-800 W, 30-90 s), 80% ethanol (25°C, 24 h), and hot water (90°C, 2 h) extraction. The extracts were analyzed for total phenolic content (TPC), total flavonoid content (TFC), ABTS and DPPH radical scavenging activities, luteolin content, and extraction yield. SWE exhibited significantly higher extraction efficiency than the other methods. At 200°C for 20 min, SWE maximized TPC, TFC, and ABTS activity, yielding 24.26±0.52 mg GAE/g, 2.25±0.03 mg QE/g, and 31.59±0.16 mg TE/g, respectively, while DPPH activity and yield were highest at 14.72±0.45 mg TE/g and 27.92±0.22% at 200°C for 15 min. In contrast, MAE exhibited substantially lower maximum values, with TPC and yield reaching only 0.65±0.04 mg GAE/g and 3.56±0.08%, respectively. Furthermore, 80% ethanol yielded a TPC of 2.01±0.02 mg GAE/g and a yield of 2.79±0.10%, while hot water extraction exhibited lower values overall. Interestingly, luteolin content was highest at 180°C for 5 min in SWE (0.33±0.01 mg/g), indicating that optimal conditions for individual marker compounds differed from those for overall antioxidant recovery. These results suggest that SWE is an efficient green extraction method for recovering antioxidant compounds from peanut hulls.

Antioxidant effect of Tartary buckwheat extract against food additive titanium dioxide-induced oxidative stress

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With increasing interest in anti-aging diets, attention has grown toward foods rich in antioxidant compounds, such as Tartary buckwheat. Tartary buckwheat contains various bioactive flavonoids, with rutin as a major component known for its strong antioxidant, anti-inflammatory, and anticancer properties. Meanwhile, titanium dioxide (TiO_2), widely used as a food coloring agent, has been banned in the European Union due to concerns regarding its potential genotoxicity. In this study, Tartary buckwheat extract (TBE) was treated prior to TiO_2 exposure to evaluate its protective effects on cells. The evaluated parameters included cytotoxicity, antioxidant enzyme activities, DNA damage, and hydrodynamic particle size. The results showed that TBE increased the hydrodynamic particle size of TiO_2 which was accompanied by lower cytotoxicity. In addition, pretreatment with TBE significantly enhanced antioxidant enzyme activities, suggesting that its antioxidant components contribute to the upregulation of these enzymes. Furthermore, pretreatment with TBE was shown to reduce DNA damage compared to the untreated group. These findings indicate that TBE provides protection against TiO_2-induced oxidative stress through its antioxidant activity and may serve as a promising functional food ingredient.

Optimizing modified atmosphere packaging for improved stability of kimchi starter culture via simplex lattice design

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Ensuring the storage stability of freeze-dried lactic acid bacteria (LAB) starter cultures is essential for improving industrial fermentation efficiency and reducing reliance on cold-chain logistics in the food supply chain. This study aimed to optimize modified atmosphere packaging (MAP) conditions to enhance the stability of *Latilactobacillus curvatus* WiKim0094 by incorporating environmental factors such as storage temperature and duration into the experimental design. A simplex lattice design (SLD) was employed to evaluate the effects of varying gas compositions (CO_2, O_2, and N_2) on LAB viability under accelerated shelf-life conditions. Viability assays, regression analysis, and shelf-life prediction modeling were conducted. The optimized MAP condition (28% CO_2+72% N_2), identified by SLD analysis, was validated through growth kinetics in MRS media and competitive dominance assays in kimchi juice, demonstrating an approximately 5-fold extension in half-life. Starter cultures stored under the optimized MAP condition exhibited earlier growth initiation and maintained high dominance (70% at day 7) during fermentation. The proposed MAP approach offers a scalable and effective strategy for extending shelf life, enhancing microbial competitiveness, and reducing cold-chain dependence in the commercial production of fermented foods.

국내산 채소류의 가공 처리에 따른 카로티노이드 성분 분석

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국내산 채소류를 대상으로 HPLC를 활용하여 루테인, 제아잔틴, β-크립토잔틴, α-카로틴, β-카로틴, 9-z-β-카로틴, 13-z-β-카로틴 등 7종의 주요 카로티노이드를 정량하고, 가공 처리와 품종 차이에 따른 카로티노이드 함량 및 변화를 평가하였다. 분석 대상은 가죽나물(*Cedrela sinensis* A. Juss.), 부지갱이(*Aster glehni* F. Schmidt), 참나물(재배, *Pimpinella brachycarpa* (Kom.) Nakai)을 선정하였고, 각 시료를 데치기, 건조 등 가공 처리를 하여 생 시료와의 카로티노이드 함량의 차이를 분석했다. 가열 처리된 가죽나물(*Cedrela sinensis* A. Juss.)은 루테인, 제아잔틴, β-크립토잔틴, 9-z-β-카로틴, 13-z-β-카로틴 함량이 생 시료 대비 증가하였으나 β-카로틴 함량은 감소하였다. 건조 가죽나물의 경우 루테인 성분만 검출되었으며 그 함량도 생 시료 대비 감소되었다. 부지갱이는 루테인, β-카로틴, 9-z-β-카로틴, 13-z-β-카로틴 함량이 데칠 경우 생 시료 대비 증가하였고, β-크립토잔틴 함량은 감소하였다. 부지갱이는 건조 시료에서 건조 가죽나물과 다르게 β-크립토잔틴, β-카로틴, 9-z-β-카로틴, 13-z-β-카로틴 성분이 추가로 검출되었으며, 검출된 5종의 성분 모두 생 시료에 비해 감소되었다. 반면에 참나물은 데칠 경우 루테인, β-크립토잔틴, β-카로틴, 9-z-β-카로틴, 13-z-β-카로틴 함량 모두 생 시료 대비 증가하였으며, 타 시료에 비해 가공 처리 시 루테인 함량의 증가량(생것, 647 μg/g; 데친 것, 746 μg/g; 말린 것, 968 μg/g)이 가장 높았다. 그리고, 참나물은 루테인, 제아잔틴, β-크립토잔틴, β-카로틴, 9-z-β-카로틴, 13-z-β-카로틴 함량이 건조 시료에서 가장 높았으며, 제아잔틴의 경우 생 시료와 데친 시료 모두에서는 검출되지 않았으나 건조 시료에서만 검출되었다. 이를 통해 가공 처리와 식품군에 따라 카로티노이드 성분의 함량 차이가 확인되었으며, 특히 건조 처리 시 특정 카로티노이드가 검출 또는 증가하였다. 본 연구를 통해 국내 농산물 카로티노이드 성분 데이터베이스 구축에 기여하고, 식품군별 카로티노이드 함량 정보와 가공 조건에 따른 적합한 전처리 방법을 제공하여 효율적인 카로티노이드 섭취에 도움을 줄 것으로 기대된다.

초산 발효 기간에 따른 식초의 품질 및 환경 특성 변화

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식초 제조 공정은 숙련자의 경험에 의존하는 경우가 많아 공정의 표준화와 품질 예측에 한계가 있다. 이에 본 연구에서는 초산 발효 기간에 따른 식초의 환경 및 품질 특성 변화를 분석하고, 식초 품질 예측을 위한 데이터 기반 서비스 모델 구축의 기초자료를 확보하고자 하였다.

전북 지역 발효식초 제조업체에서 생산한 사과식초를 대상으로 초산 발효 기간별 환경 및 품질 특성을 조사하였다. 환경 데이터로는 외부 온도, 습도, CO_2, 발효조 내부 온도, pH 및 EC를 측정하였고, 품질 특성으로는 pH, 산도, 당도, 색도, 알코올 함량 및 유기산 함량을 분석하였다.

그 결과, 발효가 활발한 20~30일 구간에서 발효조 내부 온도는 외부 온도보다 3.6~5.0℃ 높게 나타났으며, CO_2 농도 또한 증가하였다. 반면, EC와 pH는 발효 기간이 경과함에 따라 감소하는 경향을 보였다. 품질 특성 분석 결과, pH는 발효 전 3.7에서 3.2로 감소하였고, 산도는 1.4%에서 6.2%로 증가하였다. 당도는 6.3°Bx에서 4.6°Bx로 감소하였으며, 색도는 발효 기간에 따른 큰 차이를 보이지 않았다. 알코올 함량은 10.1%에서 발효 40일 이후 검출되지 않았고, 유기산 조성 중 acetic acid 함량은 발효가 진행될수록 증가하였다. 또한 초산 발효 종료 시점 예측을 위하여 산도 및 알코올 함량과 환경 인자 간 상관관계를 분석한 결과, EC와 pH가 높은 상관성을 나타내었다.

이러한 결과는 EC와 pH가 초산 발효 공정의 품질 관리 및 발효 종료 시점 예측을 위한 유용한 지표로 활용될 수 있음을 시사하며, 향후 식초 발효 공정의 표준화와 데이터 기반 품질 관리 체계 구축을 위한 기초자료로 활용될 수 있을 것으로 판단된다.

Non-destructive quality assessment and shelf-life prediction of paprika via multimodal deep learning

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Paprika quality deterioration during storage causes significant economic losses in the fresh produce industry, while conventional methods rely on subjective inspection or destructive sampling. This study developed a multimodal deep learning model integrating image, color, and FTIR data for non-destructive prediction of ripening stage and shelf-life.

A total of 390 paprika samples were monitored from Day 0 to 54 at 18°C under retail conditions. Four-view RGB images, color parameters (L*, a*, b*, Chroma, Hue), and FTIR spectral data (10 PCA components) were fused using attention-based fusion. The model consisted of three branches: an image branch using pretrained ResNet50 with multi-view attention, a color branch, and an FTIR branch. Features were concatenated for multi-task learning.

Ripening labels were generated using unsupervised agglomerative clustering based on texture and Brix, and fold-wise clustering prevented data leakage. The model achieved 90.26±5.10% classification accuracy and R^2=0.941±0.022 (MAE 2.90±0.45 days) using 5-fold GroupKFold validation. FTIR contributed most to classification, while images improved regression. The full model outperformed single-modality baselines. Hyperparameters were optimized using Optuna.

Comparison of quality and physicochemical properties of domestic (2025 Harvest) and imported wheat flours

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This study investigated the quality and physicochemical properties of domestic wheat flours produced in 2025 (Keumgang, Saekeumkang, Jogyeong, Baekgang, and Hwanggeunal) and commercially available imported wheat flours (strong, medium, and weak flours). The moisture content of domestic wheat flours ranged from 11.2% to 13.6%, while that of imported wheat flours ranged from 12.5% to 13.6. The mean particle size of imported wheat flours decreased in the order of strong (67.7 μm), medium (49.0 μm), and weak flours (40.1 μm), whereas domestic wheat flours showed larger particle sizes ranging from 81.9 to 89.7 μm. Rapid visco analyzer analysis revealed that the peak viscosity of imported wheat flours was highest in strong (129.0 RVU), medium (128.9 RVU) and weak flours (106.1 RVU). In contrast, domestic wheat flours showed variation depending on the cultivar. Jogyeong showed the lowest peak viscosity (100.1 RVU), whereas Hwanggeunal showed the highest peak viscosity (156.9 RVU), which was higher than that of the imported wheat flours. Mixolab analysis indicated that Keumgang and Hwanggeunal exhibited dough properties similar to strong flour, Jogyeong and Baekgang were comparable to medium-strong flour, and Saekeumkang showed properties similar to weak flour. These results indicate that domestic wheat cultivars possess diverse dough properties, which can serve as fundamental data for their appropriate end-use applications.

Physicochemical properties of domestic (2025 harvest) and imported wheat starches

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This study investigated the physicochemical properties of starches isolated from domestic wheat flours produced in 2025 (Keumgang, Saekeumkang, Jogyeong, Baekgang, and Hwanggeunal). Starch particle size was measured using a particle size analyzer, revealing average sizes of 22.2–27.4 μm for Korean wheat starch and 25.3–26.3 μm for commercial wheat starch. Differential scanning calorimetry showed that the gelatinization onset temperature was highest in Hwanggeunal (61.5°C) and lowest in Jogyeong (59.9°C), whereas commercial wheat starch exhibited higher onset temperatures of 62.5–63.3°C. Polarized light microscopy revealed Maltese cross patterns in both Korean and commercial starches, indicating that the crystalline structure remained intact during starch isolation. Rapid visco analyzer analysis demonstrated that the peak viscosity of Korean wheat starch was highest in Keumgang (293.0 RVU) and lowest in Jogyeong (260.3 RVU), while commercial wheat starches showed lower peak viscosities in the order of bread flour (239.0 RVU), all-purpose flour (241.9 RVU), and cake flour (246.5 RVU). X-ray diffraction analysis showed that Korean wheat starch exhibited characteristic doublet peaks at 17°–18° (2θ), indicating an A-type crystalline structure.Therefore, the findings of this study may serve as fundamental data for the application of domestic wheat in the food industry.

Enhanced extraction of phenolic compounds and antioxidants from walnut (*Juglans regia L.*) shells using subcritical water

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Walnut shells are phenolic-rich byproducts, but the extraction of bioactive compounds is limited by their rigid structure and the environmental and safety issues of conventional solvents. This study applied subcritical water extraction (SWE) to optimize the extraction of phenolic compounds from walnut shells, comparing its efficiency with conventional methanol extraction (50°C, 6 h). Expressed on a raw material basis, the total phenolic content (TPC, 34.79±0.63 mg gallic acid equivalent (GAE)/g), radical scavenging activities (DPPH: 14.17±0.08; ABTS: 51.85±0.58 mg Trolox equivalent (TE)/g), and target compounds were all simultaneously maximized at 200°C for 15 min. In the methanol control, Furthermore, the TPC (1.89±0.01 mg GAE/g), DPPH (0.84±0.03 mg TE/g), and ABTS (1.79±0.06 mg TE/g) of the methanolic extract were drastically lower than those obtained via SWE, despite the 6-hour extraction time. These findings confirm that while organic solvents are limited to surface leaching, SWE induces autohydrolysis, weakening lignin-carbohydrate complex (LCC) bonds to effectively release bound phenolics. Thus, by disrupting the rigid lignin matrix and cleaving LCC bonds, SWE proves to be a highly efficient and eco-friendly alternative for extracting bioactive compounds from walnut shells and other lignin-rich biomass.

Characterization of granular cold-water swelling rice flour (GCWSRF) prepared by ethanol–heat treatment (EHT) at different ethanol concentrations

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This study investigated the physicochemical properties of granular cold-water swelling rice flour (GCWSRF) prepared by ethanol–heat treatment (EHT) at different ethanol concentrations (30–70%). EHT induced concentration-dependent changes in the microstructure, crystalline order, solubility, swelling power (SP), oil-holding capacity (OHC), and rheological behavior of rice flour. EHT30, 40, and 50 showed disruption of double-helical structures and reduced crystalline order. In particular, when microscopy, DSC, and XRD results were considered together, EHT40 and 50 exhibited the defining structural characteristics of GCWSRF by retaining the granular structure while showing internal gelatinization and weakened native crystalline order. SP and OHC were highest in EHT30, 40, and 50, and cold-water viscosity increased markedly in EHT30 and 40. In addition, EHT30, 40, and 50 showed higher G′ and G″ during the temperature sweep test, while EHT50 exhibited the highest viscoelasticity in the frequency sweep test. Overall, ethanol concentration effectively modulated the physicochemical properties of GCWSRF: EHT40 was more effective for cold-water viscosity development, whereas EHT50 was more effective for forming a stronger viscoelastic structure.

Stepwise optimization of alkaline protein extraction from *Pyropia spp.*: Effects of physical pretreatment, extraction temperature, and insights from Polysaccharide-depleted residue

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This study systematically optimized alkaline extraction conditions for the recovery of blue proteins from *Pyropia spp.*, integrating physical pretreatment, extraction temperature control, and process intensification. Ultrasonication significantly enhanced crude protein recovery compared with alkaline extraction alone, indicating the importance of cell wall disruption. Among extraction temperatures, 40°C provided the most favorable balance between protein enrichment and structural stability, yielding the highest crude protein content and soluble protein fraction while minimizing free amino acid formation. Thermal and FTIR analyses revealed that alkaline extraction induced partial unfolding of native protein structures and a transition toward β-sheet-enriched conformations, whereas moderate temperature preserved structural integrity more effectively than higher temperature. Secondary alkaline extraction was particularly effective for polysaccharide-depleted residue (PDR), increasing total amino acid content from 371.8 mg/g to 610.5 mg/g while maintaining amino acid distribution. Therefore, these findings demonstrate that moderate alkaline extraction combined with ultrasonication enables efficient recovery of nutritionally stable marine proteins and that secondary extraction is effective for residue valorization. This study provides a scalable framework for sustainable blue protein production.

팥(*Vigna angularis*)의 로스팅 및 팽화 처리에 따른 기능성, 색도 및 수분 특성 변화

예상진*, 박현진, 최유찬, 함현미, 심은영, 박지영, 오현아, 전원태, 강문석, 천아름

농촌진흥청 국립식량과학원 식품자원개발부 품질관리평가과

팥(*Vigna angularis*)은 기능성 식품 소재로 활용되나, 가공 과정에서의 기능성 변화는 처리 방식과 조건에 따라 달라질 수 있다. 본 연구에서는 '아라리' 품종을 대상으로 로스팅(200°C, 5–20 min; R5–R20) 및 팽화(490–784 kPa; P5–P8) 처리 강도에 따른 기능성(DPPH, ABTS), 총폴리페놀(TP), 총플라보노이드(TF), 색도(L*, a*, b*) 및 수분 특성 변화를 비교하였다. 로스팅 처리에서는 처리 시간이 증가할수록 L*는 감소하고 a*, b*는 증가하여 갈변 반응이 뚜렷하게 나타났으며, 수분함량 또한 크게 감소하였다. 팽화 처리에서도 압력 증가에 따라 L* 감소 및 a*, b* 증가가 나타났으나, 변화 폭이 상대적으로 작고 증가 경향이 완만하게 나타났다. 항산화능은 로스팅 초기 조건(R5, R10)에서는 유사한 수준을 보였으나, 고강도 조건(R20)에서는 낮은 경향을 나타냈으며, 팽화 처리(P5–P8)에서는 전반적으로 유지되는 경향을 보였다. 특히 로스팅 처리에서 TP와 TF는 증가하는 경향을 보였으나 항산화능과 일치하지 않는 결과를 나타냈다. 이러한 결과는 가공 과정에서 페놀성 화합물의 정량적 증가가 실제 항산화능 변화와 일치하지 않을 수 있음을 보여주며, 로스팅과 팽화가 각각 화학적 반응과 구조적 변화에 의해 기능성에 상이한 영향을 미침을 시사한다. 따라서 기능성 및 가공 적성 향상을 위해서는 처리 방식과 강도를 고려한 공정 설계가 필요하다.

Comparison of grain quality characteristics among Korea long-grain rice cultivars, lines, and U.S. varieties

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Rice (*Oryza sativa L.*) is a major cereal crop consumed as a staple food worldwide and is generally classified into three ecotypes: japonica, indica, and javanica. In Korea most cultivars for table consumption belong to the japonica type, characterized by medium- to short-grain shapes derived from a relatively narrow genetic background. However, since approximately 90% of global rice production consists of indica varieties, diversification of grain types is required in Korea to improve industrial competitiveness and respond to climate change.

Long-grain indica rice cultivars have recently been developed in Korea to expand export markets and meet the consumption demand of foreign residents, but studies on their grain quality and processing characteristics remain limited. Therefore, this study compared the quality characteristics of Korean long-grain indica cultivars and breeding lines with those of newly developed U.S. varieties.

Whiteness ranged from 44.2 to 52.7, with Korean materials showing higher values than the U.S. varieties. Amylose content ranged from 25.6–31.0%, while RVA peak viscosity and cooked rice hardness ranged from 170.9–288.3 RVU and 9,836–16,909 g, respectively, indicating comparable physicochemical properties between Korean and U.S. materials.

K-means cluster analysis based on processing-related traits revealed distinct groups. KL1 and KL2 showed high amylose and setback viscosity, resulting in dense and firm cooked rice similar to *Basmati 389. KL3* and the cultivar Amimyeon showed high amylose but smaller viscosity changes during cooking, suggesting suitability for processed or instant rice. KL4 showed softer cooked rice and was most similar to commercially available Jasmine- and Basmati-type aromatic rice.

These results provide fundamental information for the breeding and utilization of long-grain rice in Korea.

Changes in physicochemical properties of pork subjected to ultra-high pressure processing

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Non-thermal sterilization technologies that minimize nutrient loss in foods have gained increasing attention for microbial inactivation. Among these, ultra-high pressure (UHP) processing applies uniform hydrostatic pressure of several hundred MPa to foods, thereby inducing changes in their chemical composition and physicochemical properties. Therefore, the optimization of processing pressure This study investigated the effects of UHP treatment (0.1, 100, 300, and 500 MPa for 5 or 15 min) combined with 14 days of refrigerated storage on the physicochemical properties of raw pork. As pressure and treatment time increased, moisture and protein contents, water-holding capacity, shear force, pH, lightness, and yellowness increased, whereas fat and ash contents decreased. Redness was significantly higher at 300 and 500 MPa compared to the control (0.1 MPa). These changes are attributed to pressure-induced denaturation and structural rearrangement of myofibrillar proteins, resulting in the formation of a more compact protein network. Overall, UHP treatment alters water-binding capacity and structural properties of meat, thereby affecting quality characteristics and demonstrating its potential as a non-thermal technology for the storage of raw pork.

Weissella cibaria GSKM06 postbiotics attenuate obesity by reducing adiposity and modulating gut microbial composition in high-fat diet-induced obese mice

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Obesity is a major global health issue associated with various metabolic disorders. *Weissella cibaria* has been isolated from kimchi, other fermented foods, and human feces and reported to possess anti-inflammatory, antimicrobial, and anti-obesity properties. Postbiotics, defined as inanimate microorganisms or their components that confer health benefits, have emerged as potential therapeutic agents. However, the anti-obesity effects of *Weissella cibaria* GSKM06 Postbiotics (WGP) have not yet been investigated. This study aimed to evaluate the anti-obesity effects of WGP using a high-fat diet (HFD)-induced obese mouse model. Eight-week-old male C57BL/6NCrSlc mice were randomly divided into six groups: (n=10): (1) ND (2) HFD (negative control), (3) Xenical (positive control, 50 mg/kg bw), (4) WGP_75 (HFD+75 mg/kg bw), (5) WGP_150 (HFD+150 mg/kg bw), (6) WGP_300 (HFD+300 mg/kg bw). All Mice were orally administered daily for 16 weeks. After 1 week, the high-fat diet group showed elevated body weight compared to the normal diet group, and the successful establishment of diet-induced obese mice. At the end of the intervention, the WGP_300 group significantly reduced body weight and weight gain by approximately 9.8% and 19%, respectively (p<0.01). To determine whether the WGP_ 300 group was associated with alterations in energy metabolism, respiratory metabolism was evaluated using indirect calorimetry. During the dark phase, the active period in mice, energy expenditure was significantly increased in the WGP_300 group compared to the negative control group (p<0.05). To clarify the underlying mechanism, we examined the browning and lipolysis in adipose tissue. The WGP_300 group increased browning and lipolysis by stimulating PRDM16/UCP1 (p<0.05) and by up-regulating ATGL/HSL-pS660 (p<0.01, p=0.08). In addition, shotgun metagenomic sequencing was performed to analyze changes in gut microbiota composition. Beta-diversity analysis using weighted and unweighted UniFrac distances indicated that the WGP_300 group was significantly separated compared to the negative control (p<0.001). This indicates that WGP supplementation modulated gut microbial composition in high-fat diet conditions. These results suggest that *Weissella cibaria* GSKM06 Postbiotics represent a promising functional ingredient for obesity management.

Development of an AI-based cooking support system for large-scale food preparation

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Large-scale food preparation requires consistent cooking quality, improved operational efficiency, and effective safety management. This study developed an AI-based integrated cooking support system for large-scale kitchen environments. The system was designed to analyze cooking images and sensor data to recognize cooking states, determine food loading and unloading, predict frying completion, and monitor equipment conditions. In addition, night-time monitoring and automatic on/off control based on worker presence were included to improve safety and reduce unnecessary energy consumption. The vision-based modules were designed to identify ingredient status and cooking progress from real-time cooking images. A frying completion prediction module was implemented using visual features such as color and appearance changes during the frying process. Food loading and unloading were also detected through image-based analysis of the cooking area. Furthermore, an equipment monitoring module was developed using vibration signals to distinguish normal and abnormal operating conditions. The proposed system demonstrated the potential to support cooking processes, monitor equipment status, enhance workplace safety, and improve operational efficiency in large-scale food service environments. These results suggest that the developed system can serve as a foundational platform for intelligent cooking support and future kitchen automation applications.

Amorphous granular rice flour (AGRF) prepared by high hydrostatic pressure (HHP) : impacts on physicochemical properties and cold-water swelling

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This study aimed to investigate the physicochemical properties of amorphous granular rice flour (AGRF) prepared by high hydrostatic pressure (HHP), a non-thermal physical treatment. To examine the effects of pressure intensity on the formation and characteristics of AGRF, six samples were prepared: Native rice flour and samples treated at 300, 400, 500, 550, and 600 MPa, respectively. SEM images indicated that the granular structure was retained even at the highest pressure levels. No gelatinization peak was observed at 550 and 600 MPa, confirming the formation of AGRF under these conditions. In the AGRF samples, XRD patterns shifted from A-type to V-type. FTIR analysis showed that HHP treatment altered non-covalent interactions, reduced the double-helix index, and induced partial protein rearrangement. CLSM images also showed that individual starch granules were irregularly aggregated, with proteins located between them. The cold-water swelling power and the cold-water viscosity were both significantly increased, suggesting that AGRF can effectively increase viscosity under non-heating conditions. Rheological analysis showed that the paste exhibited weak gel-like behavior (G′>G″). Furthermore, AGRF samples maintained relatively higher resistant starch (RS) content than that of native rice flour even after gelatinization. Overall, AGRF produced by HHP exhibited characteristic physicochemical properties and potential as a cold-water swelling and/or thickening agent.

Effect of different degrees of supercooling on the storage quality of pork loin

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This study aimed to evaluate the storage quality characteristics of pork loin at different degrees of supercooling (dS). The effectiveness of supercooling in preserving food quality is closely related to the degree of supercooling achieved during storage, as this may influence ice crystal formation and subsequent structural damage. Therefore, this study investigated how different dS levels affect the physicochemical and microstructural quality of pork loin during storage. The results showed that as dS increased, ice crystal formation was suppressed and microstructural damage tended to decrease. Although drip loss and color change generally increased with storage time, these quality changes tended to decrease as dS increased under the same storage period. These findings suggest that higher dS levels may help reduce quality deterioration during storage by minimizing structural damage. Although statistical significance was limited for some parameters, the overall trends indicate that dS is a key factor affecting the storage quality of pork loin.

Development and optimization of eggshell membrane-based composite (ECG) films using chitosan and guar gum

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Eggshell membrane (ESM) is a protein-rich by-product with potential for sustainable biomaterial applications. In this study, composite films (ECG films) were developed using chitosan, ESM, and guar gum, and the effects of formulation variables on film formation were investigated. Chitosan (1%, w/v) was dissolved in 1% (v/v) acetic acid, followed by the incorporation of ESM and guar gum at various concentrations. The film-forming solutions were cast and dried in a drying oven to obtain composite films.

To optimize formulation conditions, ESM concentration was evaluated at 1%, 3%, and 5%, while guar gum concentration ranged from 0.3% to 2.0%. Additionally, at low ESM content (≤1%), finer concentration gradients (0.05–1.0%) were tested. The effect of plasticizer content was also assessed by varying glycerol levels (0%, 30%, and 100% relative to chitosan content).

The results suggest that film properties were influenced by both ESM and guar gum concentrations, affecting film integrity and handling characteristics. Lower ESM concentrations enabled better dispersion within the polymer matrix, while guar gum contributed to improved film-forming ability.

This study demonstrates the potential of ESM-based composite films as biodegradable materials and provides a basis for optimizing formulation parameters for food-related applications.

건면용 밀가루 품질 기준 설정을 위한 지표 도출

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국내 면류 시장은 지속적으로 성장하고 있으며, 면류는 밀 소비의 상당 부분을 차지하는 주요 가공식품이다. 국산밀의 가공 적성 향상 및 산업적 활용 확대를 위해서는 면류별 품질 기준 설정이 필요하나, 품질에 영향을 미치는 주요 인자 및 지표에 대한 체계적인 연구는 부족한 실정이다. 이에 본 연구에서는 수입 밀가루를 대상으로 건면 품질 특성을 분석하고, 통계적 기법을 활용하여 건면용 밀가루의 품질 지표를 도출하고자 하였다. 이를 위해 시중 유통 수입 밀가루를 대상으로 일반 성분과 품질 특성을 분석하고, 전분의 호화 특성 및 구조·이화학적 특성을 평가하였다. 또한 생면 및 건면을 제조하여 조리 특성 및 물성을 측정하고, 각 특성 간 관계를 규명하기 위해 상관분석, 주성분분석(PCA) 및 회귀분석을 수행하였다. 분석 결과, 건면의 조리 특성 및 물성은 특성별로 서로 다른 영향요인을 나타내었으며, 단백질 함량, 손상전분 함량, 전분 입자크기(D10) 및 전분 구조 특성 등이 주요 영향요인으로 확인되었다. 회귀분석 결과, 단백질 함량은 경도(R^2=0.461, p=0.003) 및 인장강도(R^2=0.381, p=0.008)를 가장 잘 설명하는 변수로 나타났으며, 손상전분 함량은 응집성(R^2=0.381, p=0.008)과 높은 설명력을 보였다. 증량률은 단백질 함량(R^2=0.288, p=0.023) 및 전분 입자크기(D10; R^2=0.283, p=0.024)에 의해 설명되었으며, 다중 회귀 모델은 공선성 문제로 채택되지 않았다. 이러한 결과를 종합할 때, 단백질 함량과 손상전분 함량은 건면 품질을 전반적으로 설명하는 핵심 인자로 도출되었으며, 공정 중 관리 가능한 품질 지표로 활용될 수 있다. 또한 수입 밀가루 기준 적합 범위는 단백질 8.8~10.4%, 손상전분 7.1~9.7%로 제시되었다. 본 연구에서 도출된 품질 지표 및 기준 범위는 향후 국산밀의 건면 적성 평가 및 품질 기준 설정에 활용될 것으로 기대된다.

Effect of pulsed electric field pretreatment on autolysis efficiency and glutathione release in *Saccharomyces cerevisiae*

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Autolysis is a conventional process for yeast extract production, typically conducted at 55°C for 48 h, resulting in the degradation of heat-sensitive functional compounds. In this study, glutathione was selected as a representative heat-sensitive functional compound. The effects of pulsed electric field (PEF) pretreatment on autolysis efficiency and glutathione release in *Saccharomyces cerevisiae* were investigated. Yeast suspension was treated with PEF at 10, 15, and 20 kV/cm and then subjected to autolysis at 55°C or 35°C. PEF did not inactivate endogenous proteases and enhanced protease activity at 35°C, promoting autolysis even under low-temperature conditions. PEF pretreatment increased both the yield and rate of protein release. The PEF-treated samples after 2 h at 55°C and after 48 h at 35°C exhibited approximately 1.4-fold higher protein release than the conventionally autolyzed sample. Free α-amino nitrogen (FAN), an indirect indicator of autolysis, was higher in the PEF-treated samples, indicating enhanced autolysis efficiency under both temperature conditions. Glutathione concentration was higher in the PEF-treated samples than in the control and exhibited an energy-dependent increase. Overall, PEF pretreatment is an effective strategy for improving autolysis efficiency and increasing the yield of heat-sensitive functional ingredients.

Non-destructive identification of starches using hyperspectral imaging-based machine learning analysis

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Starches are widely used in food applications, and their physicochemical characteristics significantly influence the quality and functionality of final products. However, conventional analytical methods for starch identification are often time-consuming and destructive, highlighting the need for efficient and non-destructive techniques. In this study, six starch samples under varying processing conditions were non-destructively analyzed using hyperspectral imaging (HSI) combined with four machine learning algorithms (decision tree, random forest, k-nearest neighbor, and support vector machine). The hyperspectral spectra showed major reflectance features around 1200 nm and 1450 nm, and exhibited generally similar patterns among the starches except for potato starch. When the hyperspectral images of starch samples were analyzed at different particle size, the k-nearest neighbor model achieved the highest test accuracy of 90.8% at 100 mesh. In addition, hyperspectral analysis under different moisture content of the starch samples showed the highest classification accuracy of 97.1% at 50% moisture content. These results demonstrate that HSI-based machine learning provides a rapid and non-destructive approach for starch identification across different processing conditions.

Machine learning-based optimization of plant protein–hydrocolloid formulations for egg white substitution in muffins

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Various approaches have been explored for the partial or total replacement of eggs in response to health, sustainability, and animal welfare concerns. This study aimed to develop plant protein–hydrocolloid formulations for egg white substitution using machine learning. Random Forest, XGBoost, and Support Vector Regression (SVR) models were trained to predict the density and viscosity of the whipped mixtures. XGBoost showed the best performance, with R^2 values of 0.94 and 0.81 for density and viscosity, respectively. Differential Evolution (DE) was used to optimize the formulations, and their suitability was evaluated using muffins. The muffins showed appearance, baking loss, and density comparable to those of egg white muffins. Textural properties indicated that the muffins were softer than egg white muffins. Sensory evaluation showed similar scores for appearance, flavor, texture, and overall acceptability (p>0.05). Based on these findings, machine learning has potential as a tool for developing plant-based egg white substitutes.

Comparison of quality characteristics of domestic wheat flour and dried noodles prepared using blending technology

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Wheat is one of the three major cereals worldwide and is widely produced due to its ability to be cultivated even under poor environmental conditions. This study investigated the quality characteristics of dried noodles prepared using blending technology with domestic wheat cultivars Saekeumkang, Hwanggeunal, and Hanmyeon in order to improve the quality of domestic wheat flour. Wheat flours analyzed in this study included the cultivar Saekeumkang milled by both small- and medium-sized milling companies and large companies, as well as Hanmyeon, Hwanggeunal, and blended flour. Moisture content ranged from 11.8% to 14.6%, ash content from 0.431% to 0.468%, protein content from 9.49% to 11.54%, damaged starch from 5.01% to 5.52%, and particle size from 59.5 to 67.4 μm. These values showed different distributions depending on cultivar and milling company, suggesting potential reductions in the uniformity of both flour quality and final products. Blending Saekeumkang and Hwanggeunal, which showed relatively low ash content, increased protein content compared with single cultivars and produced improved texture in dried noodle production. Blending technology may contribute to improvement of product quality and increased utilization of domestic wheat, and additional studies including pilot-scale production may provide fundamental data for industrial applications.

Enhancing 3D printing performance via conjugation of soy protein isolate and maltodextrin

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Driven by demand for plant-based meat and personalized nutrition, 3D food printing has emerged as a transformative technology. Extrusion-based printing requires stable inks with shear-thinning properties for smooth flow and rapid structural recovery. Soy protein isolate (SPI) is a promising plant-protein base, but it often exhibits a narrow printability window due to brittle flow at high solids and poor shape fidelity. Here, SPI–maltodextrin (MD) conjugates (C-SPI) were produced via a wet-heating Maillard-type reaction (pH 7.5, 90°C) to overcome these rheological barriers. Conjugation was confirmed by increased browning intensity (304 and 420 nm), distinct FT-IR spectral shifts, and a morphological transition to angular plate-like structures. This process improved pH-dependent solubility while reducing water absorption capacity as the MD ratio increased. Rheological tests of 25% solids inks showed elastic-dominant behavior and shear-thinning for all samples. While native SPI and physical mixtures exhibited flow instabilities, C-SPI maintained smoother extrusion due to MD-driven lubrication and steric stabilization. Printing trials confirmed the highest shape fidelity for C-SPI at 10:1 and 10:2 ratios, whereas higher MD content led to structural collapse as loss factor approached 1. Overall, SPI–MD conjugation offers a robust, clean-label route to optimize the rheology and printability of high-protein inks, advancing next-generation food analogues.

Frozen-thawed tofu as a scaffold for culturing chicken fibroblast (DF-1)

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Developing scalable, food-grade scaffolds is imperative to reduce the cost of cultured meat production and to facilitate three-dimensional cell growth. In this study, tofu-prepared scaffolds were fabricated with two commercial tofu types, Buchim and Jjigae, and their microstructures were tuned by controlling freezing time (9-48 h) and freeze-thaw cycling (up to 5 cycles; 35.5 h freeze/0.5 h thaw per cycle). Across all freeze-thaw conditions, the porosity remained comparable (~50%), which was observed that the pore size was bimodal, consisting of macro-pores (~400 μm) and micro-pores (~50 μm). Also, an increase in freezing time resulted in a redistribution of pore size, leading to a decrease in the proportion of micro-pores and an increase in the proportion of macro-pores. The hardness increased with longer freezing time, whereas freeze-thaw cycling produced a non-monotonic response, consistent with syneresis. Specifically, samples maintaining ≥80% weight after freezing process were hardened with extended cycle, while those retaining <80% weight were softened as the cycle-number increased. It is noteworthy that chicken fibroblasts (DF-1) were attached to and proliferated on the scaffolds, and the gelatin-coating on the scaffolds further enhanced cell growth. Overall, these results demonstrate the viability of freezing-based processing to tune the structural properties of edible animal cell scaffolds, providing insights into the rational design of scaffolds for cultured meat.

Effect of pulsed electric field treatment on functional and antioxidant properties of fava bean protein isolate

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This study evaluated the effects of pulsed electric field (PEF) treatment on the functional and antioxidant properties of fava bean protein isolate (FBPI) at different electric field intensities (5–20 kV/cm). PEF treatment significantly altered protein functionality in an intensity-dependent manner. Protein solubility increased from 63.67% in the control to 91.15% at 10 kV/cm, followed by a decrease at higher intensities, indicating protein unfolding at moderate intensity and aggregation at higher intensity. Accordingly, emulsifying activity index (EAI) and emulsifying stability index (ESI) were maximized at 10 kV/cm (32.24 m²/g and 31.64 min), demonstrating enhanced interfacial properties. Foaming capacity (FC) increased continuously with PEF intensity, reaching 50.00% at 20 kV/cm, while foaming stability (FS) decreased from 91.87% to 83.33%, indicating a trade-off between foam formation and stability. Antioxidant activity (ABTS) increased progressively with increasing PEF intensity, rising from 48.27% in the control to 70.27% at 20 kV/cm, indicating enhanced radical scavenging activity at higher electric field strengths. Overall, PEF induced intensity-dependent functional differentiation of FBPI, with optimal conditions varying by functionality, highlighting 10 kV/cm as the optimal condition.

Biochemical characterization of non-specific lipase for structured lipid synthesis

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Structured lipids have attracted considerable attention as functional lipid materials due to their ability to modulate physicochemical and nutritional properties by incorporating specific fatty acids at defined positions on the glycerol backbone. The development of efficient and selective biocatalysts is essential for precise control of lipid structure. In this study, a novel candidate lipase was cloned, expressed, and purified to evaluate its potential as a biocatalyst for structured lipid synthesis, and its biochemical properties were characterized. Lipase activity was confirmed using a chromogenic plate assay and a *p*-nitrophenyl palmitate (*p*-NPP) lipase assay, where clear color development was observed. The enzymatic activity toward triolein was further evaluated using a reverse micelle lipase assay. The enzyme exhibited K_m values of 73.7 – 79.4 mM, V_{max} values of 4.02 – 4.17 mM/min, and k_{cat} values of 4.34 – 4.50 min^{-1}. Thin-layer chromatography (TLC) analysis revealed that hydrolysis occurred at all *sn*-1, *sn*-2, and *sn*-3 positions, producing monoacylglycerols and various diacylglycerols, indicating non-specific lipase activity. Overall, this enzyme shows potential as a useful biocatalyst for industrial lipid modification. In addition, the enzyme may be further exploited for diverse biotechnological applications, including tailored lipid synthesis and industrial biotransformation processes.

Inactivation of *Bacillus subtilis* in vegetative cells and spores using pilot-scale intense pulsed light under the same total fluence

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Intense pulsed light (IPL) is a non-thermal sterilization technology that utilizes high-energy pulses of broad-spectrum light. This study compared the IPL inactivation efficiency of *Bacillus* subtilis in vegetative cells and spores, before and after sporulation, using a pilot-scale system. Discharge voltage conditions of 1000, 1200, and 1400 V were applied by inversely adjusting pulse numbers to ensure an equivalent total energy fluence. Treatment ranges were differentiated between vegetative cells (0—0.7 J/cm²) and spores (0—10 J/cm²) based on their resistance. Fluence rates per pulse at 1000, 1200, and 1400 V were determined to be 5.57, 13.39, and 19.41 mW/cm², respectively. For vegetative cells, significant inactivation (>5-log reduction) was achieved across all conditions at a total fluence of 0.7 J/cm². Under the same number of pulses, higher discharge conditions led to an increase in the inactivation rate. However, in terms of total fluence, initial microbial reduction occurred rapidly at 1000 V, while 1400 V treatment showed the highest reduction at the end. In contrast, B. subtilis spores showed only slight reduction (<1.3-log) at 0.7 J/cm². At extended fluence, IPL treatment at 1000 V exhibited the highest inactivation efficiency. This study suggests that inactivation of *B. subtilis* spores may be more effective under low discharge voltage with an extended number of pulses in IPL treatment.

Encapsulation and release of animal-derived flavor compounds using nanostructured lipid carriers for plant-based fat applications: Impact of lipid composition on colloidal stability and flavor release

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Plant-based fat analogues require not only animal-fat-like melting behavior but also temperature-dependent release of lipid-associated flavor during cooking. We investigated the effect of the solid–liquid lipid ratio in flavor-load nanostructured lipid carrier (NLC) influences colloidal stability and flavor release. By varying the solid fraction, lipid composition and melting behavior can be tuned, providing a formulation handle for modulating flavor release. NLCs were formulated using hydrogenated soybean oil and soybean oil and stabilized with lecithin and Tween 60. Yield increased with increasing liquid lipid content, likely due to suppressed crystallization and reduced polymorphic transition, enhancing colloidal stability. Whereas Particle size, polydispersity index (PDI), and zeta potential showed no significant differences. However, when the liquid lipid content exceeded a 40%, Excess liquid lipid was not incorporated into the amorphous lipid matrix but instead formed separate droplets, as indicated by a melting peak near -20°C. Flavor release was delayed as liquid lipid content increased up to 30%, but further increases led to accelerated release. This is likely associated with changes in lipid crystallinity and internal structure of the NLC system, suggesting the need for further investigation. These results demonstrate that lipid composition can be used to control colloidal structure and flavor release in NLC systems, providing a strategy for lipid-based delivery design in plant-based fat applications.

Thermo-responsive alginate emulsion gels reinforced with 4-α-glucanotransferase-treated starch as structural fat mimetics

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The development of fat substitutes mimicking the structural and thermal behavior of animal fat is essential for improving the quality of plant-based meats. Although emulsion gels are widely used for this purpose, simultaneously replicating both the mechanical robustness and the thermal softening characteristics of animal fat remains a significant challenge. In this study, a composite emulsion gel composed of thermo-responsive 4-α-glucanotransferase-treated potato starch (GTPS) and thermally stable alginate was developed as a structural fat mimetic. The alginate-Ca^{2+} network served as a primary framework, while dispersed GTPS domains provided physical reinforcement, leading to a densified structure. Increasing GTPS content significantly improved hardness, Young's modulus, and water-holding capacity. Conversely, heating caused partial dissociation of starch-based domains, resulting in an increase in droplet size and a decrease in storage modulus (G′), indicating thermo-responsive softening behavior. This coexistence of structural reinforcement and thermal softening effectively mimics the physical behavior of animal fat during cooking. In model patty systems, the emulsion gel successfully replaced pork backfat while maintaining most textural properties. These results suggest that GTPS-based emulsion gels can serve as promising structural fat mimetics capable of simultaneously controlling mechanical strength and thermal responsiveness in food systems.

Evaluation of antioxidant and biological activities of solvent extracts from *Ixeris repens*

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Halophytes are plants that grow in salinity. These plants have a defense system that can withstand the vairous stresses of salinity. *Ixeris repens* is a type of halophyte that grows in high salinity sands found in coastal sand dunes and sandy shores. This study was conducted to investigate the contents, antioxidant potency, and biological activities of *I. repens*. In analyses of general composition, carbohydrate, protein, ash, and moisture content were 57.42%, 10.48%, 11.99% and 10.29%, respectively. Potassium, calcium, sodium, and magnesium were its most prevalent minerals. The solvents used to extract were *I. repens* 70% ethanol, 80% methanol, and distilled water. As a result, the yield showed no significant difference between solvents. Ethanol and methanol extracts displayed higher total polyphenol and flavonoid contents than the water extract. ABTS (IC50, 0.12 mg/mL) and FRAP (0.77 mM) radical scavenging activity were highest in the water extract, while methanol extract exhibited the strongest DPPH radical scavenging activity (IC50, 1.32 mg/mL), NO scavenging activity (IC50, 4.10 mg/mL), and reducing power (EC50, 0.14 mg/mL). Tyrosinase, elastase, and α-glucosidase inhibitory activities were highest in the ethanol extract. The ethanol extract also possessed the most potent acetylcholinesterase inhibitory activity. These results suggest that the *I. repens* ethanol extract has a good effect on antioxidant and biological activity. In addition, *I. repens* is thought that there are biologically functional substances that have the effect of improving cognitive function. Therefore, it is thought that additional research is needed.

Comparative analysis of antioxidant activity of various solvent extracts from *Salsola collina*

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Halophytes are plants that inhabit environments characterized by high salinity, including coastal areas, saline lakeshores, rock-salt regions, and low-lying lands subject to tidal inundation. To withstand fluctuating salinity resulting from alternating seawater and freshwater, as well as prolonged submergence, they have evolved diverse adaptive mechanisms, among which osmotic regulation plays a central role in protecting cellular functions. *Salsola collina* is a representative halophyte that naturally occurs in highly saline sandy soils of coastal dunes and sandy shores. This study was conducted to investigate the proximate composition and antioxidant activities of different solvent extracts of *S. collina.* Proximate composition analysis revealed that carbohydrate, protein, lipid, ash, and moisture contents were 78.50%, 5.91%, 0.66%, 7.36%, and 7.55%, respectively. 70% ethanol and distilled water were used as solvents to prepare extracts, and the extraction yields ranged between approximately 12.47% and 15.27%. The total polyphenol and flavonoid contents ranged from 18.10 to 24.75 mg GAE/g and from 14.17 to 32.23 mg QE/g, respectively. Antioxidant assays showed that ABTS radical scavenging activity (EC_{50}, 0.58 mg/mL) and reducing power (EC_{50}, 0.35 mg/mL) were highest in the water extract, whereas the 70% ethanol extract exhibited the strongest DPPH radical scavenging activity (EC_{50}, 4.76 mg/mL), nitrite scavenging activity (EC_{50}, 4.27 mg/mL) and the highest FRAP value (1.00 mM). These results show that extracts of *S. collina* contain antioxidant substances and demonstrate potential as functional materials. We are currently investigating further the physiological activities of these extracts, and also attempting to identify the substance that has physiological activities.

Non-thermal intense pulsed light (IPL) treatment for microbial reduction in seaweed

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This study comparatively analyzed the microbial reduction effects of intense pulsed light (IPL: 1200 V, 10 Hz, 6 cm), an eco-friendly non-thermal sterilization technology, on three types of seaweed (sea mustard, green laver, and laver) based on their processed forms (fresh, dried, and powdered) and treatment times (5, 8, and 10 min). The results revealed that morphological characteristics, including the moisture content and surface structure of the samples, are key factors determining light transmittance and sterilization efficiency. Particularly, in the fresh state with high moisture content, light energy was transmitted most effectively, demonstrating an excellent sterilization efficacy with a maximum of 2.6 log reduction after 10 min of treatment. In contrast, although light transmittance in dried seaweed was partially limited due to surface irregularities, it exhibited a stable microbial reduction trend proportional to the cumulative treatment time, achieving up to 1.3 log reduction. For the powdered form, the sterilization efficiency was the lowest across all time intervals due to the 'shadow effect' caused by the multiple overlapping of fine particles. In conclusion, this study demonstrates that introducing complex processes, such as physical agitation, rather than simply extending the exposure time, is essential for the IPL sterilization of powdered foods. Furthermore, it provides significant fundamental data for designing customized sterilization processes tailored to the specific processed forms of seaweed.

Linking hydrocolloid-induced rheological properties to sheet-forming behavior and quality of gluten-free instant noodles

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The effects of seven hydrocolloids on the sheet-forming and structural properties of gluten-free rice flour were investigated, and the quality characteristics of the resulting fried noodles were evaluated. Rice flour containing xanthan gum and guar gum exhibited high cold initial viscosity in pasting analysis and high maximum torque in GlutoPeak analysis. These rheological parameters were highly correlated with the tensile properties of gluten-free noodles, including maximum tensile strength and extensibility (r=0.86–0.94). Gluten-free fried noodles were successfully prepared using methylcellulose, xanthan gum, locust bean gum, and guar gum, which showed superior sheet-forming ability. The oil uptake of the fried noodles ranged from 15–18%, and slightly higher oil absorption was observed in the xanthan gum sample. This was attributed to the rougher surface morphology and larger pore structures, as confirmed by SEM observations.

Effect of the degree of starch gelatinization on the microstructure of soy-based high-moisture meat analogs

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This study investigated the effects of the degree of starch gelatinization, using swelling power as an indirect indicator, on Soy protein isolate (SPI)-based high-moisture meat analogues. Unlike prior studies focused on material substitution, this work examined starch functionality under extrusion using starches with different structural properties. Contrary to the hypothesis that all starches would be fully gelatinized and differ based on gel size, swelling was restricted, limiting texture development. CLSM analysis newly revealed that not only starch gel size but also spatial distribution differed, influencing protein network formation. These findings demonstrate that, beyond starch composition, gelatinizaion behavior and spatial distribution under extrusion are key determinants of structure formation.

국산 대두의 착유 공정에 따른 착유 수율 및 품질 특성 비교

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대두박으로부터 단백질을 추출하는 알칼리 추출-등전점 침전 공정에서 대두박 내 잔존 유지는 비누화 반응(saponification)을 유발하여 단백질 수율 저하 및 품질 오염의 원인이 될 수 있다. 따라서 착유 공정에서의 유지 제거 효율은 후속 단백질 추출 품질과 직결되며, 잔존 유지 함량을 최소화할 수 있는 착유 방법의 선택이 중요하다. 이에 본 연구에서는 헥산 용매 추출법, 물리적 착유법(스크류프레스), CO_2 초임계 추출법을 국산 대두에 적용하여 착유 수율, 대두박 조지방 함량, 대두유 및 대두박의 색도(CIE L*a*b*)를 비교·평가하였다. 착유 수율(초기 조지방 20% 기준)은 헥산 추출법 94.9%, CO_2 초임계 추출법 93.5%, 물리적 착유법 75.7% 순으로 나타났으며, 대두박 조지방 함량은 각각 1.02%, 1.35%, 5.65%로 헥산 및 CO_2 초임계 추출법의 유지 제거 효율이 우수하였다. 대두유 색도에서는 CO_2 초임계 추출유가 가장 낮은 a*, b* 값을 보여 색상 품질이 우수하였고, 물리적 착유유는 압착 과정에서 발생하는 열로 인해 상대적으로 높은 황색도(b*)를 나타내었다. 대두박 색도의 경우 헥산 추출 대두박의 명도(L*)가 가장 높았으며, 물리적 착유 대두박에서는 가열 압착에 의한 갈변화 경향이 관찰되었다. 각 공정은 수율, 잔존 유지 함량, 유지 및 대두박 품질 측면에서 상이한 장단점을 보였으며, 본 연구 결과는 국산 대두의 착유 공정 최적화 및 단백질 소재 생산을 위한 기초자료로 활용될 수 있을 것으로 기대된다.

Effects of hydrocolloids on the physicochemical properties and baking performance of zein-based gluten-free blends

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The demand for gluten-free bread has increased due to health-oriented diets and concerns about allergic diseases such as celiac disease. However, the quality deterioration resulting from the absence of gluten remains a major technological challenge in the food industry. In this study, zein-based gluten-free breads were prepared with four different hydrocolloids (HPMC, sodium alginate, xanthan gum, and guar gum), and their effects on the quality attributes of the gluten-free breads were characterized. Pasting analysis of the gluten-free blends showed that the use of guar gum resulted in the highest peak viscosity and breakdown values. According to the thermo-mechanical results by Mixolab, HPMC exhibited the highest C1 and the lowest C5 values. After baking, the bread with HPMC showed the highest specific volume, followed by guar gum, sodium alginate, and xanthan gum. These specific volume results showed a correlation with the hardness values measured by texture profile analysis. These findings provided useful insights for improving the quality of zein-based gluten-free bread using hydrocolloids.

Understanding the relative contributions of photodynamic and photophysical mechanisms in the inactivation of *Listeria innocua* under wavelength-specific LED irradiation

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Light-based sterilization has been widely studied as a non-thermal approach to preserve the physicochemical properties of foods; however, the inactivation mechanisms at different wavelengths remain unclear. This study aimed to investigate the roles of photodynamic and photophysical mechanisms in the inactivation of *Listeria innocua* under wavelength-specific LED irradiation. Bacterial suspensions (7±0.5 log CFU/mL) were exposed to 265, 308, 365, and 405 nm LEDs, and microbial inactivation, reactive oxygen species (ROS) generation, intracellular structural changes, and leakage of intracellular components (proteins and DNA) were evaluated. All wavelengths achieved complete inactivation, although higher fluences (0.024–492.43 J/cm²) were required at longer wavelengths. ROS generation increased with wavelength, with greater production at 365 and 405 nm. Transmission electron microscopy revealed pronounced structural alterations at these wavelengths, whereas cells treated at 265 and 308 nm remained largely intact. In contrast, no significant differences in protein and DNA leakage were observed among wavelengths. These results suggest that inactivation at 365 and 405 nm is associated with ROS-mediated and structural damage, while inactivation at shorter UV wavelengths may involve additional non-ROS-mediated mechanisms. Overall, microbial inactivation depends on a wavelength-specific interplay of distinct mechanisms, providing insight for targeted light-based control strategies.

Instant rheological control of WPI beverages via cold–water soluble starch nanoparticle for dysphagia patient

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Reduced physiological function in elderly elevates the risk of choking and aspiration pneumonia when swallowing low-viscosity fluids. Concurrently, development of high protein fluid foods is essential to combat sarcopenia commonly associated with dietary protein deficiency in this population. To achieve the target viscosity for safe consumption, WPI requires high concentrations, which leads to brittle, syneresis-prone gels, compromising product quality and ease of consumption. In this study, cold-water soluble starch nanoparticles (CWSS-NP) were prepared via aqueous–ethanol heat treatment of short-chain glucans (SCG) obtained from amylopectin debranching and applied to WPI-based beverages. CWSS-NP rapidly dispersed in cold water and reassembled with WPI to form a compact network through electrostatic interactions and hydrogen bonding. Rheological analysis indicated that WPI/CWSS-NP composite gels exhibited favorable swallowing characteristics, including shear-thinning behavior and enhanced storage modulus. According to the International Dysphagia Diet Standardization Initiative (IDDSI) framework, the composite gels can be tailored to achieve IDDSI level 2–5. Thickening effect could be adjusted by pH, owing to changes in electrostatic interactions between WPI and CWSS-NP and the self-assembly behavior of CWSS-NP. As a result, control of WPI–starch interactions enables design of high-protein fluid foods with viscosities tailored to the needs of elderly with varying dysphagia.

Machine learning-assisted digital imaging for early prediction of colorimetric biosensing in food applications

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Colorimetric biosensors are attractive platforms for food applications because they provide simple, rapid, and instrument-free visual readouts. However, practical interpretation often depends on subjective visual judgment and requires waiting until a visually discernible endpoint is reached. In this study, we developed a digital imaging-based strategy to quantitatively track analog color changes and enable early prediction in colorimetric biosensing. Time-resolved images and pixel-level data were collected from the entire reaction region during the early reaction stage under controlled illumination. From full-region images, RGB-derived intensity metrics and temporal features were computed to identify informative early-stage signals predictive of the aggregation-dependent endpoint. This approach enabled data-driven selection of informative early image features from the entire reaction region. A supervised machine learning framework was applied to early-stage image features to predict the conventional endpoint, reducing the effective readout time by more than 6-fold. By replacing subjective visual interpretation with quantitative, image-based decision making, the proposed framework improves objectivity and standardization. These findings suggest that digital imaging and predictive modeling can accelerate conventional colorimetric biosensors and support rapid, standardized early detection.

Identification, antioxidant activity, and safety assessment of *Terminalia bellirica* extract

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Terminalia bellirica is a medicinal plant that has been used traditionally in Southeast Asia and is known to have antioxidant, anti-inflammatory, and antibacterial effects. This study investigated the antioxidant function and safety of *Terminalia bellirica* extract. HPLC-MS was performed to identify physiologically active components. The antioxidant activity was evaluated by total polyphenols and flavonoids quantification and radical scavenging abilities. Intracellular reactive oxygen species (ROS) scavenging and antioxidant enzyme activity were analyzed using Caco-2, a human intestinal epithelial cell line. Cytotoxicity and genotoxicity were evaluated according to with or without metabolic activation, S9 mix. As a result, 12 phenolic compounds were identified, and quantified as having high polyphenol and flavonoid contents. The extract was found to scavenge ROS both *in vitro* and at the cellular level and to enhance antioxidant enzyme activity, demonstrating its potential as a functional antioxidant ingredient. The cell proliferation inhibition was less affected in the presence of S9 mix than in the absence of S9 mix. DNA damage assessed by the Comet assay showed that there was no significant difference between the control group and with or without metabolic activation. These results provide antioxidant activity and safety data supporting potential of the *Terminalia bellirica* extract as an antioxidant functional ingredient.

Effects on temperature changes of NaCl-based phase change material in food cold storage

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This study aimed to evaluate the effect of phase change materials (PCM) on temperature stabilization during food storage and distribution. In this study, the NaCl concentration corresponding to a phase change temperature at −10°C was determined as 13% (w/v) by regression analysis of NaCl solutions (10, 15 and 20%, w/v). A 13% (w/v) NaCl solution was prepared and vacuum-packed to produce PCM packs. The PCM packs were arranged in a rectangular structure and placed in an incubator programmed to cycle between −12°C and −8°C at 1 h intervals. A 4% agar gel (3×3×2 cm) was positioned at the center of the PCM structure. The temperature changes were monitored at the center of the gel. The PCM-treated sample maintained an average temperature at −10.18°C with a temperature deviation of ±1.70°C, whereas the control exhibited an average temperature at −11.25°C with a deviation of ±5.60°C. In addition, the SEM results showed smaller ice crystal structures in the PCM-treated gel compared with the control. Overall, 13% NaCl was identified as an effective material for maintaining temperature stability while minimizing structural changes in the gel. Therefore, these results indicate that the developed NaCl-based PCM can enhance temperature stability during cold storage of food products.

Effects of fermented rice flour on the rheological properties and quality characteristics of gluten-free dough

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This study establishes an engineering foundation for utilizing fermented rice flour (FRF) in gluten free dough systems by evaluating its impact on rheological behavior and baking quality. FRF exhibits unique water-binding characteristics compared to conventional rice flour; increasing its ratio yields more fluid dough even at lower hydration levels. A controlled approach was used to distinguish between the effects of flour composition and hydration. Dough samples with FRF-to-rice-flour ratios (100:0 to 50:50) were analyzed for viscoelastic properties (G', G", tan δ). A power-law model quantified the frequency dependence of the viscoelastic components. To ensure a fair comparison of baking performance, the hydration level for each blend was adjusted to reach a target complex viscosity (|η*|), maintaining equivalent dough consistency across all formulations. Consequently, higher FRF proportions significantly reduced the hydration level required to achieve the target fluidity. Moreover, even at matched dough consistencies, the final product texture varies with the FRF ratio. These findings suggest that FRF independently influences structural characteristics beyond its effect on dough rheology. This research provides engineering principles for optimizing gluten-free formulations by balancing FRF incorporation with rheological control to meet specific product requirements.

Differential functional compounds and volatile aroma characteristics of terminal and lateral buds in *Aralia elata*

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Aralia elata buds contains various functional components, including araloside and elatoside-based saponins, and recently, analytical research on aroma components and secondary metabolites is also expanding. As abnormal high temperatures and spring low temperatures caused by recent climate change are intensifying fluctuations in apical bud yield and quality, research on lateral buds is essential to ensure stable income generation for farmers. Protein content was significantly higher in terminal buds (29.31±0.22 g/100 g) than in lateral buds (19.57±0.06 g/100 g), while there was no significant difference in fat content between apical buds (1.88±0.14 g/100 g) and lateral buds (2.07±0.05 g/100 g). In most cases, lateral buds showed higher levels of minerals (Ca, Fe, etc.) than terminal buds. The total polyphenol content was significantly higher in lateral buds (20.08±0.20 mg TAE/ g) than in terminal buds (4.25±0.14 mg TAE/ g), and the total flavonoid content was also significantly higher in lateral buds (60.39±0.98 mg RE/ g) than in terminal buds (7.78±0.10 mg RE/ g). As a result of analyzing the volatile aroma components of the terminal and lateral buds of *Aralia elata* buds using SPME-GC-TOF/MS, the detected compounds were classified mainly into sesquiterpenes, fatty acids, aromatic compounds, aldehydes, and furan/lactone series. Among the detected components, the sesquiterpene series accounted for the highest proportion, and α-bisabolene, humulene, and cis-α-farnesene were identified as major components. Hexanoic acid was detected at the highest levels in the terminal buds and was significantly higher compared to the lateral buds (p<0.05). On the other hand, α-bisabolene, humulene, estragole, and phenylethyl alcohol showed a significantly higher trend in the lateral buds.

A study on the general composition, antioxidant effects, and processability of sesame and perilla seed meals

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This study investigated the oil cake left over after pressing sesame and perilla seeds for the development of upcycled food materials. The protein content was highest in the sesame meal, followed by the raw material and then the oil, while the fat content showed the opposite trend. Sesame and perilla seed meals were found to have high levels of minerals. Raw perilla seed meal had the highest total polyphenol and total flavonoid content. The DPPH radical scavenging activity was highest in roasted perilla seeds, followed by raw perilla seed meal, roasted perilla seed meal, and raw perilla seeds. To compare the effects of various oils on the flavor, palatability, and oxidative stability of tahini, an evaluation was conducted using sesame oil, perilla oil, grape seed oil, avocado oil, and walnut oil. The acid value of the product remained stable with no significant increase even after 48 days, indicating a low risk of early decomposition or spoilage in tahini made from sesame seed meals and perilla seed meals. Starting from the 12th day of storage, differences in peroxide value became apparent across the various oils, revealing variations in the rate of rancidity. The increase in the peroxide value was greatest when walnut oil and avocado oil were used. It was found that sesame oil and perilla oil remained stable throughout the storage period, with a slow rate of rancidity.

Effect of boiling on resistant starch retention in green banana flour compared with potato and corn starch

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This study investigated the effect of boiling on resistant starch (RS) retention in green banana flour (GBF) compared with potato starch (PS) and corn starch (CS), focusing on thermal stability, swelling behavior, and retrogradation. GBF had the highest initial RS content (76.1 g/100 g), followed by PS (63.1 g/100 g) and CS (35.1 g/100 g). However, after 30 min boiling and cooling, CS showed the highest RS retention (9.04%), followed by GBF (6.13%) and PS (1.47%). Differential scanning calorimetry (DSC) analysis showed that GBF had the highest gelatinization temperature range (67.8-88.3°C), indicating greater thermal stability, whereas PS exhibited the lowest. X-ray diffraction (XRD) analysis confirmed distinct crystalline structures, with PS exhibiting a more open and hydrated B-type, CS a densely packed A-type, and GBF an intermediate C-type. Pasting profiles revealed extensive swelling and breakdown in PS, whereas GBF and CS exhibited limited swelling and better granule integrity. Despite its higher thermal stability, GBF did not retain the most RS. PS showed the lowest RS retention due to extensive swelling and granule disintegration. In contrast, CS showed the highest RS retention despite lower thermal stability, with higher setback viscosity, suggesting greater retrogradation upon cooling. These results demonstrate that RS retention depends on the combined effects of swelling behavior, thermal stability, and retrogradation, not solely on initial RS or crystalline type.

Elucidating phase behavior-driven network formation in pea protein-based meat analogues using seaweed-derived polysaccharides as starch alternatives

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Achieving desirable meat-like texture in plant-based high-moisture meat analogues (HMMA) remains difficult when using pea protein isolate (PPI) due to its limited network-forming capacity. Conventional binders such as corn starch are widely used to improve these limitations; however, starch can form amylose–protein complexes that interfere with protein polymerization, resulting in reduced hardness and making it less suitable for PPI-based systems. Therefore, this study explored the potential of seaweed-derived polysaccharides as functional alternatives. Polysaccharides extracted from laver (LV-P) and green laver (GL-P) using a mild acid–thermal method were incorporated into PPI systems and compared with corn starch (CS) to evaluate their effects on structure formation during high-moisture extrusion. At low inclusion levels (5%), seaweed-dervied polysaccharides significantly increased hardness compared to corn starch by absorbing free water, swelling within the matrix, and acting as fillers that reduced void spaces and enhanced structural continuity. In contrast, excessive addition (10%) intensified water competition, disrupting protein alignment and reducing structural integrity. Thermal decomposition and freezing-thawing test showed that high levels (10%) of seaweed-dervied polysaccharides increased the non-freezable water fraction, limiting protein plasticization and lowering thermal stability. These results indicate that seaweed-derived polysaccharides regulate protein structuring primarily through water redistribution and matrix penetration rather than direct network reinforcement. Overall, These findings highlight the potential of seaweed-derived polysaccharides as effective and sustainable structuring agents in plant-based meat analogues.

가수분해 펙틴 용액을 이용한 열전환(pyroconversion) 가루쌀 분말의 특성

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비만 및 당뇨병 전단계 인구의 증가에 따라 저당 식품에 대한 수요가 급증하고 있다. 한국 식문화의 핵심 원료인 쌀은 높은 혈당지수(GI)와 낮은 가공 적성으로 인해 저당 식품 소재로 활용하기에 한계가 있다. 본 연구에서는 펙틴 가수분해물(pectin hydrolysate, PH)을 이용한 가루쌀분말의 열전환(pyroconversion) 효과를 규명하고자 하였다. 고메톡실(HM) 및 저메톡실(LM) 펙틴을 펙틴분해효소로 분해하여 얻은 PH용액(pH 2.7)을 가루쌀분말과 혼합한 후 50℃에서 수분 함량 7% 이하로 건조하고 150℃에서 3시간 동안 건열처리하여 열전환 가루쌀분말을 제조하였다. 열전환 가루쌀분말은 무처리 대조군보다 용해도, 팽윤력 및 페이스팅 점도가 감소하였다. 반면 열전환 가루쌀분말은 대조군보다 높은 저항전분(RS) 함량과 낮은 추정혈당지수(eGI)를 나타내었다. 이러한 열전환 가루쌀분말의 물리화학적 변화는 PH의 농도가 높을수록 더욱 뚜렷하였다. 또한 저항전분 함량이 가장 높은 열전환 가루쌀분말의 임상 실험에서 대조군보다 약 30%의 혈당지수 감소를 확인하였다. 그러므로 PH를 이용한 열전환 공정은 가루쌀분말의 물리적·유변학적 특성 저하를 최소화하는 동시에 소화율을 효과적으로 저감시킬 수 있는 매우 효과적인 전략임을 확인하였다.

Interaction of plant proteins with seaweed-originated crude polysaccharides

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The objective of this study was to characterize seaweed-derived crude polysaccharides (cpCHOs) and to determine their optimal mixing ratio with proteins for evaluating gel network properties. Compositional and structural (FT-IR) analyses showed that SM- and KP-cpCHO had alginate-like characteristics, while LV- and GL-cpCHO exhibited carrageenan-like characteristics. All cpCHOs exhibited high molecular weight (>739 kDa), with relatively lower intrinsic viscosity and anionic character, due to the partial depolymerization and neutralization. Rheological analysis revealed that SM- and KP-cpCHO showed shear-thinning behavior, with viscosity decreasing as shear rate increased. In contrast, LV-cpCHO and GL-cpCHO maintained more stable structures within the linear viscoelastic region and showed distinct thermal behaviors during heating and cooling. Specifically, LV-cpCHO formed a structured network upon heating, whereas GL-cpCHO exhibited thermoplastic behavior with structure recovery during cooling. When combined with proteins, all systems formed stable gels at 1% cpCHOs, and thermoplastic proteins exhibited a transition to thermogelling behavior. In addition, thermogelling proteins maintained their inherent gelation characteristics with an increase in storage modulus (G'), and the overall performance was comparable to that of commercial polysaccharides. These findings suggest that cpCHOs have strong potential as natural binders for improving the structural stability of plant-based meat analogues during cooking and low-temperature storage.

Fabrication of polyurethane foams using waste cooking oil treated by pulsed cold plasma

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This study developed polyurethane (PU) foams making use of waste cooking oil (WCO; soy bean oil) treated by pulsed cold plasma (PCP) treatment. WCO was subjected to PCP treatment at 30 kV for 10 min, with a 2 kHz pulse repetition rate. Polyurethane foams were manufactured by blending a petroleum-based polyester polyol with the PCP-treated WCO at weight ratios of 10:0, 7:3, 5:5, 3:7, and 0:10. The prepared PU foams were analyzed to determine their apparent density, tensile strength, tear strength, and compressive strength. The hydroxyl value of the PCP-treated WCO was 14.00 mg KOH/g, higher than the value for WCO without treatment (2.81 mg KOH/g). Stable foams were successfully formed at 10:0, 3:7, and 5:5 of the weight ratio of the polyester polyol and PCP-treated WCO. The manufactured foams at the ratios of 10:0, 3:7, and 5:5 exhibited 40.5, 48.3, and 55.7 kg/m³ as apparent density, 45.2, 38.5, and 32.1 kPa as tensile strength, 5.8, 4.9 and 3.8 kN/m as tear strength, and 5.2, 4.1, and 3.5 MPa as compressive strength, respectively. These results demonstrate that PCP-treated WCO has potential as a sustainable recycled raw material that can partially replace conventional polyurethane foam feedstocks.

Enhancing ascorbic acid stability through matrix design using whey protein isolate and lactose

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Ascorbic acid is an essential vitamin widely studied for its biological functions and applications in food, pharmaceutical, and nutraceutical systems. However, its lack of chemical stability during processing and storage remains a significant challenge. In this study, matrix composition was modified using whey protein isolate (WPI) and lactose to investigate their effects on ascorbic acid stability. Three formulation matrices were prepared: WPI, lactose, and a combined lactose–WPI system. To examine the relationship between crystallinity and glass transition temperature, two freezing protocols were applied during sample preparation: rapid freezing (one-step) and slow freezing (two-step). Samples were stored under both light and dark conditions and analyzed using ultra-high-performance liquid chromatography with diode array detection (UHPLC-DAD). Degradation kinetics were evaluated using first-order kinetic modeling to determine degradation rate constants and half-life values. Results showed that WPI matrices provided the greatest stabilization of ascorbic acid under both freezing conditions. Even under light exposure, WPI matrix ascorbic acid samples exhibited the longest half-life. A statistically significant relationship between crystallinity and half-life was observed (p<0.05), indicating that matrix structure plays an important role in stabilizing ascorbic acid.

Thermo-rheological behavior and structural stability of protein-starch mixtures with microalgae incorporation

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This study evaluated the physicochemical properties of meat analog matrices (isolated soy protein, wheat gluten, and corn starch) substituted with 0, 10, 20, and 30% (w/w) microalgae (*Chlorella, Haematococcus*, and *Spirulina*). RVA profiles showed that microalgae reduced peak and final viscosities with increasing substitution levels, suggesting reduced starch swelling and hydration. However, rheological measurements revealed that all mixtures formed stable elastic gel networks (G′>G″) during heating and cooling. The increase in storage modulus (G′) was associated with heat-induced protein denaturation and network formation. Although microalgae incorporation decreased the final G′ values, elastic behavior was maintained across all samples, indicating that the protein-rich matrix contributed to structural stability. These findings demonstrate that microalgae can be incorporated at relatively high levels while maintaining structural integrity in plant-based meat analog systems.

입도별 가루쌀 분말이 글루텐프리 케이크와 식빵의 구조 형성 메커니즘에 미치는 영향

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본 연구는 건식 제분한 가루쌀(Baromi2) 분말의 입도가 이화학적·유변학적 특성과 제품별 구조 형성 기전 및 품질에 미치는 영향을 규명하였다. 가루쌀은 롤밀 제분 후 네 개의 입도 분획(FR-P1: >60, FR-P2: 60–80, FR-P3: 80–100, FR-P4: <100 mesh)으로 구분하였다. 입도가 감소할수록 단백질 및 지방 함량은 감소하고 전분 함량은 증가하였다. RVA 분석 결과, 입도 감소에 따라 peak 및 final 점도가 증가하였으며, DSC에서도 밀가루보다 높은 호화 엔탈피(ΔH)를 나타내어 열적으로 안정한 전분 구조 형성 경향을 보였다. DHR 분석에서 temperature sweep과 frequency sweep 모두 저장탄성률(G′)이 증가하고 주파수 의존성이 감소하여 비교적 강한 점탄성 거동을 나타냈다. Mixolab 분석에서는 입자 미세화에 따라 반죽 형성 토크(C1)는 감소한 반면 전분 호화 및 노화 관련 토크(C3, C4, C5)는 증가하였다. 이러한 변화는 제품 매트릭스에 따라 상반된 품질 특성을 나타냈다. 케이크에서는 미세 입자가 반죽 점도를 증가시켜 기포의 coalescence와 drainage를 억제함으로써 비체적이 증가하고 경도는 6.1 N에서 2.9 N으로 감소하였다. 반면 식빵에서는 입도 감소에 따라 낮은 C1 토크와 전분 손상도 증가로 반죽 점착성이 증가하고 가스 보유력이 저하되어 비체적이 2.2 mL/g에서 1.3 mL/g으로 감소하고 경도는 12.4 N으로 증가하였다. 결론적으로 가루쌀의 입도는 구조 형성 기전에 따라 매트릭스 의존적 기능성을 나타냈으며, 케이크에는 미세 입자가, 식빵에는 중간 입도(60–80 mesh)가 최적인 것으로 확인되었다. 본 연구는 가루쌀의 매트릭스 의존적 기능성을 규명하고 글루텐프리 제품 설계를 위한 공정 최적화 방향을 제시한다.

Dual-modified floury rice flour suppresses starch recrystallization and delays staling in par-baked brioche buns

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This study evaluated dual-modified floury rice flour (M-FRF) as a functional ingredient to improve quality and delay staling in par-baked brioche buns. M-FRF was produced by reactive extrusion of floury rice (Baromi2) with sodium tripolyphosphate (STPP), inducing phosphorylation and pre-gelatinization. Compared with native floury rice flour (N-FRF) and strong flour (SF), M-FRF exhibited higher water-holding capacity, swelling power, and solubility, and more than twice the resistant starch (RS) content (15.1%), which remained stable after heating (16.4%). Enhanced freeze–thaw stability indicated suitability for frozen processing. DSC and RVA revealed low gelatinization enthalpy and near-zero setback viscosity, indicating suppressed starch recrystallization. In reconstituted wheat flour (RWF) with 10% and 20% replacement, these effects were maintained. Mixolab showed reduced final torque (C5) and C5–C4 values, indicating restricted starch rearrangement during cooling. After rebaking and ambient storage (1, 4, and 8 h), buns containing M-FRF retained higher crumb moisture and lower firmness and penetration force than the control. Water adjustment based on Mixolab absorption further minimized moisture loss and firmness increase. These findings demonstrate that M-FRF enhances storage stability of frozen and reheated bakery products by suppressing starch recrystallization.

Multilayer O/W nanoemulsions encapsulating beef flavor oil for improved physicochemical stability

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This study developed multilayer O/W nanoemulsions encapsulating beef flavor oil (BFO) to improve physicochemical stability. Nanoemulsions were sequentially coated with chitosan and arabic gum using a layer-by-layer (LbL) process to form up to six interfacial layers. During deposition, BFO was incorporated at each step, distributing flavor compounds throughout the multilayer interface. Physicochemical stability was evaluated using particle size, ζ-potential, transmission electron microscopy (TEM), Fourier transform infrared spectroscopy (FT-IR), differential scanning calorimetry (DSC), and sensory analysis. Particle size increased from 251.73 to 386.41 nm with increasing layer number (p<0.05), while alternating ζ-potential values indicated electrostatic deposition of oppositely charged polymers. TEM observations confirmed polymer layers surrounding droplets. FT-IR spectra showed alternating peak shifts between 1572 and 1602 cm^{-1}, supporting multilayer formation. DSC thermograms showed broader transitions and reduced exothermic peaks after multilayer coating, suggesting partial coverage of flavor oil by the coating layers. Sensory evaluation revealed flavor intensity decreased from 5.38 to 2.57 with increasing layers. These results demonstrate improved physicochemical stability of BFO through multilayer interfacial coating while modulating flavor perception. Overall, multilayer O/W nanoemulsions offer a promising approach for stabilizing volatile flavor oils in food systems.

Influence of sea mustard (*Undaria pinnatifida*) powder on the physicochemical properties of high-moisture meat analogs

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This study investigated the effects of incorporating sea mustard (*Undaria pinnatifida*) powder on the physicochemical properties of high-moisture meat analogs (HMMA). A base formulation consisting of isolated soy protein, wheat gluten, and corn starch (6:3:1) was prepared, and sea mustard powder was added at levels of 0, 3, 6, 9, 12, and 15%. Extrusion was conducted at 150°C, 65% moisture content, and 300 rpm. Lightness (L*) decreased significantly with increasing sea mustard content, while redness (a*) generally decreased. Hardness and chewiness exhibited a non-linear trend, increasing up to 6%, decreasing at 9%, and increasing again at higher levels. Springiness and cohesiveness decreased with increasing sea mustard content. Cutting strength reached a maximum at 12% addition. Additionally, DPPH and ABTS radical scavenging activities increased in a dose-dependent manner. These results indicate that sea mustard powder enhances antioxidant activity while affecting the textural properties of HMMA. An addition level of 6% may provide a balance between textural quality and processing stability.

Comparison of quality of grilled pork belly prepared by an automatic cooking robot and conventional cooking method

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This study compared the quality characteristics of grilled pork belly prepared using an automatic cooking robot (Autowok) versus conventional manual cooking. As the food service industry adopts automation for consistency, understanding robotic systems' impact on meat quality is essential. Pork belly samples were cooked under standardized conditions and evaluated for physicochemical and textural properties. Color analysis showed autowok samples exhibited significantly higher brightness (L*) with reduced redness (a*) and yellowness (b*), indicating controlled surface browning. Texture profile analysis revealed autowok samples had significantly lower hardness (2407.3±39.1 g), gumminess (2020.9±33.4 g), and chewiness (2333.1±43.7 g) versus control samples (3414.8±42.6 g, 2784.5±33.8 g, 3014.7±52.9 g), representing 29.5%, 27.4%, and 22.6% reductions respectively. Springiness and cohesiveness showed no significant differences, suggesting maintained structural integrity. Moisture content was significantly higher in Autowok samples (36.58±0.79%) versus control (33.63±1.02%), an 8.8% improvement correlating with reduced hardness. The robotic system's precise temperature control and consistent heat distribution moderate protein denaturation during heating, preventing moisture loss. Consequently, automated cooking produces pork belly with superior tenderness and water retention, demonstrating significant potential for standardized commercial food service applications.

Quality characteristics of muffins supplemented with rice bran fermentate

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This study investigated the quality characteristics of muffins supplemented with rice bran fermentate (RBF). Muffins were prepared by replacing 3%, 6%, 9%, 12%, and 15% of the total weight with RBF, which possessed a solid content of 19.13±0.11%. The pH of the muffins decreased as the RBF content increased, ranging from 7.68 in the control group to 6.58–7.26 in the experimental groups. Moisture content significantly increased with higher RBF concentrations, from 26.03% in the control to 26.60–28.84%. The baking loss rate also increased from 6.81% in the control to 7.81–8.47%. Weight, height, and volume exhibited a decreasing trend with increasing RBF addition. Regarding color values, the L* value increased with higher RBF content, while a* and b* values showed a decreasing trend. Hardness decreased from 238.69 g in the control to 126.49–224.07 g in the experimental groups. Gumminess also decreased from 190.61 to 103.70–180.84, indicating a downward. Springiness increased in the experimental groups compared to the control, whereas cohesiveness was lower. In the consumer sensory evaluation, the control group received the highest preference scores for appearance, aroma, and overall preference, followed by the RBF 6 and RBF 9 groups. For moistness, the RBF 3 group showed the highest preference, while the RBF 9 group was most preferred for its fermented flavor. Based on these overall results, the addition of 6–9% RBF is considered the optimal formulation for muffin preparation.

Artificial intelligence-based prediction of hazardous substance migration from food packaging to model food systems

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This study developed machine learning-based regression models to predict the concentration of hazardous substances migrating from food packages to food based on the kind of package, package thickness, initial concentration of hazardous substance in the package, food simulant type, food volume, food-packaging contact area, processing type, and storage temperature and time. Datasets were compiled from the literature, and random forest, XGBoost, LightGBM, histogram-based gradient boosting, and support vector regression (SVR) were employed to build predictive models, with hyperparameters optimized using GridSearchCV. Based on the cross-validation results for the collected datasets, XGBoost showed the best performance for LDPE and PP, whereas SVR performed best for PET. When these selected models were applied to the test sets, the R^2 values for LDPE, PET, and PP were 0.93, 0.99, and 0.99, respectively. The SDMetrics results, including the quality score, column shapes score, column pair trends score, and the performance metrics of the optimal model for each package on the mixed dataset, constructed by adding synthetic data generated using synthetic data vault to the collected data, indicated that the synthetic data were appropriate for use in combination with the collected data for prediction. These findings demonstrate that machine learning-based regression models can be effectively used to predict the concentration of hazardous substances migrating from food packaging materials into food.

Inhibitory effect of Maillard reaction products derived from 2'-fucosyllactose on the oxidation of avocado oil

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This study evaluated the inhibitory effects of Maillard reaction products (MRPs) derived from five reducing sugars, including 2′-fucosyllactose (2′FL), on avocado oil oxidation. Avocado oil was pre-oxidized for 5 or 10 h and reacted with lysine and reducing sugars (2′FL, glucose, galactose, fucose, and lactose) to generate MRPs combined with avocado oil (MAO). Storage stability, assessed by acid and peroxide values, showed that all MAO samples significantly improved oxidative stability compared to untreated oil, regardless of oxidation time. Lysine content decreased with oxidation, with the greatest reduction in Glu–Lys and the highest retention in Fuc–Lys. Residual sugar analysis indicated that 2′FL was more reactive than lactose in the Maillard reaction. Browning index results showed lower absorbance at 294 nm in 5 h-oxidized samples, while melanoidin formation at 420 nm increased as sugar structure shifted from tri- to monosaccharides. Antioxidant evaluation demonstrated reduced MDA levels and enhanced DPPH radical-scavenging activity following MRP treatment. Fatty acid analysis revealed that 2′FL-derived MRPs most effectively preserved monounsaturated fatty acids. Overall, MRPs, particularly those from 2′FL, effectively inhibited lipid oxidation in avocado oil, suggesting their potential for food upcycling and natural antioxidant development.

Clean-label flavor enhancement of faba bean and sunflower seed protein hydrolysates prepared under high hydrostatic pressure

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Growing consumer interest in health and environmental sustainability has increased demand for clean-label ingredients. Excessive sodium intake poses a cardiovascular risk, and negative perceptions of MSG remain widespread. This study investigated taste-enhancing peptides from faba bean protein (FP) and sunflower seed protein (SP) extracted via clean-label processes. Enzymatic hydrolysis at 100 MPa and 200 MPa was applied, and hydrolysates were evaluated for saltiness- and umami-enhancing effects. Amino nitrogen content increased with pressure, indicating a higher degree of hydrolysis. Electronic tongue analysis revealed that FP hydrolysates enhanced saltiness while SP hydrolysates enhanced umami. FH200 achieved 438.2% saltiness enhancement with potential to replace over 50% of NaCl, and SH200 exhibited 43.9% umami enhancement with potential to replace over 16.7% of MSG. FH200 showed the highest proportion of peptides below 1 kDa associated with saltiness-enhancement, while SH200 contained the greatest content below 3 kDa and highest levels of umami-related free amino acids. Foaming properties improved under atmospheric and 100 MPa conditions, whereas emulsifying properties improved under high-pressure conditions. These results demonstrate that high-pressure-assisted enzymatic hydrolysis effectively generates taste-enhancing peptides from plant proteins, offering a promising approach for clean-label, multifunctional ingredients capable of partially replacing NaCl and MSG.

Effects of puffing and lactic acid fermentation on a soybean-based coffee alternative

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Deforestation in coffee-growing regions is accelerating due to global warming, highlighting the urgent need for sustainable coffee alternatives. In this study, caffeine-free coffee was produced from soybeans. Soybeans were puffed at 700, 900, 1100, and 1300 kPa at 230°C and then fermented with *Lactiplantibacillus plantarum* at 30°C for 48 h, which grew without additional nutrients. Notably, the sample fermented after puffing at 1300 kPa showed the darkest color (L*=26.00) and a pH of 5.47, which was close to that of Brazilian coffee (5.45) and Ethiopian coffee beans (5.66), while exhibiting the highest titratable acidity. A lactic acid concentration of 224.65 mg/L indicated that the organic acid composition was most comparable to that of roasted coffee beans. Volatile compound analysis showed that furan compounds increased with increasing puffing pressure but were consumed during fermentation. However, the electronic tongue results showed similar bitterness (4.81) to Brazilian coffee (4.82) with hot water extraction. In addition, the PCA plot of the overall taste profile indicated the highest similarity to Brazilian coffee. Among all samples, this condition also exhibited the strongest antioxidant capacity. These results suggest that, if the flavor profile is further improved by optimizing the fermentation process, applying puffing and fermentation to soybeans could provide a coffee-like beverage base and offer a sustainable platform for next-generation coffee alternatives.

Sunflower oleosome extraction using plasma activated water

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This study determined the optimal conditions for the sunflower oleosome extraction using plasma-activated water (PAW), which maximize the recovery of oleosomes, and compared the physicochemical properties of oleosomes extracted under the optimized conditions with those extracted using distilled water (DW). The PAW treatment conditions were optimized against oleosome recovery using central composite design in response surface methodology, with plasma jet treatment time for PAW generation (2–10 min) and PAW immersion time (30–180 min). During PAW or DW immersion, the pH was adjusted to ~9 prior to oleosome recovery, and the yield, ζ-potential, and particle size of the recovered oleosomes were determined. The optimal conditions were a plasma jet treatment time of 4.5 min and a PAW immersion time of 105 min, reducing the immersion time by 135 min compared with the DW treatment. The yields of oleosomes extracted with PAW and DW were 82.0 and 74.9%, respectively (p<0.05). In addition, compared with DW-treated oleosomes, PAW-treated oleosomes showed an increase in the absolute ζ-potential value from -31.7 to -40.3 μm, and a decrease in particle sizes from 1.46 and 1.02 μm, indicating a significant improvement in dispersion stability (p<0.05). Therefore, these results suggest that PAW-assisted extraction of sunflower seed oleosomes has potential as an effective method for reducing extraction time and improving both yield and the stability of physicochemical properties.

Cavity size dependent self-assembly of whey protein hydrolysate-cyclodextrin complexes for enhanced bitterness masking

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This study investigated the bitterness-masking effects and physicochemical characteristics of whey protein hydrolysate (WPH) complexes with α-, β-, and γ-cyclodextrins (CDs). WPH was reacted with CDs at molar ratios of 1:0.5–1:3 (M/M) to evaluate cavity size–dependent binding behavior. Free amino acid analysis revealed a high proportion of hydrophobic residues (41.6%), contributing to pronounced bitterness. Fluorescence quenching analysis showed decreased intrinsic fluorescence intensity with increasing CD concentration, indicating complex formation; Stern-Volmer constants (K_{sv}) for α- and β-CD decreased with temperature (23.71→11.45 and 17.78→9.08 M^{-1}), suggesting static quenching, whereas γ-CD increased (7.23→10.33 M^{-1}), indicating dynamic quenching. α-CD exhibited higher binding affinity (K_a=4.19–8.02 M^{-1}, ΔG=-3.55 to -5.50 kJ/mol). Isothermal titration calorimetry confirmed exothermic and spontaneous binding for α- and β-CD, while γ-CD showed negligible interaction. Molecular docking demonstrated stronger binding to α- and β-CD (-6.41 to -7.86 kcal/mol) than γ-CD (-2.77 to -4.56 kcal/mol), highlighting the importance of cavity size. Electronic tongue analysis showed that α- and β-CD significantly reduced both initial and aftertaste bitterness, whereas γ-CD had limited effects. These findings demonstrate that WPH-CD self-assembly is governed by cavity size-dependent interactions, with α-CD forming stable inclusion complexes that enhance bitterness masking.

고령친화식품용 호화밀가루 기반 식용 3D 프린팅 잉크 설계: 잔탄검 최적화 및 스피루리나 첨가 효과

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일반적인 밀가루 기반 3D 프린팅 식품은 출력 후 가열 공정이 필수적이나, 이는 제품의 경도를 증가시키고 영양 성분을 파괴하여 고령자용 식품으로 직접 적용하기에는 실용적 한계가 존재한다. 이에 본 연구는 추가 가열 없이 출력 직후의 부드러운 텍스처를 유지할 수 있는 호화밀가루(pre-gelatinized wheat flour) 기반의 식용 3D 프린팅 잉크 시스템을 새롭게 제안하였다. 구조 형성체인 잔탄검(XG, 0~1.5%)과 기능성 소재 스피루리나(0~7.5%) 첨가에 따른 베이스 잉크(우유/호화밀가루 비율 약 0.8:1)의 유변학적 특성 및 물성 변화를 평가하였다. 그 결과, 모든 처리군에서 명확한 고체적 거동(G'>G")이 관찰되었다. 특히 XG 0.3% 첨가 조건은 주파수 증가에 따른 높은 손실 계수(tan δ)를 보여 우수한 압출 적합성(printability)을 나타냈으며, 3ITT 및 텍스처 프로파일 분석 결과 높은 구조 회복률(14.22%)을 확보하고 고령친화식품 3단계 기준(20,000 N/m^2 이하)을 충족시키는 경도 특성(4,860 N/m^2)을 나타내어 최적 배합으로 선정되었다. 선정된 최적 베이스 잉크에 스피루리나(0~7.5%)를 첨가하였을 때 모든 조건에서 전단박화(shear-thinning) 거동이 확인되었고, 저전단 구간(0.1~1 s^{-1})에서는 첨가량에 비례하여 점도가 상승하였다. 결과적으로 본 연구는 가열 공정을 원천 생략할 수 있는 호화밀가루 기반 시스템을 설계함으로써, 3D 프린팅 잉크로서의 우수한 활용 가능성을 입증하였다. 향후 스피루리나를 적용한 출력물 평가를 통해 영양과 물성이 최적화된 즉석 섭취형 맞춤형 고령친화식품 개발의 새로운 패러다임을 제시할 수 있을 것이다.

Upcycled wheat bran as a functional dietary fiber ingredient for sustainable cracker products

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Food processing by-products are increasingly recognized as sustainable resources for developing functional food ingredients. In particular, wheat bran, a major by-product of the milling industry, contains abundant dietary fiber and phenolic compounds but remains underutilized. This study aimed to evaluate the potential of upcycled wheat bran (re:nergy wheat bran) as a functional ingredient in cracker products. Wheat bran was processed through drying, roasting, and micronization to improve flavor and functional properties. The processed powder exhibited a particle size of 144.60 μm, bulk density of 1.00 g/mL, and higher water holding capacity (207.5%). Crackers were prepared by substituting wheat flour with re:nergy wheat bran at levels of 0–30%, and their physicochemical properties and antioxidant activities were analyzed. As the substitution level increased, moisture content and baking loss decreased, whereas hardness and chewiness increased. Color values also changed significantly with increasing wheat bran addition, showing decreased lightness (L*) and increased redness (a*) and yellowness (b*). Furthermore, total polyphenol content significantly increased from 32.81 to 91.61 mg GAE/100 g with increasing wheat bran content. Antioxidant activities measured by ABTS, DPPH, and FRAP assays also showed significant dose-dependent increases. These results indicate that upcycled wheat bran can enhance both the nutritional and functional properties of cracker products while promoting the value-added utilization of food processing by-products. The findings suggest that upcycled wheat bran has strong potential as a sustainable dietary fiber ingredient for functional food applications.

Changes in volatile compounds of edible oils during storage

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Edible oils are widely used in food systems, where their compositional stability plays a critical role in determining overall quality and sensory characteristics during storage. Changes in lipid composition and the formation of volatile compounds are closely associated with oxidative deterioration, particularly under elevated temperature conditions. In this study, five types of oils, including sunflower oil, olive oil, coconut oil, lard, and tallow, were stored at 45°C for 21 days to evaluate changes in volatile compounds and fatty acid profiles. Volatile compounds were analyzed to monitor flavor-related changes, while fatty acid composition was assessed to examine structural alterations associated with lipid oxidation. Overall, storage resulted in changes in both volatile profiles and fatty acid composition across all oil samples. In general, oxidation-related compounds, particularly aldehydes, tended to increase over time, reflecting progressive lipid degradation. The magnitude of these changes varied depending on the oil type, which may be attributed to differences in fatty acid composition and inherent oxidative stability. Oils containing higher levels of unsaturated fatty acids showed relatively greater changes, whereas more saturated fat-rich oils exhibited comparatively higher stability. These results provide fundamental insights into the relationship between lipid composition and flavor stability of edible oils during storage.

Development of *in situ* edible coatings using soy protein isolate–xanthan gum to inhibit starch retrogradation in cooked rice

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Cooked rice readily undergoes starch retrogradation during chilled storage, resulting in moisture redistribution, structural reorganization, and quality deterioration. This study developed an edible coating system that forms during cooking to inhibit retrogradation in cooked rice. Soy protein isolate–xanthan gum (SPI–XT) composites were incorporated into soaking water, allowing the coating layer to form naturally during cooking. The coating systems were prepared at different SPI:XT ratios and evaluated after storage at 4°C for 0 h and 48 h. The SPI–XT complexes showed stable colloidal properties with zeta potentials below −30 mV. SEM analysis showed that SPI–XT (4:1) formed a continuous surface layer and maintained a uniform microporous internal structure during storage, indicating improved moisture retention within the rice matrix. This structural stability reduced moisture movement and lowered hardness by 56% compared with the Control after 48 h. XRD analysis showed that relative crystallinity increased by only 2.4% in SPI–XT (4:1), whereas the Control increased by 13.5%. FTIR and NMR results also confirmed reduced short-range ordering and molecular rearrangement in coated rice. In addition, TGA and DTG analysis suggested that the coating and starch behaved as a combined structure. Overall, the SPI–XT coating formed during cooking effectively suppressed starch retrogradation and improved the storage stability of cooked rice.

Linking lipid polymorphism, thermal transitions, and rheological behavior in plant-based emulsion gels for animal fat mimicking

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Plant-based fat analogs have largely been designed by immobilizing oils within hydrocolloid networks, yet this matrix-centered approach remains insufficient to reproduce the crystallization-driven thermal and mechanical behavior of animal adipose tissue. In this study, plant-based emulsion gels were formulated using soybean-oil-based solid and liquid lipids at different solid-liquid ratios to examine how lipid polymorphism and thermal transitions govern fat-mimetic rheological behavior. Increasing the solid-lipid fraction improved oil retention (64.65 to 99.80%), hardness (7.31 to 25.31 N), and storage modulus (~9 × 10^3 to 1.8 × 10^6 Pa). Temperature sweep analysis showed that the gels reproduced key features of the dual thermoelastic behavior of animal fat, including low-temperature crystal-driven rigidity, residual elasticity at high temperature, and modulus recovery during cooling through recrystallization. Mid-range formulations showed the closest response to animal fats, with softening near 55–60°C and ~4-fold G′ recovery after cooling. DSC together with XRD and FTIR supported composition-dependent polymorphic transitions and molecular packing changes, linking lipid crystal form and melting-recrystallization behavior to rheology. These results demonstrate that controlled solid-liquid lipid crystallization is a practical strategy for designing plant-based fats with animal-fat-like thermo-responsive functionality.

소형양조장 적용을 위한 제조 맥아의 제맥조건별 품질특성

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본 연구는 수제맥주를 생산하는 소형양조장에서 활용 가능한 소규모 맥아 제조기술을 제시하고, 이를 통해 제조한 맥아 및 맥주의 품질특성을 구명하고자 수행되었다. 국내 맥아는 대부분 수입에 의존하고 있어 소형양조장에서 적기·적량으로 확보하는 데 어려움이 있으며, 국산 맥주보리 품종 또한 소규모 제맥기술의 미흡으로 활용이 제한되고 있다. 따라서 국내 생산 여건에 적합한 소규모 맥아 제조기술의 개발과 현장적용이 요구된다.

맥아 제조는 실내온도 18℃ 조건에서 수행하였다. 침맥은 수침 8시간과 건침 16시간을 2회 반복한 후 2일간 발아를 진행하였으며, 침맥 과정 중 발열 조절을 위해 2~3시간 간격으로 침맥수를 교환하였다. 건조는 온도와 시간 조건을 달리한 3개 처리로 실시하였다. 제조된 맥아에 대해서는 맥아수율, 단백질 함량 및 당도를 분석하였고, 이를 이용하여 제조한 맥주에 대해서는 pH, 산도, 당도 및 알코올 함량을 측정하였다.

그 결과, 침맥 48시간 후 보리의 수분 함량은 제맥에 적합한 수준인 45%에 도달하였고, 부피는 약 2배 증가하였다. 맥아수율은 72.0~88.4% 범위로 나타났으며, 단백질 함량은 9.6~10.2%, 당도는 9.6~11.3°Brix로 측정되어 건조조건에 따라 맥아 품질이 달라지는 것을 확인하였다. 반면 효소역가는 117 WK 수준으로 다소 낮게 나타나 침맥온도 등 제맥 조건의 추가적인 개선이 필요한 것으로 판단되었다. 제조 맥아를 이용하여 양조한 맥주의 pH, 산도, 당도 및 알코올 함량은 시판 맥아를 사용한 맥주와 유사한 수준을 나타냈다.

이러한 결과는 소규모 환경에서도 맥아 제조가 가능함을 보여주며, 향후 제맥조건의 최적화를 통해 국산 맥주보리의 활용성을 높이고 소형양조장의 차별화된 맥주 생산 기반을 구축하는 데 기여할 수 있을 것으로 판단된다.

Enhanced solubility of dietary fiber from Korean cabbage by-products via pressure-assisted enzymatic treatment

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Vegetable processing by-products are generated in large amounts but are often underutilized, despite being rich in structural polysaccharides. Their use as functional ingredients is limited mainly by the low solubility of dietary fiber. In this study, structural and biochemical changes in dietary fiber from Korean cabbage by-products were examined after applying pressure-assisted enzymatic treatment (HPET) under previously optimized conditions (2% enzyme, 100 MPa, 210 min). The treatment increased dietary fiber content from 3.85% to 5.52%, along with an improvement in water solubility index from 46.55% to 64.61%. Analysis of molecular weight distribution showed a clear shift toward lower molecular weight fractions (≤10 kDa), indicating partial depolymerization of polysaccharides. These changes were supported by structural analyses. FT-IR spectra suggested alterations in glycosidic linkages, and X-ray diffraction results indicated a decrease in crystallinity. Microscopic observations further showed that the compact cell wall structure became disrupted, leading to a more porous and fragmented morphology. Overall, these structural changes were associated with improved hydration and solubility of the dietary fiber. The results suggest that HPET can be used to convert insoluble fiber into more soluble forms, providing a useful approach for improving the value of cabbage by-products as functional food ingredients.

Synthesis of polyols from ultrasound-treated linseed oil via thiol-ene reaction for polyurethane foam production

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This study synthesized a linseed oil-based biopolyol (LOPt) via an ultrasound (US)-assisted thiol-ene reaction and subsequently prepared a bio-based polyurethane (PU) foam using the synthesized biopolyol. LOPt was synthesized by mixing linseed oil and 2-mercaptoethanol at a double bond-to-thiol equivalent ratio of 1:2, followed by adding azobisobutyronitrile (2 mol%), stirring the mixture, and applying ultrasound treatment (700 W, 00 min). The formation of hydroxyl groups was confirmed by Fourier transform infrared spectroscopy, as a characteristic hydroxyl group peak appeared at 3200–3600 cm^{-1}, indicating the successful introduction of hydroxyl groups into LOPt. The synthesized LOPt was blended with polyester polyol and then reacted with methylene diphenyl diisocyanate to prepare PU foams. The equivalent ratio of hydroxyl to isocyanate groups was set at 1:1. The acid value (AV), iodine value (IV), and hydroxyl number of linseed oil were 0.31 mg KOH/g, 213.3 g I_2/100 g, and 2.1 mg KOH/g, respectively, whereas those of the synthesized LOPt were 0.37 mg KOH/g, 159.1 g I_2/100 g, and 20.3 mg KOH/g, respectively. The apparent density, tensile strength, compressive strength, and tear strength of the prepared PU foam were determined to be 00.10 kg/m^3, 19.61 kPa, 00.032 MPa, and 2.996 kN/m, respectively. These results demonstrate that bio-based PU foam can be successfully prepared using LOPt synthesized via the US-assisted thiol-ene reaction.

Effect of liquid-to-solid triacylglycerol ratio on the physicochemical characteristics and gastrointestinal digestion fates of curcumin-loaded triacylglycerol nanoparticles

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The effects of the weight ratio (3:0, 2:1, 1:2, and 0:3) of the liquid (tricaprylin, TC) to solid (tristearin, TS) triacylglycerols (TAGs) were investigated on the physicochemical properties and gastrointestinal fates of curcumin-loaded TAG nanoparticles (C-TNPs). All C-TNPs exhibited yields of ~92–96% and entrapment efficiencies of ~94–102%, indicating decent colloidal and encapsulation stabilities. Moreover, the particle size, emulsifier surface load, and lipid crystallinity increased with an increasing ratio of TS, while the ζ-potential slightly decreased. Curcumin distributed homogeneously in both the 3:0 and 0:3 formulations, whereas it localized at the TC-dominated interface in the 2:1 formulation and was entrapped within the core by the TS-dominated interface at the 1:2 formulation. The cumulative release of curcumin followed the order of 3:0>0:3>1:2≈2:1. During the simulated salivary and gastric digestion phases, all C-TNPs exhibited no significant change in particle size and ζ-potential. In contrast, extensive lipolysis occurred in the simulated intestinal fluid, releasing ~87–162% of free fatty acids, accompanied by a significant increase in particle size and a remarkable decrease in ζ-potential. Although the bioaccessibility of curcumin increased (85.5→91.9%) with a higher TS ratio, its Caco-2 monolayer permeation rate was highest in the 3:0 formulation. These findings may inform the rational composition of lipid-based formulations for nutraceutical delivery.

Effects and mechanisms of bacterial inactivation under UV-A and blue light irradiation: comparison of low-pressure UV lamp and LEDs

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The germicidal actions of UV-A light and blue light have received less attention than UV-C light. Despite various light-emitting sources, fundamental studies comparing their sterilization efficacy remain limited. In this study, the microbial reduction effects of a UV-A lamp, a 365 nm LED, and a 405 nm LED were investigated against *Escherichia coli* (ATCC 25922), *Bacillus* subtilis (ATCC 6051), and *Shigella sonnei* (ATCC 29930). Bacterial inactivation efficiencies were quantitatively evaluated based on total fluence and electrical energy consumption. Response parameters in *E. coli* were assessed before and after treatments to elucidate primary inactivation mechanisms. Higher fluences (210–572 J/cm^2) were required for maximum reduction with the 405 nm LED, while *B. subtilis* exhibited the highest resistance with a distinct tailing effect. The Double Weibull model was determined to be the best-fit model across all experimental conditions (R^2>0.96, RMSE<0.32). The 365 nm LED treatment achieved the lowest 4D-values for *E. coli* (27.46 J/cm^2) and *S. sonnei* (73.50 J/cm^2), as well as the lowest electrical energy per order (E_{EO}, kWh/m^3). After all treatments, *E. coli* cells exhibited an increase in intracellular reactive oxygen species (ROS) levels, a decrease in ATP concentration, depolarization of membrane potential, loss of membrane integrity, and morphological damage. Notably, a ROS scavenger assay confirmed hydroxyl radicals play a crucial role in bacterial inactivation.

Formulation of spray-dried milk phospholipid powders and evaluation of dispersion stability

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This study aimed to improve the dispersion stability of milk phospholipid-based functional lipid systems by applying high-pressure homogenization and spray-drying processes. The effects of different wall materials and surfactants on the physicochemical properties of reconstituted dispersions were investigated. Gum arabic (GA), whey protein isolate (WPI), and denatured whey protein isolate (DWPI) prepared by pH and heat treatment were used as wall materials, while Tween 80 and Span 60 were applied as surfactants. The spray-dried powders exhibited water activity below 0.2 and moisture content below 8%, indicating adequate storage stability. Dispersion analysis showed that the WPI system exhibited the lowest Turbiscan Stability Index (TSI), indicating the highest dispersion stability. In contrast, the DWPI system showed slightly higher viscosity and TSI values than WPI, while the GA system exhibited the highest TSI values, indicating the lowest stability among the tested wall materials. The addition of the hydrophobic surfactant Span 60 increased the polydispersity index (PDI), viscosity, and TSI values, suggesting reduced dispersion stability. These results indicate that WPI is an effective wall material for improving the dispersion stability of milk phospholipid-based functional lipid systems.

Effects of cooking methods and refrigerated storage on leachate and structural characteristics of cooked rice

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This study investigated the effects of different cooking methods on the physicochemical properties of cooked rice by analyzing leachate composition and structural characteristics during refrigerated storage. Rice samples were prepared using an electric rice cooker (ECR), an electric pressure rice cooker (EPCR), and high-pressure steam (HPS) at 0.05, 0.10, and 0.15 MPa, and stored for 1, 2, and 7 days. Leachate was obtained by rinsing cooked rice with warm water. HPS-treated samples exhibited softer textures, whereas EPCR samples showed higher hardness than ECR. Regardless of cooking method, rice hardness increased with storage time. The total starch content in the leachate decreased during storage, while protein content increased, suggesting reduced starch leaching due to structural changes within the rice matrix. Consistently, differential scanning calorimetry revealed an increase in retrogradation enthalpy, and X-ray diffraction analysis showed increased relative crystallinity with storage time, indicating progressive starch recrystallization. Scanning electron microscopy further demonstrated that pore structures were better preserved in samples treated at 0.10 and 0.15 MPa, suggesting enhanced structural stability under these conditions. Overall, cooking method and storage duration significantly influenced the textural and structural properties of cooked rice, with high-pressure conditions contributing to improved quality retention during refrigerated storage.

Identification of bioactive characteristics of lactic acid bacteria isolated from Kanjhi (a traditional fermented beverage in Pakistan)

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In this research, Kanjhi a traditional fermented beverage from Pakistan was being studied. The utter focus remained on the isolation of DNA from the food sample and the identification of specific Lactic Acid bacteria strains which play key role in improving digestive health, there were total of the twenty isolates that were taken and out of which ten were being used for further study. Among all isolates, three predominant strains *Pediococcus pentosaceus*, *Lactiplantibacillus plantarum*, and *Leuconostoc mesenteroide*, were recognized as the dominant strains in Kanjhi drink. Furthermore, the newly identified isolates were further examined for their biological and functional attributes more related to digestive health. In-vitro tests include assessments of enzymatic activities and other bioactive properties. Statistical analysis (ANOVA, $p<0.05$) revealed strain-dependent variations in enzymatic and probiotic characteristics, confirming the adaptability and incompatible capability of chosen strains. Overall, the kanjhi-derived LAB demonstrated notable antimicrobial and antioxidant activities, indicating their promise as bioactive and probiotic traits for future functional food and health applications.

Mechanistic insights into leachate behavior of cooked rice during refrigerated storage: roles of starch retrogradation and structural reorganization

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This study investigated the effects of cooking conditions and refrigerated storage on leachate characteristics and their relationship with structural evolution and starch retrogradation in cooked rice. Rice samples were prepared using an electric rice cooker and an autoclave system under different pressure conditions, followed by storage at 4°C for up to 7 days. Leachate analysis showed that starch-derived components, including amylopectin and total solids, decreased during storage, whereas protein content increased. Microscopic observations revealed that cooking induced swelling and disruption of starch granules, forming a continuous matrix in which protein components were initially embedded. During storage, the starch matrix became progressively compact and reorganized, while protein components became more spatially separated and accessible. These results indicate progressive reassociation of starch chains and redistribution of water within the matrix. Based on these findings, a mechanism is proposed in which starch retrogradation leads to structural consolidation of the matrix, thereby restricting starch leaching while facilitating protein release due to structural rearrangement. Overall, the results demonstrate that leachate behavior in cooked rice is governed by the coupled effects of starch structural reorganization and water redistribution during storage.

Preparation of bio-based polyurethane foams using linseed oil-based polyols synthesized by microwave-assisted hydroxylation

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In this study, bio-based polyurethane foam was prepared using a linseed oil-based bio-polyols. The physical and mechanical properties of the bio-based polyurethane foam were evaluated by determining apparent density, tensile strength, elongation at break, tear strength, and compression strength. Linseed oil-based bio-polyols were synthesized via a microwave-assisted hydroxylation reaction, in which microwave irradiation at 150 W for 30 min were used to enhance the reaction efficiency. For this reaction, hydrogen peroxide and acetic acid were mixed at a molar ratio of 1.3:0.5. The synthesized bio-polyols were blended with a conventional petroleum-based polyether polyols at a weight ratio of 1.0:1.0 for polyurethane foam formation. After the microwave-assisted hydroxylation reaction, the acid value of linseed oil increased from 0.3 to 0.6 mg KOH/g, and the hydroxyl value increased from 2.1 to 35.5 mg KOH/g, while the iodine value decreased from 203.3 to 165.4 g I/100 g. In addition, a characteristic OH band peak was observed in the 3600-3300 cm-1 region, confirming the synthesis of the bio-polyols. The dennsity, tensile strength, elongation at break, tear strength, and compression strength of polyurethane foam prepared using the synthesized bio-polyols were 111.0 kg/m^3, 6.8 kPa, 30.7%, 5.6 kN/m, and 4.9 kPa. These results confirm that linseed oil-based bio-polyols can be synthesized through a microwave-assisted hydroxylation reaction and demonstrate its potential as a raw material for environmentally friendly polyurethane foams.

Comparative analysis of starch and flour properties in domestic wheat cultivars

Yuri Ha*, Doyoung Kim, Hyun-Jung Chung

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Understanding how starch structure relates to flour functionality in domestic wheat cultivars remains limited despite its importance in quality optimization. This study investigated the structural and physicochemical properties of starches and flour quality attributes and compared these characteristics to evaluate cultivar-dependent differences.

Amylose content ranged from 19.2% (*Hwanggeumal*) to 24.7% (*Younbaek*), indicating genotypic variation, whereas amylopectin chain length (19.9–20.5) showed limited differences. Despite similar molecular structure, functional properties varied among cultivars. *Hwanggeumal* showed the highest gelatinization enthalpy and pasting viscosity, while *Baekkang* showed the lowest. During cooling, *Baekjoong* showed the greatest increase in storage modulus(G'), whereas *Hwanggeumal* showed the lowest gel hardness, reflecting differences in network formation and retrogradation behavior. Flour properties also showed cultivar-dependent variation. Water SRC% was lower in domestic cultivars (59–65%) than ASW (70%), whereas lactic acid SRC% was highest in *Hanbaek* and *Keumkang*. This tendency was reflected in GPI, with *Keumkang* showing the highest value (0.82). Color and ash contents further reflected compositional variability among cultivars. These findings highlight cultivar-dependent differences in starch and flour properties of domestic wheat and provide fundamental data for quality evaluation and utilization.

Shiitake mushroom (*Lentinula edodes*) as a functional ingredient for modulating structure and enhancing antioxidant properties of low-moisture extruded meat analogs

Ayeon Han*, Bon-Jae Gu

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Growing global demand for sustainable food systems has intensified interest in plant-based extruded meat analogs, with extrusion serving as a key technology for developing meat-like fibrous structures. Shiitake mushroom (*Lentinula edodes*), rich in bioactive compounds and umami components, has potential as a functional ingredient for improving both quality and functionality. This study investigated the physicochemical and antioxidant properties of extruded meat analogs fortified with shiitake mushroom powder (0, 5, 10, 15, and 20%) using a base mixture of isolated soy protein, wheat gluten, and corn starch (6:3:1). Extrusion was conducted at 35% moisture content, 120°C barrel temperature, and 200 rpm screw speed. Increasing mushroom content significantly reduced the expansion ratio, lightness (L*), water absorption index (WAI), water holding capacity (WHC), and TPA parameters (hardness, springiness, and chewiness), while enhancing water solubility index (WSI), antioxidant activities (DPPH, ABTS, and FRAP), and piece density. Notably, while cutting strength rose with higher incorporation, the texturization degree peaked at 5%, indicating that low levels effectively promote meat-like fibrous structures. Consequently, the 5-10% range was considered the optimal level for balancing functional benefits with structural integrity, establishing shiitake mushrooms as a viable ingredient for value-added, sustainable extruded meat analogs.

Physicochemical and biological responses of food-grade TiO_2 as influenced by polyphenols

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Titanium dioxide (TiO_2) is a representative food additive with high stability and excellent opacity, widely used to enhance the whiteness and brightness of processed foods such as candies and chewing gum. However, concerns regarding the potential toxicity of TiO_2 when used as a food additive have been continuously raised, leading to a ban on its use in food products in the European Union (EU). This regulatory action further emphasizes the need for a clear evaluation of its safety. In this study, the cytotoxicity and physicochemical properties of food-grade TiO_2 nanoparticles with two different particle sizes were evaluated in the presence of three polyphenols (quercetin, rutin, and curcumin) to investigate potential protective effect of polyphenols. The hydrodynamic diameter was measured to analyze physicochemical characteristics, and cytotoxicity was evaluated through cell viability analysis (WST-1) and reactive oxygen species (ROS) measurement. The results showed that polyphenols induced changes in the hydrodynamic diameter and biological responses of TiO_2. These findings suggest that antioxidant compounds may contribute to help reduce the potential genotoxic effects associated with TiO_2.

Food grade antimicrobials as safe alternatives to antibiotics in cultured meat

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The cultured meat industry is rapidly expanding with strong support from companies, government agencies, and startups, but ensuring microbial safety remains a major challenge for commercialization due to contamination risks during cell culture. Currently, Penicillin-Streptomycin (P/S) is widely used for its broad antimicrobial activity. However, concerns about allergic reactions, neurological effects, and antibiotic resistance have led regulators to require the removal of antibiotics from final products. Therefore, developing antibiotic-free systems is essential. This study evaluated food-grade antimicrobial substances as potential alternatives for cultured meat production. Minimal Inhibitory Concentration (MIC) assays were conducted against key foodborne pathogens, including *Escherichia coli* O157:H7, Salmonella Typhimurium, Staphylococcus aureus, and *Listeria monocytogenes*. The results showed that ε-poly-L-lysine, lysozyme, nisin, sodium nitrite, and sodium polyphosphate effectively inhibited Gram-positive and Gram-negative bacteria at food-compatible concentrations while maintaining cell culture compatibility. These findings suggest that food-approved antimicrobials can replace conventional antibiotics, improving microbial safety and supporting regulatory compliance without compromising cell viability, thereby contributing to safer and more sustainable cultured meat production systems.

Optimization of inoculation level of lactic acid bacterial and fermentation characteristics in meat system

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This study investigated the effects of lactic acid bacteria (LAB) inoculation levels on the fermentation characteristics of fermented meat and determined the optimal level. The meat was prepared with *Lactobacillus spp*. at 7, 8, and 9 log CFU/g (LC7, LC8, and LC9, respectively). The mixture was fermented at 25°C for 48 h and aged at 4°C for 10 days. The results showed that pH in LC8 decreased to 4.71 during fermentation, indicating stable fermentation. LAB counts increased until 48 h and then slightly decreased by approximately 1.5 log CFU/g, with the total aerobic count (TAC) remaining low at approximately 3 log CFU/g. In contrast, LC7 showed only a slight decrease in pH, suggesting limited fermentation progress, whereas LC9 exhibited a rapid pH decrease to 4.13 along with a gradual decline in LAB counts. The water activity decreased more rapidly in LC9 (0.81 at day 12), with a more gradual decline observed in the other treatments. The moisture content in LC7 remained at 30% on day 12, indicating slower reduction, with the other treatments reaching approximately 20%. LC7 and LC8 maintained the typical fermented meat color, whereas LC9 exhibited a relatively pale appearance. Based on these results, an inoculation level of 8 log CFU/g was considered optimal, providing stable fermentation, moisture reduction, and desirable appearance.

Utilization of red algae as dietary fiber to mitigate oil uptake in fried instant noodles

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In this study, 6 different red algae were applied as dietary fiber sources to design the functional fried instant noodles with reduced oil content. When the red algae mixed with all-purpose flour, they showed distinct pasting properties, thermal properties, and dough formations. It is likely that the results from differences in fiber content and chemical structure, resulting in different levels of water interactions. Furthermore, the fried instant noodles mixed with 6 different red algae exhibited significantly decreased textural properties, R_{max} and extensibility, and decreased the oil contents in fried instant noodles compared to the control. Especially, the fried instant noodle treated with *Chondria crassicaulis* had the lowest oil content (10.85%), acting as a physical oil barrier. Our findings provide insights into how to use seaweed as a new category of dietary fiber to design functional carbohydrate-based foods with reduced oil content to manage obesity and diabetes.

Development of a tensile test-based system to evaluate binding strength via machine learning analysis

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Binding strength is generally measured by compressing the final product; however, a systematic method for evaluating food-grade binders has not yet been established. The objective of this study was to develop a tensile test-based testbed to evaluate intrinsic binder characteristics using machine learning (ML). The binding interactions between binders (methylcellulose, MC; hydroxypropyl methylcellulose, HPMC) and probes differing in material (A: acrylic; S: stainless steel), shape (C: cylindrical; S: spherical), and diameter (φ)-were measured via tensile testing. Data were generated by extending the tensile length to 80 mm, while varying immersion depth (1–3 cm) and tensile speed (1–10 mm/s). Key parameters, including maximum force (F_{max}), distance at F_{max} (D_{max}), work to peak (W_{topeak}), adhesion detachment point (ADP), and force at 70 mm (F_{70}), were drawn from force-strain curves. Among various ML models, the Random Forest model was selected for sensitivity and correlation analyses. Surface area-normalized parameters (F_{max}/S_{area}, F_{70}/S_{area}, and W_{topeak}/S_{area}) exhibited high sensitivity to material composition. These parameters showed a negative correlation with D_{max} (primarily driven by immersion depth), suggesting their efficacy as indicators of binding performance. Based on predictive performance ($R^2 \geq 0.9$, RMSE ≤ 3.0) and reproducibility, optimal conditions were identified as AC25 (φ25 mm; 2 cm; 3 mm/s), SC20 (φ20 mm; 3 cm; 3 and 10 mm/s), and SS20 (φ20 mm; 2 cm; 10 mm/s).

Fabrication of subcritical water-treated cellulose-based aerogels for sustainable food packaging

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The demand for sustainable food packaging materials has driven global research efforts. Expanded polystyrene (EPS) has been widely used due to its desirable properties; however, its non-biodegradability and limited structural stability restrict its practical use. Accordingly, bio-based aerogels have emerged as promising sustainable materials, characterized by low density and high porosity. Nanocellulose, a nanoscale form of cellulose which can be used as a building block for aerogels, exhibits outstanding properties, yet its conventional production methods are environmentally intensive and pose scalability challenges.

Therefore, this study introduces pilot-scale subcritical water-treated cellulose (SWT-C) as a sustainable and scalable alternative and explores its application in aerogel fabrication. Microcrystalline cellulose was treated under subcritical water conditions to obtain SWT-C, which served as the structural matrix of the aerogel. SWT-C was analyzed for its physicochemical properties, and the aerogels were further evaluated by SEM, BET analysis, and key physical and mechanical properties. The results showed that SWT-C-based aerogels exhibited distinct structural behavior compared to conventional materials. In addition, pore structure and mechanical properties varied with SWT-C content, enabling versatile use across a range of packaging applications.

Overall, SWT-C-based aerogels represent a sustainable and effective solution for food packaging applications.

국내 다소비 식품의 *in vitro* 소화 모델 적용을 위한 입 저작 모사 전처리 조건 확립

황인선*, 서미경, 정가현

국립식량과학원 식품자원개발부 식생활영양과

본 연구는 주요 영양성분 및 성상을 반영하는 다양한 매트릭스별 식품을 *in vitro* 소화 모델에 적용하기 위한 전처리 방법을 확립하고자 수행되었다. 이를 위해 국내 성인의 다빈도·다소비 식품을 기반으로 영양성분·성상별 대표 식품 매트릭스를 선정하고, 입 저작 모사 중심의 전처리 조건을 확립하고자 하였다. 먼저 질병관리청 국민건강영양조사('22-'23) 식품섭취량 조사 자료에서 하루 섭취량의 95% 이상을 차지(다소비)하거나 응답자의 10% 이상이 1일 1회 이상 섭취(다빈도)하는 식품을 추출한 뒤, 식품별 탄수화물·단백질·지방 및 총식이섬유 함량을 기반으로 k-means 방법으로 군집화를 수행하였다. 또한, ScienceDirect, Dbpia 등에서 식품별 물성 연구 문헌 총 138건을 수집하여 경도(N), 응집성(%), 점도(Pa·s) 값을 기준으로 대표 성상 특성(고경도형, 고응집형 등)을 도출하고 성분·성상별 대표식품을 최종 선정하였다. 대표 식품별 입 저작 모사 전처리 방법 설정을 위해 기존 모델에서 사용되었던 균질화기(mixer) 방식과 다지기(mincer) 방식을 비교하였다. 매트릭스별 식품 시료 50 g과 입 소화액 40 mL를 혼합하여 믹서 및 다지기 방식으로 각각 수행한 후, 습식 체(wet sieving) 방식으로 입자 크기별 분획 후 50℃ 오븐에서 10분 건조 후 중량 누적 비율을 측정하였다. 모든 식품에 대해 분쇄 기기별 3회 반복 실험 후 성능 타당성을 분석한 결과, 믹서를 이용한 균질화 시 실제 인체 저작 문헌 참고치보다 미세 입자 비율이 크며 불연속적 크기 분포를 보였다. 반면 다지기 사용 시, 식품 입자 크기 분포가 문헌값과 유사하게 나타났으며 상대표준편차가 10~15% 범위로 나타나 정밀도가 우수하였다. 다지기 적용 시 식품별 입자 크기의 누적 비율 중간값(d50)은 아몬드 0.63~1.0 mm (≒ 0.8 mm), 쿠키 0.63~1.0 mm (≒ 0.6 mm), 가래떡 1.8 mm, 계란흰자 1.8~2.5 mm (≒ 2.2 mm), 돼지고기 1.8 mm, 바나나 및 식빵 0.63~1.0 mm (≒ 0.8 mm)으로 나타났다. 따라서, 국내 다소비 식품 자료와 물성 문헌 고찰을 기반으로 식품 매트릭스별 대표 식품을 체계적으로 선정하여 입 저작 모사 전처리 조건을 실험한 결과, 기존 사용한 믹서 방식보다 다지기 방식이 실제 저작 특성 및 재현성 측면에서 더 적합한 것으로 판단되었다. 본 연구 결과는 향후 대표 식품 매트릭스별 표준화된 *in vitro* 소화 모델 프로토콜 확립과 식품 성분의 소화·흡수율 데이터 생산을 위한 기초자료로 활용될 것으로 기대한다.

SPI-maltodextrin Maillard conjugates as interfacial stabilizers for HIPEs

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High internal phase emulsions (HIPEs) have attracted attention as structured-fat systems for developing fat analogs. In this study, soy protein isolate (SPI)-maltodextrin (MD) Maillard conjugation was investigated to modify SPI properties relevant to interfacial stabilization and structure retention. Maillard reactions were performed with SPI fixed at 2% (w/v) and MD adjusted to 1, 2, or 4% (w/v), corresponding to SPI:MD ratios of 2:1, 1:1, and 1:2. Higher MD levels led to lower water absorption index (WAI) and emulsifying activity index (EAI), while water solubility index (WSI) and emulsifying stability index (ESI) increased. HIPEs were formulated at 75 and 80 wt% oil using conjugate dispersions (2-8 wt% w/w) and characterized by viscosity, oscillatory amplitude/frequency sweeps, and three-interval thixotropy tests. Overall, SPI-MD conjugates were applied as interfacial stabilizers in high-oil HIPE gels to examine how composition-dependent emulsification properties translate into rheology and HIPE structure retention.

AUTHOR INDEX

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"유리 상태의 유용 미생물-생리활성" 상호작용 기반 소재 맞춤형 바이오 코팅 제형 기초융합연구

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"한국산업식품공학회-건국대학교 글로벌기초연구실" 공동 개최

	식품품질 향상을 위한 냉동 및 유리화 제어 전략	2026.04.17 / 여수 소노캄 그랜드볼룸 2
13:20-13:45	냉동식품 시장 동향과 냉동레디밀 품질 특성 연구	송민경 (CJ제일제당)
13:45-14:10	저장 조건에 따른 아이스크림 얼음입자 성장과 품질 저하 특성	김지연 ((주)풀무원)
14:10-14:30	단백질-당-지질 복합계의 유리화 특성	최미정 (건국대학교)
14:30-14:50	저수분 환경에서의 유리화 특성과 미생물 생리활성 보존 전략	한민기 (건국대학교)

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연구 내용

소재 맞춤형 유용 미생물 및 생리활성 물질 유리화 연구 기초 인프라 구축

↓

유리 상태의 유용 미생물/생리활성 상호작용 기전 연구

↓

유리 상태의 유용 미생물/생리활성 물질 캡슐 제형화를 통한 맞춤형 바이오 식품 구현

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01
학교소개

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- 운영시간 평일 08:30~17:30(방학 중 근무시간 변경)
  토요일 및 공휴일 휴무

푸드테크 (기능성식품) 학과 모집 안내

기능성 식품시장 성장에 따라
향후 식품산업 트렌드 변화에 대응할 수 있도록
제조·연구개발 분야의 핵심인력을 양성합니다.

한양대학교의 IC-PBL, 캡스톤디자인 등 혁신적 교육 프로그램을 기반으로,
기능성 소재 제조·연구개발 분야 핵심 인력을 양성합니다. 급성장하는 기능성식품 시장과
식품산업 트렌드 변화에 선제적으로 대응할 수 있는 전문 역량을 강화합니다.

사업 시작 연도 2020년	재학생 15명	졸업생 40명

운영기간/인원

2년(4학기) / 총 20명 이내(대학별 20명 이내)

입학일정

원서접수 2026. 10. 12.(월)~10. 15.(목)17:00
서류제출 2026. 10. 12.(월)~10. 16.(금)17:00
면접시험 2026. 11. 7.(토)9:00 ~
합격발표 2026. 11. 20.(금)14:00

고광웅
교수/학과장

안녕하십니까, 한양대학교 푸드테크 계약학과 고광웅교수 입니다..
저희 학과는 급변하는 식품산업의 미래를 선도할 혁신적 인재 양성을 목표로 하고 있습니다.
저희 학과에서는 최신 기술과 실무 중심 교육을 통해 학생들이 창의적이고 전문적인 역량을 갖추도록 지원하겠으며,
또한, 산업체와의 긴밀한 협력을 바탕으로 실무 경험과 네트워크를 확장하며, 지속적인 연구와 개발로 식품의 안전성과 품질 향상에 기여하는 인재를 배출하겠습니다.
여러분의 열정과 도전 정신이 곧 미래의 식품산업을 이끄는 힘이 될 것입니다. 함께 성장하며 세계적인 푸드테크 인재로 거듭나길 기대합니다. 감사합니다.

> 열정과 도전이
> 미래의 식품산업을
> 이끄는 힘

농림축산식품부 | 한국농수산식품유통공사 Korea Agro-Fisheries & Food Trade Corporation | 한양대학교

2026 (사)한국산업식품공학회
춘계 정기총회 및 학술대회

인 쇄 | 2026.04.09
발 행 | 2026.04.13
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