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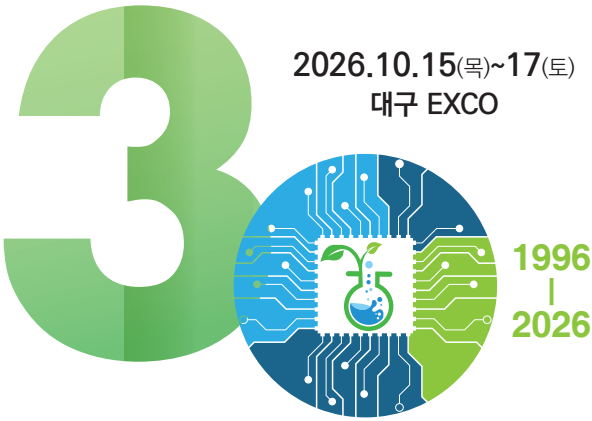
추계 정기총회 및 학술대회

한국산업식품공학회 30년의 기록

디지털 혁명을 통한 미래 푸드테크

The 30-Year Legacy of the Korean Society for Food Engineering:

Future Food Tech through Digital Revolution



2026.10.15(목)~17(토)

대구 EXCO

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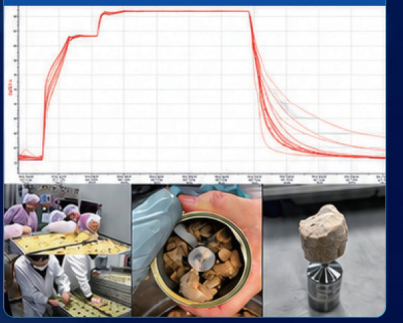
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레토르트 밸리데이션





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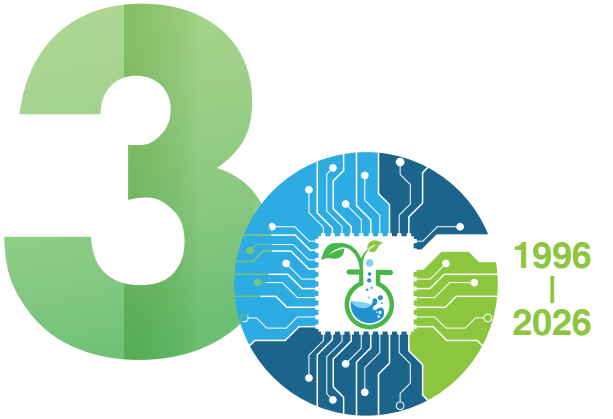
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2026 (사)한국산업식품공학회

추계 정기총회 및 학술대회



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한국산업식품공학회

Korean Society for Food Engineering

| GREETINGS |

존경하는 한국산업식품공학회 회원 여러분!

한국산업식품공학회가 올해 뜻깊은 창립 30주년을 맞이하였습니다. 지난 30년 동안 우리 한국산업식품공학회는 식품공학 분야의 학문적 발전과 산업 현장의 기술 혁신을 연결하며 대한민국 식품산업의 성장과 함께해 왔습니다. 그 여정에 한결같은 관심과 열정으로 동참해 주신 회원 여러분께 깊은 감사의 말씀을 드립니다.

다가오는 2026년 10월 15일(목)부터 17일(토)까지 대구 EXCO와 인터불고 엑스코 호텔에서 한국산업식품공학회 추계 학술대회 및 정기총회를 개최합니다. 이번 학술대회는 창립 30주년을 기념하여 "한국산업식품공학회 30년의 기록: 디지털 혁명을 통한 미래 푸드테크 (The 30-Year Legacy of the Korean Society for Food Engineering: Future Food Tech through Digital Revolution)"라는 주제로 마련하였습니다.

지난 30년의 성과를 돌아보는 것을 넘어, 앞으로의 30년을 이끌 식품공학의 새로운 방향을 함께 그리고자 합니다. 인공지능과 데이터 기반 식품 시스템, 디지털 식품안전, 첨단 식품가공 및 살균 기술, 정밀생명공학과 미래 식품소재, HMR 생산 기술, 지속가능 식품 포장 등 식품산업의 변화를 주도할 핵심 기술을 중심으로 학계, 산업계 그리고 연구기관의 전문가들이 최신 연구 성과와 산업 현장의 경험을 공유하는 자리가 될 것입니다.

특히 학회 창립 30주년을 기념하는 고려대학교 이철호 명예교수님의 기조강연과 식품산업 현장에서의 35년 여정을 담은 매일유업 조상우 부사장님의 기조강연을 비롯하여, 다양한 전문 심포지엄 및 학술세션과 신진연구자 세션, AI 기반 푸드테크 산업의 기술 동향과 전망을 조망하는 워크숍, 대학원생 우수논문 발표, 대학원생 및 학부생 제품 개발 경진대회까지 분야와 세대를 아우르는 풍성한 프로그램을 준비하였습니다.

지난 30년간 축적된 지식과 경험이 미래 푸드테크의 혁신으로 이어지는 자리에 여러분을 정중히 초대합니다. 회원 여러분의 적극적인 참여와 성원을 부탁드립니다.

감사합니다.

2026. 10

(사)한국산업식품공학회 회장 **정 명 수**

| CONTENTS |

Program ····· 6

Graduate Competitions

GC1. **대학원생 우수논문 선발대회 (A)** ····· 9
GC2. **대학원생 우수논문 선발대회 (B)** ····· 11
GC3. **대학원생 우수논문 선발대회 (C)** ····· 13

기조강연 1. 이철호 (고려대학교) ····· 15

Symposium Sessions

S1. 다기능 탄소나노점의 맞춤형 활용기술 개발 ····· 19
S2. 글로벌 기준규격과 규제 동향 ····· 29
S3. 직접 스팀 살균 기술을 이용한 고부가가치 식품 개발 ····· 37
S4. 고부가가치 식품 공정 개발을 위한 식품 장치 산업의 역할 ····· 45
S5. AI·데이터 기반 식품위해예측과 디지털 식품안전관리의 미래 ····· 53
S6. AI가 바꾸는 식품산업: 식품 R&D부터 스마트 품질관리까지 ····· 61
S7. HMR 식품 생산기술 고도화 전략 ····· 69
S8. New paradigms in HFF ingredient development: AI, organoids, and regulatory implementation ····· 77

기조강연 2. 조상우 (매일유업) ····· 85

Symposium Sessions

S9. 정밀생명공학 기술을 통한 미래 식품소재 생산 ····· 89
S10. 식품 스마트제조 혁신과 산업화: 산학연 협력이 만드는 지역생태계 ····· 97
S11. 지속가능 식품포장 소재 기술의 현재와 미래 ····· 105

UC 2026 KSFE 학생 제품개발 경진대회 ····· 113
YS 차세대 식품공학의 연구 동향 ····· 115

Poster Session ····· 127
Author Index ····· 265
Sponsors ····· 270

10.15(목)

09:00–18:00 등록

GC-I (가공·공학I)

10:00–11:30 **대학원생 우수논문 선발대회 A**
장소 211호
좌장 도한솔 (이화여자대학교), 반충진 (서울시립대학교)

GC-II (가공·공학II)

10:00–11:30 **대학원생 우수논문 선발대회 B**
장소 314호
좌장 김우주 (서울과학기술대학교), 정성민 (전남대학교))

GC-III (비가공·공학)

10:00–11:30 **대학원생 우수논문 선발대회 C**
장소 315호
좌장 김미주 (경희대학교), 김진철 (KIST 강릉분원)

11:30–12:30 Break

12:30–13:30 진행 신혜림 아나운서 장소 211호
개회사 | 정명수 (한국산업식품공학회 회장)
축 사
시 상
30주년 기념행사 (동영상 및 경품추첨)

13:30–14:10 **기조강연 (PL1)**
장소 211호 좌장 민세철 (서울여자대학교)
[학회 창립 30주년 기념 강연] 토기와 한민족 선사 음식문화
이철호 (고려대학교)

14:10–14:20 Break

S1

다기능 탄소나노점의 맞춤형 활용기술 개발
후원 : 고려대학교 탄소나노점-AI 융복합 연구사업단
장소 211호 좌장 이정수 (부산대학교)

14:20–14:45 Development of carbon, sulfur, and zinc quantum dots-based active and intelligent food packaging materials
김준대 (경희대학교)

14:45–15:05 **탄소나노점을 활용한 생분해성 다기능 식품포장재 개발**
한재준 (고려대학교)

15:05–15:25 **기능성 성분 전달시스템을 위한 탄소나노점의 표면기능화 연구**
이민혁 (고려대학교)

15:25–15:50 Machine-learning framework for property prediction and optimization of carbon nanodot synthesis
손홍석 (고려대학교)

S2

글로벌 기준규격과 규제 동향
후원 : 한국식품산업협회
장소 314호 좌장 최수진 (서울여자대학교)

14:20–14:50 **CODEX 가공과채류분과위원회(CCPFV) 소개 및 운영 방향**
박재우 (식품의약품안전처)

14:50–15:20 **한국 식품산업의 EU PPWR 대응: 식품포장 특화 표준 가이드라인의 핵심과 실무**
이주형 (법무법인광화문)

15:20–15:50 **MAHA 정책과 기능성식품 산업의 변화와 전망**
이종훈 (가천대학교)

S3

직접 스팀 살균 기술을 이용한 고부가가치 식품 개발
후원 : IPET 소스 살균 과제 연구팀
장소 315호 좌장 박성희 (서울과학기술대학교)

14:20–14:50 **다이렉트 스팀 살균 기반 소스 기술 개발 현황 및 대상푸드플러스(주) 소개**
장경민 (대상푸드플러스㈜)

14:50–15:20 **식품 가공시스템 설계 및 공정 조건 최적화 접근법**
이승현 (충남대학교)

15:20–15:50 **직접증기주입 기술을 활용한 액상 식품 살균 식품공정 기술: 닭육수와 커피 우유 적용 사례**
심준보 (서울과학기술대학교)

15:50–16:00 Break

S4

고부가가치 식품 공정 개발을 위한 식품 장치 산업의 역할
후원 : ㈜경한, ㈜켐리시스, ㈜에코기어
장소 211호 좌장 반충진 (서울시립대학교)

16:00–16:30 **K-푸드 수출을 위한 수확 후 저장 및 유통 혁신 기술: 천연 가식성 나노코팅**
박지훈 (㈜에코기어)

16:30–17:00 **곡물·커피 로스팅의 장치 기술과 공정 제어: 드럼 및 열풍 로스팅을 중심으로**
정인석 (㈜태환자동화산업)

17:00–17:30 **마이크로파를 활용한 식품 가공 및 건식 연속 살균/멸균**
정연실 (비손테크인터내셔널)

S5

AI·데이터 기반 식품위해예측과 디지털 식품안전관리의 미래
후원 : 식품안전정보원
장소 314호 좌장 김해영 (경희대학교)

16:00–16:05 **개회사** | 이재용 (식품안전정보원)
내빈 및 좌장 소개 | 방선녀 (식품안전정보원)

16:05–16:30 **식품위해예측센터의 출범과 데이터 기반 식품안전관리의 발전방향**
배근휘 (식품안전정보원)

16:30–17:00 **머신러닝을 활용한 식중독 미생물 예측 모델 개발**
김상순 (건국대학교)

17:00–17:30 **AI·데이터 기반 원료부터 제품표시까지 통합 솔루션 구축**
엄태건 (㈜아워홈)

S6

AI가 바꾸는 식품산업: 식품 R&D부터 스마트 품질관리까지
후원 : ㈜풀무원
장소 315호 좌장 강태영 (충남대학교)

16:00–16:30 **Next-generation alternative seaweed meat manufacturing using AI-Driven 3D robotic food printing**
김상오 (단국대학교)

16:30–17:00 **From bytes to bites: AI-Driven design from food data**
이수용 (세종대학교)

17:00–17:30 **차세대 Food Structure 설계를 위한 식품 도메인-AI 융합 방법론: 해조류 추출 조건 최적화 및 HMMA 물성 예측 모델 구현**
한정우 (경희대학교)

17:30–18:30 학생 참여 이벤트 (WINE 시음) 장소 211호

10.16(금)

09:00–09:30 등록

09:30–09:50 정기총회

09:50–10:00 Break

S7

HMR 식품 생산기술 고도화 전략
후원 : 정푸드코리아
장소 211호 좌장 목진홍 (동국대학교)

10:00–10:30 **HMR 식품의 최신 가공기술 동향: 전처리, 살균, 건조 및 냉동**
조원일 (동원F&B)

10:30–11:00 **Supercooling and superchilling storage processes as alternatives to freezing for food freshness retention**
강태영 (충남대학교)

11:00–11:30 **조합가공기술을 활용한 고품질 HMR 식품 생산**
박성희 (서울과학기술대학교)

11:30–12:10 **기조강연 (PL2)**
장소 211호 좌장 김용노 (서울대학교)
연구는 제품이 되고, 안전은 문화가 된다. – 식품산업에서 보낸 35년의 여정–
조상우 (매일유업㈜)

12:10–13:20 Break

S8

New paradigms in HFF ingredient development: AI, organoids, and regulatory implementation
후원 : 건강기능식품 기능성 원료 스마트 제품화 지원 연구단
장소 314호 좌장 이홍진 (중앙대학교)

10:00–10:30 **AI를 활용한 기능성 천연물소재 발굴과 작용원리 검증**
강경수 (한국과학기술연구원(KIST))

10:30–11:00 **Development and application of next-generation organoid-based models for functional food evaluation**
김동환 (한국식품연구원)

11:00–11:30 **신기술 적용 기능성 소재의 개발과 규제 대응 전략**
서승오 (서울과학기술대학교)

S9

정밀생명공학 기술을 통한 미래 식품소재 생산
공동개최: 강원대학교 IPET글로벌푸드테크 과제연구팀, 강릉영커사업단
장소 211호 좌장 박성훈 (강원대학교)

13:20–13:50 **Precision bioconversion for the production of high-value sugars and their derivatives**
김동현 (경북대학교)

13:50–14:20 **Precision fermentation for the production of natural flavor and functional food ingredients**
김선기 (중앙대학교)

14:20–14:50 **미래 식품 생산을 위한 차세대 유전자 조립 기반 합성생물학 플랫폼**
신종혁 (세종대학교)

S10

식품 스마트제조 혁신과 산업화: 산학연 협력이 만드는 지역생태계
후원 : 구미전자정보기술원, 경운대학교 앵커총괄사업단
장소 314호 좌장 서동호 (경운대학교)

13:20–13:50 **AI 시대, 작은 공장의 큰 레시피: 데이터로 밀간하고 AI로 간을 맞추는 중소 식품공장**
차동호 (SK㈜ AX)

13:50–14:20 **AI 기반 식품 스마트제조 혁신과 식품산업 혁신 생태계**
임정호 (한국식품연구원)

14:20–14:50 **식품 스마트제조 공정의 품질관리 고도화 전략**
정영성 (경운대학교)

S11

지속가능 식품포장 소재 기술의 현재와 미래
후원 : ASPT, 한솔제지, 씨케이, ATP
장소 315호 좌장 도한솔 (이화여자대학교)

13:20–13:50 **지속가능 식품포장 개발: 친환경 r-PET 용기 제품화 중심**
이윤석 (연세대학교)

13:50–14:20 **ESG 공시 강화에 대응하는 포장재 지속가능 전략**
안덕준 (SPC Pack)

14:20–14:50 Comparative life cycle assessment of reusable packaging systems for fresh food distribution: EPE-based foldable box and EPP-based injection-molded box
강동호 (한국생산기술연구원)

14:50–15:00 Break

UC

2026 KSFE 학생 제품개발 경진대회
장소 211호 좌장 한정우 (경희대학교), 박현우 (고려대학교)

15:00–15:25 **식물성 육포형 스낵 "Mush-Chew (머쉬츄)"**
팀명 Born-Up (본업) 소속 건국대학교

15:25–15:50 **솜닭**
팀명 FPE 소속 충남대학교

15:50–16:15 **콩란큐브[콜드체인프리 식물성 식사형 계란큐브]**
팀명 미담 소속 건국대학교

16:15–16:40 **IN2FU**
팀명 TENOVA(TENebrio+NOVA) 소속 경희대학교

YS

차세대 식품공학의 연구 동향
장소 314호 좌장 김현수 (경상국립대학교)

15:00–15:20 **AI-based SEM image analysis for predicting physicochemical properties of enzyme-hydrolysed protein powders and their exploratory association with in vitro myogenic differentiation**
현지민 (국립부경대학교)

15:20–15:40 **Development of meat products formulated with plant-based lipids**
이지선 (경상국립대학교)

15:40–16:00 **Engineering high-moisture meat analog structure: from protein functionality to process control**
최현우 (가톨릭대학교)

16:00–16:20 **Micro/Nanoengineering technologies for the production of alternative foods**
박상배 (서울대학교)

16:20–16:40 **현미경 이미지 딥러닝 기반 식품 미생물 신속분석법 개발: YOLO 모델의 성과와 한계 및 foundation model 기반 zero-shot 탐지 체계로의 확장**
김정헌 (한국식품연구원)

17:00–17:30 시상식 및 폐회식 장소 211호

10.17(토)

09:00–12:00 Workshop AI 기반 푸드테크 산업 기술 동향 및 전망

GC1

대학원생 우수논문 선발대회
(A)

장소 211호 좌장 도한솔 (이화여자대학교), 반충진 (서울시립대학교)

10:00-10:10 | PLA-based active food packaging films with sustained-release antimicrobial agents for extended shelf life
이다예

10:10-10:20 | *In situ* plasma-activated water treatment for the microbial decontamination and deodorization of brewer's spent grain
권일령

10:20-10:30 | 반응압출성형공정을 이용한 글루텐프리 제빵용 쌀 소재 개발 및 특성 규명
김나윤

10:30-10:40 | Sequence-controlled ion assembly controls Na^+/K^+ availability in gellan gum-based NaCl-KCl particles, enhancing saltiness while reducing KCl-associated bitterness
김연경

10:40-10:50 | 김 다당 추출 잔사의 탈색 공정 최적화 및 신규 식물단백질로 이용가능성 탐색
김태인

10:50-11:00 | Hydrogenated soybean lecithin-containing reduced-fat mayonnaise: formulation characteristics, subjective fullness, and subsequent energy intake
이지민

11:00-11:10 | Biphaisc co-encapsulation of piperine and curcumin in O/W nanoemulsion and 4-α-glucanotransferase-treated potato starch for enhanced bioaccessibility and dysphagia-oriented delivery
정인근

11:10-11:20 | Matrix- and surfactant-dependent properties of spray-dried milk phospholipid-rich extract powders: reconstitution stability and in vitro lipid digestion
최희연

GC2

대학원생 우수논문 선발대회 (B)

장소 314호 좌장 김우주 (서울과학기술대학교), 정성민 (전남대학교)

10:00-10:10 | Structural modification of chickpeas by tempering–roasting for enhanced β–carotene delivery via nanoemulsion impregnation
박재은

10:10-10:20 | Thermoresponsive alginate–GTPS composite emulsion gels as porcine back fat mimetics for reduced–fat meat products
이신재

10:20-10:30 | Freeze–thaw tofu as a scaffold for culturing chicken fibroblasts (DF–1)
이서영

10:30-10:40 | OSA–modified starch microspindles with different morphologies for HIPPE formation and pork fat replacement
이성주

10:40-10:50 | 펙틴 가수분해물을 이용한 가루쌀 분말 및 가루쌀 전분의 열전환(pyroconversion) 에 따른 물리화학적 및 소화 특성
장은정

10:50-11:00 | Digital twin of a microwave oven based on deep learning for real–time endpoint control during steamed egg cooking
최고은

11:00-11:10 | Ionized gas–assisted epoxide ring–opening of epoxidized waste cooking oil for bio–based polyurethane foam production
하예은

11:10-11:20 | Characteristics of ginseng and red ginseng powder using subcritical water and spray drying integrated process
허희원

GC3

대학원생 우수논문 선발대회 (C)

장소 315호 좌장 김미주 (경희대학교), 김진철 (KIST 강릉분원)

10:00-10:10 | Puffing-induced structural and phytochemical changes and their associations with biological activities in grapefruit (Citrus paradisi) peel
김초아

10:10-10:20 | Genome-based AI prediction of lactic acid bacterial β-glucosidase activity and enhanced ginsenoside bioconversion of puffed ginseng by Lactiplantibacillus plantarum KFOM0044
윤형락

10:20-10:30 | Agricultural waste valorization and development of multifunctional food packaging materials with antimicrobial, antioxidant, and antifouling performance
장혜원

10:30-10:40 | Freeze-drying process fabrication of smart absorbent pads integrating antibacterial activity and real-time colorimetric monitoring for food packaging and freshness indication
최진명

10:40-10:50 | Temporal organization of fat- and emulsion-related oral sensations across mayonnaise formulation matrices consumption
박지수

10:50-11:00 | Effects of high hydrostatic pressure levels on the preparation and physicochemical properties of granular cold-water swelling rice flour (GCWSRF)
유현지

11:00-11:10 | Bitterness characterization of structurally distinct food flavonoids across concentration and preparation contexts
이나원

11:10-11:20 | Consumer-perceived sensory direction in grape tomatoes: cross-format convergence and paired-descriptor response patterns
양시윤

기조강연 1

장소 211호 좌장 민세철 (서울여자대학교)

13:30~14:10 **[학회 창립 30주년 기념 강연] 토기와 한민족 선사 음식문화**
이철호 (고려대학교)

토기와 한민족 선사 음식문화

CURRICULUM VITAE



이 철 호

근무처
- 고려대학교 식품공학과 명예교수

학력
- 고려대학교 농화학과 (농학사)
- 덴마크 왕립수의농과대학 식품저장학교실 (Ph.D.)

경력
- 미국 MIT공과대학 식품영양학과 Postdoc 연구원
- 고려대학교 식품공학과 부교수, 교수
- (재)한국식량안보연구재단 이사장, 명예이사장

주요활동
- IUFoST 제 11차 세계식품과학기술대회 사무총장
- Codex 제15차 아시아지역조정위원회 의장
- 한국콩박물관건립추진위원회 위원, 제3대 위원장
- 한국산업식품공학회, 한국미생물생명공학회, 한국식품공학회, ILSI Korea 회장
- 한국과학기술한림원 정회원, 종신회원
- 미국 식품공학회(IFT) Fellow

수상
- 2010. 한국식품과학회 학술대상
- 2009. 홍조근정훈장 서훈
- 1998. 국민훈장 석류장 서훈

기타
- 단행본(단독/공저) 30여권 출판, 연구논문 270여 편 발표.

ABSTRACT

우리나라 식품사(食品史) 연구의 과거와 현황을 개관하고, 한민족 음식문화의 기원과 초기 발달사를 식품과학과 인류학적 관점에서 고찰한다. 한반도는 신석기 초기(1만년 전) 토기음식문화의 발상지일 가능성에 대하여 논하고, 서양의 구이문화와 동양의 끓임 문화를 구분하는 분기점이었음을 논증한다. 토기는 인류가 만들어낸 최초의 생물반응기(bioreactor)이다. 한반도 대한해협연안의 초기 신석기인들은 토기를 이용하여 해산물을 끓임으로써 식량자원의 가용성과 저장성을 획기적으로 높였으며 토기에 물기 많은 음식을 저장하면서 발효 기술을 터득하였다. 한반도에 산재해 있는 오래된 패총(조개무덤)에서 신석기 초기의 토기 조각들이 지층에 따라 시대별로 발굴되고 있으며 찌개용 뚝배기, 발효용 항아리, 저장용 독 등이 확인되고 있다. 한반도 원시토기문화는 찌개를 주식으로 하는 식생활로 특징지을 수 있으며, 농경사회(기원전 5천년-)가 발전하여 곡물 생산이 많아지면서 찌개→ 죽→ 밥 문화로 전개되었다고 본다. 해변의 채집자들이 토기에 바닷물을 담아 찌개를 끓이면 그릇 주변에 돋아나는 소금 결정을 발견하게 되므로 신석기 초기에 이미 소금 제조법을 알게 되었을 것이며, 이를 이용한 염장 발효 기술은 김치, 젓갈, 자반 등 한민족 전통음식으로 남아 있다. 찌개가 한민족의 가장 중요한 주식이었으므로 신석기 말 콩 재배가 시작되면서 찌개의 맛을 내기 위한 조미용 콩 발효식품(된장, 간장, 청국장 등)이 크게 발전하였다. 토기를 이용한 콩 음식의 일반화는 초기 신석기인들의 영양과 식품 안전·위생을 획기적으로 증진시켜 인구의 증가와 지능과 체력의 향상으로 동아시아 최초의 국가 '고조선'(기원전 2333년) 문명을 탄생시키는 원동력이 되었다. 기원전 7세기에 고조선문명권에 있던 산융(山戎)에서 재배 콩(大豆)이 중국 제(齊)나라에 전래되면서 콩 가공기술(장류, 두부 등)도 함께 전파되었다. 기원전 3-4 세기에는 콩 재배 이용 기술이 일본과 남중국으로 전파되어 한민족 선사 음식문화는 동북아시아 끓임·발효 문화(쌀밥과 콩장)의 기초가 되었다.

S1

다기능 탄소나노점의 맞춤형 활용기술 개발

후원: 고려대학교 탄소나노점-AI 융복합 연구사업단

장소 211호 좌장 이정수 (부산대학교)

14:20-14:45 | Development of carbon, sulfur, and zinc quantum dots-based active and intelligent food packaging materials
김준태 (경희대학교)

14:45-15:05 | 탄소나노점을 활용한 생분해성 다기능 식품포장재 개발
한재준 (고려대학교)

15:05-15:25 | 기능성 성분 전달시스템을 위한 탄소나노점의 표면기능화 연구
이민혁 (고려대학교)

15:25-15:50 | Machine-learning framework for property prediction and optimization of carbon nanodot synthesis
손홍석 (고려대학교)

Development of carbon, sulfur, and zinc quantum dots-based active and intelligent food packaging materials

CURRICULUM VITAE



김 준 태

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경력
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• 계명대학교 식품가공학과 조교수/부교수
• 한국과학기술연구원(KIST) 연구원
• Cornell University, Postdoctoral Researcher

주요활동
• 2025.01~현재. 한국포장학회지 편집위원장
• 2021.01~현재. 국립환경과학원환경표준심의회의 포장환경성 전문위원
• 2021.01~현재. ISO/TC122/SC4 및 ISO/TC315 전문위원회 위원
• 2020.08~현재. 식품의약품안전처 식품위생심의위원회 위원
• 2013.01~현재. (사)한국포장학회 학술/총무/수석/부회장

수상
• 2026.06. 2025년도 Kyung Hee Fellow (연구) 선정
• 2026.05. 식품의약품안전처장 표창장
• 2025. 세계 상위 2% 연구자 선정
• 2023.04. 식품의약품안전처 연구개발사업 우수성과 장려상

ABSTRACT

This study presents a process for developing multifunctional, active, and intelligent food packaging materials by incorporating carbon-, sulfur-, and zinc-quantum dots(CQDs, SQDs, and ZnQDs) into a biopolymer matrix. Nanocomposite films were synthesized, and their physical, active, and optical sensing properties were comprehensively evaluated. The introduction of QDs significantly enhanced the matrix's UV blocking ability, thermal stability, and mechanical strength. As an active packaging platform, the QDs-functionalized film exhibited excellent antioxidant activity and potent antimicrobial effects against major foodborne pathogens. As an intelligent monitoring platform, the unique fluorescence properties of the quantum dots enabled sensitive optical responses, displaying distinct fluorescence extinction and color changes induced by pH changes and bio-volatile amines released during food spoilage. Collectively, this study demonstrates that QDs-based nanocomposite films possess promising potential as an eco-friendly and dual-functional packaging strategy capable of extending food shelf life and visually evaluating food quality in real time.

탄소나노점을 활용한 생분해성 다기능 식품포장재 개발

CURRICULUM VITAE



한 재 준

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수상
• 2025.07. 오뚜기함태호학술상 수상
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ABSTRACT

본 연구에서는 액티브 식품포장 소재를 은행나무잎 기반 탄소나노점(gCD)과 옥수수전분(CS)으로부터 제조하였다. 먼저 은행나무잎(GBL)을 바이오매스 유래 탄소 전구체로 사용하여, 수열합성법을 통해 친환경적인 탄소점(CDs)을 합성하였다. 이렇게 합성한 GBL 기반 탄소나노점(gCDs)의 특성을 분석한 후 압출 공정을 통해 CS 고분자 매트릭스에 혼입하여 CS/gCD 나노복합 필름을 제조하였다. 다양한 gCD 농도가 CS/gCD 복합 필름의 물리화학적·기능적 특성에 미치는 영향을 체계적으로 조사하였다. gCD는 최대 1000 μg/mL 농도까지 Caco-2 세포에 대해 세포독성을 나타내지 않았다. CS 필름에 gCD를 첨가한 결과 기계적 물성이 향상되었으며, 특히 CS/gCD2% 나노복합 필름의 인성(toughness)은 CS 필름 대비 198% 우수한 것으로 나타났다. 또한 산소 차단성 및 자외선 차단 특성도 크게 개선되었다. 더 나아가, CS/gCD 나노복합 필름은 gCD의 우수한 항산화 활성 덕분에 오메가-3 오일의 저장 수명을 유의미하게 연장시켰으며, 15일간의 저장 기간 동안 과산화물가가 단 9 meq/kg에 불과하였다. 본 연구 결과는 개발된 CS/gCD 활성 복합 필름이 식품 저장 수명 연장과 식품 폐기물 감소를 위한 환경친화적이고 지속가능한 솔루션의 유망한 후보가 될 수 있음을 보여준다.

기능성 성분 전달시스템을 위한 탄소나노점의 표면기능화 연구

CURRICULUM VITAE



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기타
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• (논문) Emulsion-loading-driven transitions in microstructure and release kinetics of sodium alginate films incorporating a succinylated pea protein–stabilized cinnamon essential oil Pickering emulsion. *International Journal of Biological Macromolecules*, (2026), 360, 151930.
• (논문) Enhanced emulsion stability through synergistic interactions in ternary Maillard conjugates of soy protein isolate, maltodextrin, and gum Arabic. *Food Chemistry*, (2025), 496, 146933.

ABSTRACT

Carbon nanodots(CNDs) have emerged as promising nanomaterials for biomedical and functional applications because of their small size, high surface-to-volume ratio, favorable biocompatibility, and readily tunable surface chemistry. In particular, the abundant surface functional groups of CNDs provide opportunities to modulate their physicochemical properties and interactions with functional compounds, highlighting their potential as versatile platforms for delivery applications. However, the surface chemistry of CNDs is strongly influenced by precursor composition and synthesis conditions, and systematic strategies for controlling and functionalizing their surface properties are still required to enable tailored delivery functions. In this study, we investigate surface engineering strategies for CNDs with the long-term objective of developing delivery systems for functional compounds. Biomass-derived precursors and nitrogen- or sulfur-containing compounds are employed to tailor the formation process and surface functional-group characteristics of CNDs through controlled hydrothermal synthesis. The effects of precursor composition, supplementation with functional molecules, and synthesis conditions on elemental composition, surface functional groups, charge characteristics, and accessible reactive groups are evaluated using complementary physicochemical analyses. Particular attention is given to the modulation and preservation of nitrogen- and sulfur-containing functional groups, as these surface characteristics may influence the interactions of CNDs with functional compounds and their subsequent loading and delivery behavior. The resulting CNDs are further characterized in terms of particle size and morphology, optical properties, and antioxidant activity to establish relationships between synthesis conditions, surface chemistry, and functional properties. This study aims to provide fundamental insights into the controlled surface functionalization of CNDs and to establish a basis for designing CNDs with tailored interfacial properties. Although the development of functional compound delivery systems is still ongoing, the present work explores key surface engineering strategies required to control the interactions between CNDs and target compounds. These findings will contribute to the future development of surface-functionalized CND platforms for the loading, stabilization, and delivery of bioactive compounds.

Machine-learning framework for property prediction and optimization of carbon nanodot synthesis

CURRICULUM VITAE



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ABSTRACT

Carbon nanodots(CNDs) possess tunable optical properties, but their synthesis is difficult to optimize because synthesis variables interact nonlinearly. In this study, we developed a machine-learning framework to predict CND properties from synthesis conditions and identify conditions suitable for targeted performance. An experimental database integrating precursor composition, concentration, pH, temperature, reaction time, and other process variables with optical and physicochemical properties was constructed. Multiple regression algorithms, including random forest, gradient boosting, support vector regression, and Gaussian process regression, were evaluated using batch-aware cross-validation. Model interpretation was performed using feature-importance and SHAP analyses to identify influential synthesis variables and their interactions. The optimized model captured relationships between synthesis conditions and CND properties and was combined with constrained Bayesian optimization to generate experimentally feasible candidate conditions. The resulting framework enabled data-driven prediction and optimization while reducing dependence on empirical trial-and-error. This study demonstrated the potential of interpretable machine learning as a practical tool for guiding CND synthesis and supporting iterative improvement through additional experimental data.

S2

글로벌 기준규격과 규제 동향

후원: 한국식품산업협회

장소 314호 좌장 최수진 (서울여자대학교)

14:20-14:50 | **CODEX 가공과채류분과위원회(CCPFV) 소개 및 운영 방향**
박재우 (식품의약품안전처)

14:50-15:20 | **한국 식품산업의 EU PPWR 대응: 식품포장 특화 표준 가이드라인의 핵심과 실무**
이주형 (법무법인광화문)

15:20-15:50 | **MAHA 정책과 기능성식품 산업의 변화와 전망**
이종훈 (가천대학교)

CODEX 가공과채류분과위원회(CCPFV) 소개 및 운영 방향

CURRICULUM VITAE



박 재 우

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경력
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주요활동
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수상
- 2026. 제1차 공무원 특별성과 포상

기타
- Park JW, Park JS, Jung DK, Song SO,Woon JH, Kim JM and Wee SH. The Analysis for Trans Fatty Acids in Dairy Products Imported to Republic of Korea. Korean J. Food Sci. Ani. Resour. 31(3): 477-483, 2011

ABSTRACT

1964년 설립된 Codex 가공과채류분과위원회(CCPFV)는 김치·고추장·인삼제품 등 우리 전통식품과 밀접한 관련이 있는 Codex(국제식품규격위원회) 산하 분과위원회이다. 지난 60여 년간 운영되어 온 CCPFV는 2025년 11월 제48차 Codex 총회에서 대한민국이 미국으로부터 의장국 지위를 정식 이관 받으며 새로운 전환점을 맞이하였다. 대한민국은 의장국 수임에 발맞춰 2026년 3월 CCPFV 사무국 설치 및 운영 규정을 제정하고, 의제 대응단, 의제 대응 거버넌스, CCPFV 운영자문, 사무국 운영지원의 체계를 구축했다. 아울러 정부·연구기관·전문기관·산업계·학회 등 15개 기관이 참여하는 민관 협력 거버넌스를 통해 의제 발굴과 Codex 회의 대응전략을 상시적으로 수립하고 있다. CCPFV의 중요성은 최근 글로벌 시장 환경에서도 뚜렷하게 뒷받침된다. 글로벌 가공과채류 시장은 2026년 4,176억 달러에서 2035년 6,206억 달러로 연평균 4.5% 성장할 전망이며, K-푸드 수출 역시 2025년 1~9월 누계 84.8억 달러로 9년 연속 증가세를 기록하고 있다. 특히 소스류(고추장·된장 등)와 같은 복합 가공식품은 국제 규격 제정 여부가 수출 경쟁력에 직결되므로 CCPFV 의장국 수임의 전략적 가치는 매우 크다. 2026년 7월 제49차 Codex 총회에서 의장국인 대한민국의 주도로 6년 만에 CCPFV 정식 활동 재개가 확정되었으며, 서류분말류, 캐슈너트 등 2건의 신규작업 승인과 함께 분과위원회의 업무범위(Terms of Reference) 현행 유지가 결정되었다. 향후 CCPFV는 C(과학 기반 기준)·C(회원국 균형과 포용성)·P(실용적·예측가능한 운영)·F(미래 지향적 대응)·V(무역·소비자 가치)의 'CCPFV 5대 추진 전략'을 바탕으로 운영된다. 2026년 조직·제도 정비를 시작으로, 2027~2028년 제30차 CCPFV 대한민국 개최를 통한 회의 정상화, 2029년 이후 우리나라 전략품목의 국제규격 선점이라는 단계적 로드맵을 이행하여 국제 식품 규격 분야에서 대한민국의 리더십을 확고히 하고자 한다.

한국 식품산업의 EU PPWR 대응: 식품포장 특화 표준 가이드라인의 핵심과 실무

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- 전) 중앙대학교 대학원 식품안전규제과학과 겸임교수

주요활동
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- 현) 중소벤처기업부 중소기업 규제영향평가 자체점검위원회 위원
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기타
- 현) 월간포장 「수출 마스터 이주형의 PPWR 실전 솔루션」 연재
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- FSPCA PCQI·FSVP-QI, ServSafe Food Protection Manager 자격 취득

ABSTRACT

EU 포장 및 포장폐기물 규정(Regulation(EU) 2025/40, PPWR)은 2025년 2월 11일 발효되어 2026년 8월 12일부터 적용되고 있다. 기존 Directive 94/62/EC를 대체하는 PPWR은 포장의 물질요건, 재활용성, 재생원료 사용, 포장 최소화, 표시, 적합성평가 및 공급망 정보관리 등을 포괄하는 통합적인 규제체계를 구축하고 있으며, 각 요건은 규정에서 정한 일정에 따라 단계적으로 적용된다. 특히 식품산업에서는 PPWR의 포장 일반요건과 기존 EU 식품접촉재료(food contact materials, FCM) 규제가 함께 적용된다는 점에서 체계적인 대응이 필요하다. 2026년 8월 12일부터 적용되는 식품접촉포장의 PFAS 제한(제5조 제5항)은 대표적인 사례로, EU 집행위원회의 이행 가이던스에 따르면 적용일 이전에 생산된 재고에 대해서도 별도의 소진 유예기간이 인정되지 않으며, 적용일 이후 EU 시장에 최초로 출시되는 식품접촉포장은 관련 기준을 충족하여야 한다. 아울러 제조자는 제15조 및 부속서 VII에 따라 해당 시점에 적용되는 PPWR 요건에 대한 적합성평가와 기술문서의 작성·보관 체계를 갖추고, 적합성이 입증된 포장에 대해서는 제39조 및 부속서 VIII에 따른 EU 적합성 선언을 작성하여야 한다. 이에 따라 식품기업은 용기·뚜껑·필름·라이너·라벨·단상자·완충재·운송포장 등 다양한 포장 구성요소의 적용요건과 공급망 자료를 제품 단위에서 체계적으로 관리할 필요가 있다. 본 발표에서는 한국식품산업협회의 연구용역을 통해 마련한 식품포장 특화 표준 가이드라인의 기본 구조와 주요 내용을 소개한다. 가이드라인은 개별 식품제품의 포장구조와 구성부품을 식별하고, 기업의 경제운영자 지위와 포장별 적용요건을 판단한 후, 공급망으로부터 필요한 재질·조성·시험·적합성 정보를 확보하여 규제요건과 연결할 수 있도록 하는 실무적 접근방법을 제시한다. 또한 포장재 명세와 구성정보, 적용요건, 근거자료(evidence), 미확인사항(gap), 기술문서(technical documentation) 및 적합성 선언(declaration of conformity)을 상호 연계함으로써 제품별 적합성 입증과 변경관리가 가능하도록 하는 문서관리 체계를 제안한다. 아울러 실제 식품포장에 가이드라인을 적용하는 과정을 중심으로 포장구조 파악 → 적용요건 판정 → 공급망 자료확보 → 적합성 근거관리 → 기술문서 및 적합성 선언 작성으로 이어지는 실무 절차와 주요 쟁점을 살펴본다. 이를 통해 PPWR 대응은 특정 시험성적서를 확보하거나 개별 법조항을 확인하는 데 그치는 것이 아니라, 포장 설계·공급망 정보·적합성 증빙 및 기업 내부 문서관리 체계를 지속적으로 연결하는 규제준수 시스템을 구축하는 과제임을 제시하고자 한다.

MAHA 정책과 기능성식품 산업의 변화와 전망

CURRICULUM VITAE



이 종 훈

근무처
- 가천대학교 식품생명공학과

학력
- Ph. D., Rutgers Univ. Dept. of Food Science
- 연세대학교 의과대학 의학공학교실 석사
- 연세대학교 공과대학 생명공학과 학사

경력
- 가천대학교 식품생명공학과 조교수, 부교수, 교수
- 차 의과학대학교 식품생명공학과 조교수

주요활동
- 산업식품공학회 재무 운영위원
- 한국식품과학회 학술 운영위원
- 한국식품과학회 사업 운영위원

ABSTRACT

The Make America Healthy Again(MAHA) initiative, launched in 2025 to address childhood chronic disease, is reshaping U.S. food and dietary supplement policy. The FDA's 2026 priorities include food-chemical safety, a proposed mandatory notification system for newly claimed Generally Recognized as Safe(GRAS) substances, replacement of petroleum-based synthetic dyes, development of a federal definition of ultra-processed foods, and consideration of front-of-package nutrition labeling. Dietary supplement oversight is also being modernized by clarifying existing new dietary ingredient(NDI) notification requirements and expanding risk-based enforcement. These changes may raise compliance costs while strengthening demand for clean-label and scientifically substantiated ingredients. For Korea's functional food industry, the evolving regulatory environment presents both challenges and opportunities. Companies that improve safety documentation, reformulation capacity, and evidence-based labeling will be better positioned to compete in the U.S. market.

S3

직접 스팀 살균 기술을 이용한 고부가가치 식품 개발

후원: IPET 소스 살균 과제 연구팀

장소 315호 좌장 박성희 (서울과학기술대학교)

14:20–14:50 | **다이렉트 스팀 살균 기반 소스 기술 개발 현황 및 대상푸드플러스(주) 소개**

장경민 (대상푸드플러스㈜)

14:50–15:20 | **식품 가공시스템 설계 및 공정 조건 최적화 접근법**

이승현 (충남대학교)

15:20–15:50 | **직접증기주입 기술을 활용한 액상 식품 살균 식품공정 기술: 닭육수와 커피 우유 적용 사례**

심준보 (서울과학기술대학교)

다이렉트 스팀 살균 기반 소스 기술 개발 현황 및 대상푸드플러스(주) 소개

CURRICULUM VITAE



장 경 민

근무처
- 대상푸드플러스㈜

학력
- 순천대학교 식품영양학과 학사
- 서울과학기술대학교 식품공학과 석사 재학중

경력
- 대상푸드플러스 연구개발팀 대리 2년차

ABSTRACT

기존의 Indirect Steam Heating 기술을 대체할 수 있는 Direct Steam Injection(DSI) 기술을 개발함으로써 열화에 의한 품질 저하 현상을 개선하고 기존 열처리 기술 대비 동등한 살균 처리 수준의 살균력을 확보하면서 공정시간 단축을 과제 목표로 연구하고 있습니다. 대상푸드플러스㈜는 공동연구개발기관으로 DSI에 적합한 제품군을 선정하였고 선정된 제품에 대해 기존 가열 공정과 비교할 수 있는 기초데이터(가열조건, 미생물안정성, 이화학 등)를 확보하였습니다. 현장 실증을 통해 효율성 검증을 할 예정입니다. 이 과제를 통하여 열화에 의한 품질 저하를 최소화하여 고품질의 액상류 제품을 확보할 것으로 판단됩니다. 대상푸드플러스는 대상그룹의 추출/농축회사로 고효율의 추출농축액 가공 기술을 고도화하고 있습니다. 해당 기술을 적용하여 상용화한 주요 사례와 기존 대비 향상된 품질 성과를 공유하고, 향후 B2B 식품 시장에서의 발전 방향을 제시하고자 합니다.

식품 가공시스템 설계 및 공정조건 최적화 접근법

CURRICULUM VITAE



이 승 현

근무처
- 충남대학교 스마트농업시스템기계공학과

학력
- 2010.08~2014.08. University of Hawaii 공학박사, Molecular Biosciences and Bioengineering
- 2008.08~2010.08. University of Hawaii 공학석사, Molecular Biosciences and Bioengineering
- 2007.02. 충남대학교 생물자원공학부 생물산업기계 공학사

경력
- 2025.03~현재. 충남대학교 스마트농업시스템기계공학과 정교수
- 2024.06~현재. 충남대학교 그린바이오혁신융합대학사업단 부단장

주요활동
- 농림축산식품부 기획자문단
- 농촌진흥청 농업과학기술 연구개발사업 평가위원
- 농림축산식품부 과일 간식 가공업체 심사위원
- 한국식품연구원 기술자문 위원
- 한국농업기계학회 이사
- 한국정밀농업학회 편집위원

수상
- 2025. 농림축산식품부 장관 표창
- 2023. 충남대학교 우수강의 최우수상
- 2023. 충남대학교 우수 교육공무원 표창

기타
- NeoVitalink 대표이사

ABSTRACT

식품 가공공정은 원료의 특성, 가공조건, 장치의 구조 및 운전환경 등 다양한 요인이 복합적으로 작용하므로, 효율적인 공정 설계와 최적화를 위해서는 개별 요소뿐만 아니라 공정 전반을 종합적으로 고려하는 접근이 필요하다. 본 연구에서는 다양한 식품 가공공정에 적용할 수 있는 가공시스템의 설계 및 공정조건 최적화 접근법을 제시하고자 하였다. 식품 및 공정의 특성을 바탕으로 가공과정에 영향을 미치는 주요 요인을 분석하고, 가공 목적과 대상 식품에 적합한 시스템을 설계하였다. 또한 실험적 분석과 공학적 해석을 활용하여 공정조건에 따른 시스템의 거동과 식품의 품질 변화를 평가하고, 이를 바탕으로 공정 성능을 개선할 수 있는 조건을 검토하였다. 이러한 과정에서 식품의 품질과 안전성뿐만 아니라 처리효율, 에너지 이용 및 시스템의 안정적인 운전 등을 종합적으로 고려하였다. 결과적으로 식품과 공정에 대한 이해를 기반으로 시스템 설계, 공정 분석 및 실험적 검증을 상호 연계하는 접근은 다양한 식품 가공기술의 공정조건 설정과 성능 개선에 효과적으로 활용될 수 있다. 또한 이러한 접근법은 가열, 냉각, 건조, 살균 등 다양한 식품 가공공정의 개발과 산업적 적용을 위한 기초적인 방법론으로 활용될 수 있을 것으로 판단된다.

직접증기주입 기술을 활용한 액상 식품 살균 식품공정 기술: 닭육수와 커피 우유 적용 사례

CURRICULUM VITAE



심 준 보

근무처
- 서울과학기술대학교 식품생명공학과 박사과정

학력
- 2026.02. 서울과학기술대학교 식품생명공학과 박사수료
- 2016.02. 건국대학교 바이오산업공학과 석사
- 2014.02. 안양대학교 해양생명공학과 학사

경력
- 2019.10~2024.01. (주)다노 브랜드사업운영본부 팀장
- 2016.03~2019.08. (주)우양 중앙연구소 선임연구원

주요활동
- HMR 식품 개발 및 출시 36종
- 이너뷰티 식품 개발 및 출시 4종
- 건강기능식품 개발 및 출시 2종
- 오뚜기 콜라보 컵누들 개발 및 출시
- 현대그린푸드 콜라보 채식도시락 개발 및 출시

수상
- A study on the use of methyl cellulose in the production of plant-based meatball with ohmic and conventional cooking, 2025년 추계 산업식품공학회 우수포스터상 (공저자)
- Minimized use of gluten in the production of plant based meat analogue using ohmic cooking, 2025년 추계 산업식품공학회 우수포스터상 (공저자)
- Application of ohmic heating for pretreatment of tomato sauce before sterilization, 2024년 한국식품과학회 우수포스터상 (공저자)

기타
- 식품기술사

ABSTRACT

본 연구에서는 살균 과정 중 액상식품의 과도한 열처리에 의한 품질 저하를 최소화하기 위해 직접증기주입(direct steam injection, DSI) 기술을 닭육수와 커피우유에 적용하고 기존 레토르트 공정과 비교하였다. DSI는 포화증기를 식품에 직접 주입하여 응축 잠열을 전달함으로써 단시간에 목표온도까지 가열하는 공정이다. 닭육수의 경우 DSI 처리에서 레토르트와 동등한 열동등성 수준의 F_0값(16.47–17.65 min)을 확보하면서 승온시간과 살균시간을 크게 감소시켰다. 닭육수의 품질 지표와 관련하여 갈변과 향미 변화를 줄이고 유리아미노산 함량을 높게 유지하였다. 커피우유에서도 DSI는 레토르트보다 빠른 승온과 낮은 열노출량을 나타냈으며, 특히 135℃ 처리에서 레토르트와 유사한 F_0값을 확보하면서 입자 응집, 침전, 갈변 및 향기 변화를 감소시켰다. 또한 모든 열처리구에서 미생물이 검출되지 않았다. 이상의 결과를 통해 DSI는 필요한 살균효과를 확보하면서 누적 열노출을 줄여 액상식품의 품질 변화를 최소화할 수 있는 고온단시간 열처리 기술로 활용될 수 있을 것으로 판단된다.

S4

고부가가치 식품 공정 개발을 위한 식품 장치 산업의 역할

후원: ㈜경한, ㈜켐리시스, ㈜에코기어

장소 211호 좌장 반충진 (서울시립대학교)

16:00-16:30 | **K-푸드 수출을 위한 수확 후 저장 및 유통 혁신 기술: 천연 가식성 나노코팅**

박지훈 (㈜에코기어)

16:30-17:00 | **곡물·커피 로스팅의 장치 기술과 공정 제어: 드럼 및 열풍 로스팅을 중심으로**

정인석 (㈜태환자동화산업)

17:00-17:30 | **마이크로파를 활용한 식품 가공 및 건식 연속 살균/멸균**

정연실 (㈜비손테크인터내셔널)

K-푸드 수출을 위한 수확 후 저장 및 유통 혁신 기술: 천연 가식성 나노코팅

CURRICULUM VITAE



박 지 훈

근무처
- 이화여자대학교 과학교육과/㈜에코기어

학력
- KAIST 화학과 이학사
- KAIST 화학과 이학박사 (전공: 유기화학)

경력
- KAIST 자연과학연구소 연수연구원
- Georgia Institute of Technology, 화학생물분자공학 Postdoc
- 이화여자대학교 과학교육과 화학교육전공 부교수
- 이화여자대학교 기술지주회사 자회사 ㈜에코기어 대표이사

주요활동
- Nano Materials Science Youth Editorial Board (2023-2025)
- Early Career Advisory Boards for Chemistry – an Asian Journal (2020-2024)
- 한국천연고분자학회 국제 협력/교육운영위원
- 한국포장학회 학술이사

수상
- 2024. 농협중앙회 오픈이노베이션 NHarvest X 프로그램 최우수상
- 2024. 농촌진흥청장 농업기술산학협력 표창 (농업신기술확산 부문)
- 2022. 산업단지 오픈이노베이션 프로그램 우수상

ABSTRACT

최근 K-콘텐츠의 전 세계적 확산과 더불어 한국산 신선 농산물 및 가공식품(K-푸드)에 대한 글로벌 수요가 급증하고 있다. 그러나 신선 농산물은 수분 함량이 높고 조직이 연약하여 장거리 해상 및 항공 운송 과정에서 품질 열화 및 선도 저하라는 치명적인 한계에 직면해 있다. 이를 극복하기 위해 기존의 화학적 보존제나 비친환경 플라스틱 포장재를 대체할 수 있는 지속가능하고 안전한 수확후 관리(post-harvest management) 기술의 개발이 시급한 실정이다. 본 발표에서는 K-푸드 수출 물류의 패러다임을 전환할 혁신 기술로 '천연 가식성 나노코팅(edible nanocoating)' 시스템을 제안하고, 관련 최신 연구 동향과 식품공학적 적용 사례를 논의하고자 한다. 본 기술은 안전성이 입증된 천연 생체고분자 소재와 기능성 활성 물질들을 나노에멀전(nanoemulsion) 형태로 가공하여 농식품 표면에 초박막 코팅층을 형성하는 원리이다. 나노화 공정을 거친 코팅액은 입자의 비표면적이 극대화되어 미세한 굴곡이 있는 표면에도 균일하게 젖음성(wettability)을 나타내며, 투명도가 뛰어나 농식품 고유의 외관 품질을 훼손하지 않는다. 이렇게 형성된 가식성 나노코팅막은 선택적 기체 투과성을 지녀 농산물의 호흡 속도를 제어하고 에틸렌 가스의 작용을 억제함으로써 노화 및 숙성을 지연시킨다. 또한, 강력한 수분 장벽(moisture barrier) 역할을 수행하여 유통 중 발생하는 중량 감소와 시들음 현상을 방지하며, 나노 캡슐화된 천연 항균 물질의 서방형 방출(sustained release)을 통해 부패를 유발하는 곰팡이 및 병원성 미생물의 생육을 효과적으로 차단한다. 실제 적용 실험 결과, 나노코팅 처리된 신선 농식품은 무처리군 대비 저장 수명이 1.5~2배 이상 연장되었으며, 장기 저장 기간 동안에도 경도(firmness), 색도 및 핵심 영양 성분의 보존율이 통계적으로 유의미하게 향상되는 결과를 나타내었다. 결론적으로, 천연 가식성 나노코팅 기술은 수확 후 손실(post-harvest loss)을 획기적으로 낮추어 물류비용 절감 및 K-푸드의 글로벌 수출 경쟁력 강화에 직접적으로 기여할 수 있는 핵심 공학 기술이다. 나아가 글로벌 수입국의 엄격한 식품 안전 기준 및 친환경·탈플라스틱 규제에 선제적으로 대응할 수 있는 지속 가능한 솔루션으로서, 향후 다양한 고부가가치 K-푸드 품목으로의 확장 및 산업적 상용화가 강하게 기대된다.

곡물·커피 로스팅의 장치 기술과 공정 제어: 드럼 및 열풍 로스팅을 중심으로

CURRICULUM VITAE



정 인 석

근무처
- ㈜태환자동화산업

학력
- University of California, Los Angeles (UCLA)
  (Microbiology, Immunology & Molecular Genetics)

경력
- 현) ㈜태환자동화산업 이사
- 전) M&H 해외영업 이사
- 전) ㈜스페이스링크 해외영업 팀장

주요활동
- 국제무역전문가과정 (수출역량강화사업) – 중기부 & 벤처기업협회
- 한중 FTA 종합실무 교육 –중국시장의 이해와 마케팅전략 – 서울중기청
- 전) 벤처기업협회 벤처마케팅포럼 해외판로위원
- 한국스카우트연맹 스카우트 지도자

ABSTRACT

로스팅은 곡물과 커피의 향, 색, 수분 및 조직 특성을 변화시키는 주요 열가공 공정으로, 장치의 구조와 열전달 방식에 따라 공정 특성과 결과가 달라질 수 있다. 본 발표에서는 드럼 로스터와 열풍 로스터를 중심으로 각 방식의 기본적인 장치 구조와 열전달 특성을 비교하고, 온도, 열투입, 풍량, 혼합 및 체류시간 등 주요 공정변수와 제어 방법을 살펴본다. 또한 곡물과 커피의 원료 특성에 따른 로스팅 조건의 차이와 산업 현장에서의 균일성, 재현성 및 스케일업의 중요성에 대해 소개하고자 한다.

마이크로파를 활용한 식품 가공 및 건식 연속 살균/멸균

CURRICULUM VITAE



정 연 실

근무처
• ㈜비손테크인터내셔널

학력
• 서울과학기술대학교 전자공학과
• 성균관대학교 전력전자 대학원 수료

경력
• 2020~현재. ㈜비손테크인터내셔널
• 2004~2020. ㈜비손테크

주요활동
• 마이크로웨이브, RF 연구 개발
• 초고주파수를 이용한 고춧가루 살균 장치 개발 상용화
• 초고주파수를 이용한 연속 건조장치 개발 상용화
• 초고주파수를 이용한 연속 식품 해동장치 개발 상용화
• 초고주파수를 이용한 3D 프린팅 소성 장치 개발 상용화
• 초고주파수를 이용한 고품질 커피 건조장치 개발 상용화

기타
• 식품 제조 공정 혁신 관련 다양한 연구 개발 및 장치 개발
• 연속 건조, 해동, 살균 등 제조 자동화 공정 기술 개발

ABSTRACT

• **식품 건조**: 마이크로파를 이용한 연속 식품 건조장치 기술 소개. 30분 내외 빠른 건조로 인해 컨베어 연속 자동화 생산을 접목할 수 있습니다. 과일, 감자, 고구마, 미역등 다양한 식품에 활용 소개
• **식품 해동**: 영하 40도 이하의 냉동상태의 제품을 컨베이어를 통해 6분 내외로 해동 하는 기술 소개. 냉동육류 해동, 냉동 원액 해동, 냉동 식자재 해동 등
• **식품 살균**: 마이크로파 살균장치 기술소개, 포장 후 식품의 내부 까지 건식으로 빠르게 살균하는 기술, 고춧가루, 분말, 빵, 식품 첨가제, 등 다양한 제품에 적용 기술을 소개 합니다.

S5

AI·데이터 기반 식품위해예측과 디지털 식품안전관리의 미래

후원: 식품안전정보원

장소 314호 좌장 김해영 (경희대학교)

16:00-16:05 | **개회사** – 이재용 (식품안전정보원)
| **내빈 및 좌장 소개** – 방선녀 (식품안전정보원)

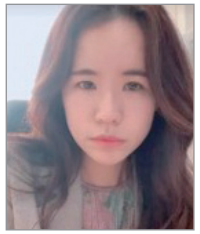
16:05-16:30 | **식품위해예측센터의 출범과 데이터 기반 식품안전관리의 발전방향**
배근휘 (식품안전정보원)

16:30-17:00 | **머신러닝을 활용한 식중독 미생물 예측 모델 개발**
김상순 (건국대학교)

17:00-17:30 | **AI·데이터 기반 원료부터 제품표시까지 통합 솔루션 구축**
엄태건 (㈜아워홈)

식품위해예측센터의 출범과 데이터 기반 식품안전관리의 발전방향

CURRICULUM VITAE



배 근 휘

근무처
- 식품안전정보원 위해예측센터 위해예측실

학력
- 고려대학교 대학원 소비자 및 광고심리 전공 석사 과정수료
- 홍익대학교 광고홍보학부 졸업

경력
- 현) 식품안전정보원 위해예측실장
- 전) 식품안전정보원 해외직구식품데이터부장
- 전) NHN SERVICES 네이버 디스플레이광고 상품기획 및 운영

주요활동
- 2026. AI·자동화 기반 해외직구식품 안전관리 디지털 전환 및 AX 혁신 과제 기획·추진
- 2025. 피지컬 AI 기반 해외직구식품 스마트 검사체계 기획·구축
- 2020. 식품안전 빅데이터 기반 잠재 위해이슈 탐지·분석 시스템 기획 및 정책활용 모델 개발

수상
- 2026. 대한민국 혁신대상 AI 혁신 분야 '대상' — 피지컬 AI 기반 해외직구식품 안전관리 혁신
- 2025. 제14회 대한민국 지식대상 행정안전부 '장관상' (우수상) — AI·자동화 기반 해외직구식품 안전관리 혁신

ABSTRACT

기후변화와 이상기후의 증가, 글로벌 식품 공급망 확대, 식품 생산·유통환경의 변화와 새로운 위해요인의 출현은 식품안전관리의 불확실성과 복잡성을 높이고 있다. 이에 따라 기존의 사전예방적 식품안전관리를 더욱 고도화하기 위해 다양한 데이터를 기반으로 위해 발생 가능성을 탐지·예측하고, 이를 실제 안전관리 의사결정에 활용할 수 있는 AI·데이터 기반 관리체계의 중요성이 커지고 있다. 2026년 식품위해예측센터는 기후·환경, 시험검사, 식중독 발생, 생산·유통 등 다양한 데이터를 연계하여 주요 위해요소 10종에 대한 AI 예측모델을 개발하고, 2025년 개발된 아플라톡신 예측모델을 고도화하고 있다. 이와 함께 AI 활용을 위한 데이터 기반을 마련하고, 예측결과를 위험지수·위험등급·위해예측 지도 등으로 시각화하여 실제 식품안전관리에 활용할 수 있는 정보제공 체계를 구축하고 있다. 그러나 AI 위해예측의 가치는 모델의 정확도만으로 완성되지 않는다. 중요한 것은 예측결과를 실제 식품안전관리의 의사결정과 행동으로 연결하는 것이다. 이에 위해예측센터는 고위험 품목·지역·시기를 사전에 포착하고, 예측정보를 검사대상 선정과 관리 우선순위 결정에 활용하며, 실제 검사결과와 후속조치를 다시 모델 개선에 활용하는 방향으로 정책 활용체계를 발전시키고자 한다. 향후에는 국내·외 위해정보와 행정데이터에서 위해신호를 탐지하고, 국내 영향을 분석하여 우선 검토대상을 제시하며, 정책담당자의 실제 조치를 지원하고 그 결과를 다시 데이터와 모델에 환류하는 연속적인 정책실행 지원체계로 발전하는 것을 지향한다. 이 과정에서 AI는 정책담당자의 전문적 판단을 대체하는 것이 아니라 분산된 데이터를 분석하고 판단에 필요한 우선순위와 근거를 제공하는 지원도구로 활용된다. 이는 기존에 추진되어 온 사전예방 중심의 식품안전관리를 AI와 데이터 기반으로 더욱 정교화·고도화하는 과정이다. 초기에는 정책담당자의 과학적인 검사·점검 및 관리 의사결정을 지원하고, 향후에는 영업자의 자율적인 위해예방 활동을 지원하며, 장기적으로는 국민이 일상에서 활용할 수 있는 식품안전 예방정보 서비스까지 단계적으로 확대하고자 한다. 본 발표에서는 식품위해예측센터의 출범과 현재 추진 중인 AI·데이터 기반 위해예측 사업을 소개하고, 데이터–예측–의사결정–실행–환류가 연결되는 디지털 식품안전관리체계의 발전방향을 제시한다. 이를 통해 정부의 정책실행, 산업현장의 자율예방, 궁극적으로 국민이 체감하는 식품안전 수준 향상으로 이어지는 미래 식품안전관리의 가능성을 논의하고자 한다.

머신러닝을 활용한 식중독 미생물 예측 모델 개발

CURRICULUM VITAE



김 상 순

근무처
• 건국대학교

학력
• 서울대학교 식품생명공학과 학사
• 서울대학교 식품생명공학과 석사
• 서울대학교 식품생명공학과 박사

경력
• 2019-2025. 단국대학교 식품공학과 조교수

주요활동
• 한국식품과학회 정보운영위원
• 한국식품과학회 영문지 편집위원
• 한국식품과학회 국문지 편집자
• 전국식품공학교수협의회 이사
• 한국식품저장유통학회 정보운영위원

수상
• 한국식품과학회 학술지 우수 편집자
• 한국식품과학회 학술지 우수 논문 심사위원
• 한국식품저장유통학회 우수연구자상

ABSTRACT

In this study, machine learning was used to predict Bacillus cereus growth trends across various food matrices using data from the ComBase database. The developed framework features a predictive model for log growth values and a classification model for risk assessment developed using the Neural Designer and Colaboratory(Colab) platforms. The data quality was improved through k-means clustering and Density-Based Spatial Clustering of Applications with Noise(DBSCAN) for filtering, whereas dimensionality reduction via principal component analysis, followed by DBSCAN facilitated better outlier detection. To effectively capture microbial growth dynamics, mathematical models such as the Gompertz and Double Weibull models were integrated into the machine learning pipeline. Experimental validation confirmed the practical utility of the model and demonstrated its ability to predict B. cereus growth under diverse conditions.

AI·데이터 기반 원료부터 제품표시까지 통합 솔루션 구축

CURRICULUM VITAE



엄 태 건

근무처
- ㈜아워홈 품질경영부문

학력
- 충남대학교 식품공학과 학사 (2007년 졸업)

경력
- 2024.09~현재. ㈜아워홈 품질경영부문장 – 품질 및 식품안전 관리 총괄– 식품안전 LAB 업무총괄 (KOLAS, 식품위생검사기관 등) – GFSI승인인증(FSSC22000 등) 및 HALAL 등 기획 및 운영 총괄
- 22.01~24.08. ㈜아워홈 품질기획팀장

주요활동
- 2026. 에이전트 AI기반 식품안전 신속검사 시스템, 산통부
- 2024. VisionAI 식재검품/검수시스템개발 및 MES연계, 과기부
- 2022~2023. Farm to Meal Care 디지털클러스터, PM, 중소벤처기업부
- 2012~2014. 한식할랄인증을위한제품/메뉴개발, 연구원,농림축산식품부

수상
- 2023. 식품의약품안전처 처장상, HACCP확산 기여
- 2015. 농림축산식품부 장관상, 한식세계화 기여

기타
- 할랄식품전문위원 (KS규격) (2022~2023)
- 식약처 위해예방관리계획 민간자문위원 (2016~2018)
- FSSC22000/HACCP 심사원

ABSTRACT

기후변화, 글로벌 공급망의 복잡성 심화, 급변하는 식품안전 규제 환경 속에서 사후 대응 중심의 전통적 품질관리는 명확한 한계에 직면해 있다. 아워홈은 이러한 패러다임 전환에 발맞추어 디지털 전환(DX)을 넘어 인공지능 전환(AX)을 식품안전 및 품질·위생 전반에 접목하며 선제적 예방 체계로의 혁신을 가속화하고 있다. 본 발표에서는 아워홈이 K-급식과 Supplier현장에 구축·적용 중인 핵심 AI 솔루션의 실제 적용 사례를 공유하고, 데이터 기반 디지털 식품안전관리의 미래 비전을 가속화 하고 있다. 우선 복잡한 법적 표시 규제와 마케팅 리스크를 최소화하기 위해 개발된 'AI 표시·광고 검증 솔루션' 구축 사례를 소개한다. 법령 및 가이드라인 데이터를 학습한 AI 모델을 통해 인적 오류를 줄이고 검토 효율성을 획기적으로 개선한 성과를 다룬다. 연계하여 현장의 입출고 검사는 2024년 본격 도입된 'AI 비전 기반 원료 검수·검품 시스템'과 '글로벌 표준 오딧(Audit) 디지털화' 모델을 살펴본다. 컴퓨터 비전 기술을 활용해 원료의 외관 결함, 이물, 신선도를 입고 단계에서 실시간 판별하는 자동화 프로세스와, 해외 소싱처 및 생산 거점을 체계적으로 점검할 수 있는 데이터 기반의 표준화된 글로벌 품질 감사 체계를 강화하고자 한다. 마지막으로 기후위기와 연계한 'AI 기반 선제적 위해예측 시스템'을 다룬다. 이상기후 및 환경 변화 데이터를 공급망 품질 데이터와 결합하여 원료별 미생물 증식 위험도, 곰팡이독소 발생 가능성 등 잠재적 리스크를 사전에 예측하고 선제 차단을 위한 빅데이터를 강화하고 있다. Smart LIMS와 연계하여 실제 예방적 안전성 검사를 진행하고 제어하는 공급망과 최종소비자까지의 value-chain의 신뢰성 있고 투명한 안전성 관리를 추진하고자 한다. 현장 데이터와 AI 기술의 유기적 결합이 어떻게 식품 위해 요소를 조기에 차단하고 품질 신뢰도를 높이는지 아워홈의 실증 경험을 바탕으로 설명하고 공유함으로써 향후 식품산업 전반이 지향해야 할 자율적·지능형 식품안전 생태계 확산을 기대하고 있다.

S6

AI가 바꾸는 식품산업: 식품 R&D부터 스마트 품질관리까지

후원: ㈜풀무원

장소 315호 좌장 강태영 (충남대학교)

16:00-16:30 | **Next-generation alternative seaweed meat manufacturing using AI-Driven 3D robotic food printing**
김상오 (단국대학교)

16:30-17:00 | **From bytes to bites: AI-Driven design from food data**
이수용 (세종대학교)

17:00-17:30 | **차세대 Food Structure 설계를 위한 식품 도메인-AI 융합 방법론: 해조류 추출 조건 최적화 및 HMMA 물성 예측 모델 구현**
한정우 (경희대학교)

Next-generation alternative seaweed meat manufacturing using AI-Driven 3D robotic food printing

CURRICULUM VITAE



김 상 오

근무처
• 단국대학교 식품공학과

학력
• 서울대학교 식품생명공학전공 농학박사
• 서울대학교 식품공학 농학석사
• 서울대학교 식품공학 농학사

경력
• 2024.09~현재. 단국대학교 식품공학과
• 2020.03~2024.08. 상명대학교 식품공학과
• 2004.05~2020.02. 엘지전자 HA연구소

주요활동
• 2021~2024, 2026~현재. 한국산업식품공학회 운영위원
• 2024. 한국식생활교육학회 운영위원
• 2022~2025. 한국식품과학회 운영위원
• 2023~현재. 식공간학회 운영위원
• 2022~현재. 대한지역사회영양학회 운영위원
• 2021~현재. 한국급식외식위생학회 운영위원
• 2021~2023. 한국식품저장유통학회 운영위원

수상
• 제28회 농림축산식품 과학기술대상 장관표창
• 제33회 과학기술우수논문상

ABSTRACT

This study presents an AI-driven 3D robotic food printing platform for next-generation alternative seaweed meat manufacturing. The system integrates a six-degree-of-freedom(6-DOF) robotic arm, teaching-based trajectory control, AI-based pattern recognition, and precision food extrusion. Teaching trajectories for various geometric patterns were collected and utilized to develop flexible robotic motion control for complex food structures. In parallel, a multi-material extrusion system combining motor-driven plunger feeding with screw-based precision extrusion was developed to improve the stable delivery of high-viscosity food materials and enable layered and multi-material structures. The integration of AI, robotic manipulation, and precision extrusion provides a flexible approach for controlling the shape and structural characteristics of alternative seaweed meat. This platform demonstrates the potential of intelligent 3D food printing for customized food design, automated process control, and next-generation smart food manufacturing.

From bytes to bites: AI-Driven design from food data

CURRICULUM VITAE



이 수 용

근무처
• 세종대학교 식품생명공학과

학력
• 2000~2003. Purdue Univ 식품공학 박사
• 1998~2000. 서울대학교 식품공학 석사
• 1992~1998. 서울대학교 식품공학 학사

경력
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• 2020~2021. 세종대학교 연구처장 및 산학협력단장
• 2012~2013. Wheat Marketing Center, USA, 방문교수
• 2003~2006. 미국 농무성 Research Food Technologist

주요활동
• 2026~현재. Food Science and Biotechnology, Senior Editor
• 2025. 한국산업식품공학회 학술/총무/감사/운영위원장
• 2023. 한국식품과학회 학술위원
• 2018~현재. 농촌진흥청 국립식량과학원 현장명예연구관
• 2019~2020, 2025. 전국식품공학교수협의회 이사

ABSTRACT

The growing availability of food-related data is creating new opportunities for artificial intelligence to contribute to the development of innovative food products. From compositional and physicochemical properties to processing parameters and sensory characteristics, diverse forms of food data can now be transformed into meaningful information through data-driven modeling. However, the potential of artificial intelligence extends beyond identifying patterns or predicting individual product attributes. This presentation will discuss the pathway from digital data to practical food products, illustrating how artificial intelligence can support the transformation of experimental knowledge into actionable design decisions. This data-to-design perspective may enable more efficient exploration of formulation and processing variables and facilitate the development of food products with desired characteristics. AI-driven food design has the potential to bridge the gap between computational prediction and real-world food innovation, opening new possibilities for the development of next-generation food products.

차세대 Food Structure 설계를 위한 식품 도메인–AI 융합 방법론: 해조류 추출 조건 최적화 및 HMMA 물성 예측 모델 구현

CURRICULUM VITAE



한 정 우

근무처
• 경희대학교 식품생명공학과

학력
• 2020.02. 서울대학교 농생명공학부 농학박사
• 2011.08. 서울대학교 식품생명공학전공 농학사

경력
• 2026.03~현재. 경희대학교 조교수
• 2023.03~2026.02. 덕성여자대학교 식품영양학과 조교수
• 2021.09~현재. Founder & CEO in ㈜제타푸드랩
• 2020.03~2023.02. 서울대학교 식품바이오융합연구소 연구교수

주요활동
• 2026.01~현재. Food Science and Biotechnology, editor
• 2026.01~현재. 식품과학과 산업 editor
• 2025.01~현재. 산업식품공학회지 editor
• 2025.01~현재. 산업식품공학회 임원 (해외)
• 2024.01~현재. 월드푸드테크협의회 대체단백질 연구그룹장

ABSTRACT

Next-generation food structure research requires a systematic understanding of how raw-material characteristics and processing history are translated into macroscopic functionality. In this work, artificial intelligence(AI) is used not as an independent modeling objective, but as an analytical tool for addressing scientific questions originating from the food domain. Food scientists first define the relevant hypotheses, material descriptors, processing variables, and functional responses, while AI researchers collaborate in translating these relationships into analyzable data structures and identifying meaningful multivariate associations. The resulting outputs are subsequently interpreted and validated from a food-science perspective. One representative study focuses on polysaccharides extracted from different seaweed species under varying processing conditions. Rather than simply maximizing extraction yield, the study investigates how extraction history modifies molecular and compositional characteristics, including molecular-weight distribution, sulfate and uronic-acid contents, and monosaccharide composition, and how these changes are reflected in rheological and gelation behavior. AI-assisted data integration is used to identify the molecular characteristics most strongly associated with rheological fingerprints and gel functionality, thereby establishing links among seaweed source, extraction conditions, molecular characteristics, and gelation behavior. A second application addresses high-moisture meat analogue(HMMA) structuring using diverse plant-protein materials. Plant proteins are characterized in terms of their physicochemical properties, such as composition, solubility, water-binding behavior, particle characteristics, and thermal properties, together with rheological responses during heating, holding, and cooling. These material-level descriptors are then integrated with HMMA properties, including hardness, chewiness, tensile behavior, anisotropy, and texturization characteristics. AI tools are used to determine which combinations of physicochemical and rheological descriptors are most strongly associated with the development of desirable HMMA structures. Importantly, this approach seeks to move beyond comparisons based solely on protein source and instead establish transferable material property–rheology–HMMA structure relationships that can support the screening of new protein ingredients and prediction of their structuring potential. Together, these studies illustrate a hypothesis-driven and integrative approach in which AI extends food-science reasoning by connecting complex experimental variables, identifying hidden multivariate relationships, and supporting more rational design of next-generation food structures.

S7

HMR 식품 생산기술 고도화 전략

후원: 정푸드코리아

장소 211호 좌장 목진홍 (동국대학교)

10:00-10:30 | **HMR 식품의 최신 가공기술 동향: 전처리, 살균, 건조 및 냉동**
조원일 (동원F&B)

10:30-11:00 | **Supercooling and superchilling storage processes as alternatives to freezing for food freshness retention**
강태영 (충남대학교)

11:00-11:30 | **조합가공기술을 활용한 고품질 HMR 식품 생산**
박성희 (서울과학기술대학교)

HMR 식품의 최신 가공기술 동향: 전처리, 살균, 건조 및 냉동

CURRICULUM VITAE



조 원 일

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학력
• 2006. 연세대학교 대학원 생물소재공학과 박사, 학위논문 (Antimicrobial Activity of Torilin Isolated from Torilis japonica against Bacillus subtilis: 천연항균제를 이용한 내열성 바실러스 포자 살균 연구)
• 1994. 연세대학교 대학원 식품생물공학과 석사
• 1992. 연세대학교 공과대학 식품공학과 학사

경력
• 2019~현재. 동원F&B 식품과학연구원
• 1994~2019. 씨제이제일제당 식품연구소

주요활동
• 씨제이제일제당 식품연구소 수석연구원 (부장) 근무 (25년)/레토르트, 건조, 소스, 조미식품 등 다양한 가공식품 연구개발, 상품화/가열 및 비가열 살균기술 연구개발 (레토르트, 초고압, 천연항균제 등)
• 동원에프앤비 식품과학연구원 수석연구원 (부장) 근무 중 (7년)/HMR (레토르트 등) 식품 연구개발, 상품화/살균기술 및 식품소재 연구/연구기획

수상
• 2020. 동원에프앤비 공로상
• 2018. 씨제이제일제당 기술상

기타
• 자격증: 식품기술사, 위생사, 국제기술사 (생명공학)
• 논문게재: SCI급 및 국내외 저널 게재 33여편
• 특허출원등록: 국제특허등록 포함 31여건

ABSTRACT

최근 HMR(home meal replacement) 식품은 단순한 편의성을 넘어 전문점 수준의 맛과 식감, 영양, 안전성 및 장기보존성을 동시에 확보하는 방향으로 고도화되고 있으며, 제조공정 역시 품질 손실을 최소화하면서 생산성, 에너지 효율 및 공정 안정성을 향상시키기 위한 기존 공정의 정밀화와 첨단 가공기술의 융합을 중심으로 발전하고 있다. 레토르트 분야에서는 야채, 육, 수산 원물의 품질 유지를 위해 정밀 블랜칭, 진공함침, 과열수증기 처리 등의 전처리 기술이 적용 또는 개발되고 있으며, 살균공정에서는 회전·진동·왕복교반 기반 shaking·agitated retort 등의 기술을 적용하여 열전달을 향상시켜 과도한 열처리에 따른 품질열화를 줄이는 방향으로 발전하고 있다. 또한 RF(radio frequency), MW(microwave), ohmic heating 등 식품 내부에서 직접 열을 발생시키는 가열기술은 기존 가열공정과의 결합을 통해 가열속도와 균일성을 향상시켜 품질저하를 최소화하기 위한 연구 및 산업 적용이 확대되고 있다. 건조 분야에서는 열풍건조의 긴 처리시간과 동결건조의 높은 에너지 및 비용 부담을 개선하기 위해 MW, RF, IR(infrared), 진공 및 열펌프 등을 결합한 하이브리드·다단 건조기술이 개발되고 있다. 특히 MW 보조 진공 및 동결건조는 식품 내부의 직접가열을 이용하여 수분 제거 및 승화 속도를 향상시키고 공정시간과 에너지 소비를 감소시킬 가능성이 보고되고 있으며, 최근에는 MW 출력과 제품온도의 정밀 제어를 통해 가열 불균일성을 개선하는 연구가 진행되고 있다. RF 역시 높은 침투깊이와 내부가열 특성을 활용한 건조기술로 연구 및 산업 적용 가능성이 검토되고 있다. 냉동 분야에서는 급속송풍, IQF 및 접촉식 냉동과 같은 상용기술의 열전달 효율 향상과 함께 액체질소 등 극저온 냉동, 초음파, 고압, PEF(pulsed electric field), 전기장 및 자기장·전자기장 보조 냉동기술이 연구되고 있다. 이러한 연구의 핵심은 단순한 냉동속도 향상을 넘어 과냉각과 얼음 핵생성 및 결정성장을 제어하여 얼음결정의 크기와 분포를 최적화하고 세포조직 손상과 해동 드립을 최소화하는 것이다. 특히 PEF 전처리, 초음파 및 전자기장 보조 냉동은 품질을 개선할 가능성이 보고되고 있으나, 식품 종류와 공정조건에 따른 효과의 변동성이 크며, 산업적 scale-up 및 연속공정 적용을 위한 추가적인 검증이 필요한 기술이다. 향후에는 개별 단위기술의 적용뿐만 아니라 상용화 기술과 신가공 기술의 하이브리드화, 연속·자동화, 센서 기반 실시간 모니터링과 데이터 기반 모델링 및 AI를 활용한 공정 최적화가 HMR 가공기술의 주요 발전 방향이 될 것으로 전망된다. 이를 통해 안전성을 확보하면서 소비자가 체감하는 원물감과 품질을 높이고, 동시에 에너지 절감과 생산효율을 향상시키는 기술개발이 더욱 중요해질 것으로 판단된다.

Supercooling and superchilling storage processes as alternatives to freezing for food freshness retention

CURRICULUM VITAE



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기타(selected publication)

• Jeong, I.-U., Kang, T.* (2026). Investigation of low-strength static magnetic field (SMF) effects on food freezing under controlled electromagnet heat generation. Food and Bioproducts Processing, 158, 239-246.
• Yun, S., Kim, T., Jeong, I.-U., Choi, S.-Y., Kim, S., Mok, J. H.*, Kang, T.* (2025). Development of a feedback-regulated temperature control system to enable supercooling reversion in beef preservation. Innovative Food Science & Emerging Technologies, 105, 104199.
• Jeong, I.-U., Lee, C. J., Mok, J. H., Kang, T.* (2025). Effect of permanent magnetic fields on freezing characteristics of agar gel and potato. International Journal of Refrigeration, 178, 1-8.

ABSTRACT

Freezing remains the most reliable method for long-term food preservation. However, ice crystal formation causes mechanical damage to cellular structures, freeze concentration of solutes, and protein denaturation, resulting in texture loss and excessive drip after thawing. Supercooling and superchilling have drawn attention as alternatives to conventional freezing. Both are sub-freezing-point storage strategies that avoid or strictly limit ice formation while keeping the product below its initial freezing point. In supercooling, the product is maintained in a metastable liquid state below its freezing point without phase transition, preserving fresh-like quality without ice-induced damage. In superchilling, only a small and controlled fraction of water is converted to ice, which suppresses microbial growth and enzymatic activity without severe structural damage to the food matrix. This presentation first outlines the principles that distinguish the two processes with emphasis on the metastability of the supercooled state and the stochastic nature of ice nucleation that limits its practical stability. Recent research trends are then reviewed, including physical treatments for nucleation control along with advances in temperature control and non-destructive monitoring. Superchilled transport and storage is already practiced in the seafood and meat industries, whereas supercooling systems largely remain at the laboratory or prototype stage. The requirements for translating supercooling into practical cold chain applications are then discussed. Finally, ongoing work on field-assisted supercooling and on approaches to characterize the frozen state is briefly introduced, and the prospects for extending these processes to a wider range of food products are considered.

조합가공기술을 활용한 고품질 HMR 식품 생산

CURRICULUM VITAE



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ABSTRACT

현대 소비자는 병원성 미생물 및 부패 미생물에 의한 위험성이 없으면서도 최소한으로 가공된 식품을 요구하고 있으며, 그러한 요구는 활발히 소비되는 HMR 식품에도 적용된다. 식품공정공학 지식을 활용하여 안전한 식품을 생산하는 것은 기술적으로 어려운 일이 아니며, 미생물 포자를 포함한 내열성 미생물을 완벽히 사멸하여 실온에서 저장 가능한 멸균 제품을 생산하기 위해서는 고온에서 장시간 식품을 열처리하는 기술이 이용되고 있다. 그러나 이 과정에서 식품 고유의 영양성분 및 풍미가 변화하여 품질 저하가 일어나기 때문에, 실제 식품 생산 공정에서는 안전성(safety)과 품질의 균형을 맞추어야 고품질의 HMR 식품 생산이 가능하다. 기존 레토르트 기술의 경우 멸균 효과는 우수하나 장시간 열처리에 의한 품질 변화가 큰 제약이 있다. 최근 들어 이러한 전통적인 단일 열처리 공정의 제약점을 극복할 수 있는 조합가공기술(combination technology)이 활발히 연구되고 있다. 조합가공기술은 각기 다른 가공 기술의 물리적 처리(온도, 전기장, 압력, 진동도)를 조합한 시너지 효과를 활용하여 멸살균 온도의 조절, 처리 시간의 단축 등을 통하여 식품생산공정 중의 품질변화를 최소화 할 수 있는 것으로 나타났다. 본 발표에서는 서울과학기술대학교 식품공정공학 실험실에서 진행된 적외선 동결건조, 오믹 진공농축, 오믹 대체육 제조, 오믹 발효 제어, 과열증기 멸균조리, 전기전도도 신선도제어 기술을 중심으로 조합가공 기술의 식품 공정 적용 가능성을 논의한다.

S8

New paradigms in HFF ingredient development: AI, organoids, and regulatory implementation

후원: 건강기능식품 기능성 원료 스마트 제품화 지원 연구단

장소 314호 좌장 이홍진 (중앙대학교)

10:00-10:30 | **AI를 활용한 기능성 천연물소재 발굴과 작용원리 검증**
강경수 (한국과학기술연구원(KIST))

10:30-11:00 | **Development and application of next-generation organoid-based models for functional food evaluation**
김동환 (한국식품연구원)

11:00-11:30 | **신기술 적용 기능성 소재의 개발과 규제 대응 전략**
서승오 (서울과학기술대학교)

AI를 활용한 기능성 천연물소재 발굴과 작용원리 검증

CURRICULUM VITAE



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ABSTRACT

최근 인공지능(AI)과 데이터 과학은 다양한 산업 분야에 폭넓게 도입되어 생산성과 연구개발 효율성을 획기적으로 향상시키고 있다. 이러한 기술 발전은 건강기능식품 및 의약품 개발을 포함한 천연물 연구의 패러다임에도 중요한 변화를 가져오고 있다. 특히 천연물 유래 기능성 식품소재 및 신약 개발에서는 방대한 천연물 자원으로부터 유효 후보물질을 신속하게 선별하고, 이들의 약리학적 표적과 작용기전을 예측하는 기술이 연구개발 생산성 향상을 위해 중요하다. 2003년 설립된 KIST 강릉 천연물연구소는 천연물 기반 기능성 소재 및 의약품 개발을 위한 전주기 연구개발을 수행하는 정부출연연구소이다. KIST는 천연물 연구의 효율성과 정밀성을 높이기 위해 자체적인 AI 기반 단백질 표적 예측 및 후보물질 발굴 기술을 개발해 왔으며, 대표적으로 천연물 특화 AI 플랫폼인 NPI-Finder를 구축하여 활용하고 있다. 본 세미나에서는 천연물 연구를 가속화하기 위해 KIST가 개발하고 활용하고 있는 데이터 기반 천연물 발굴 플랫폼을 소개한다. 특히 AI 기반 표적 예측 및 후보물질 발굴 기술을 실험적 효능·기전 검증 시스템과 연계하여, 다양한 인간 질환의 예방 및 치료에 활용할 수 있는 생리활성 천연물 소재를 발굴한 대표적인 연구 사례를 소개하고자 한다. 이를 통해 AI 기반 예측을 통해 천연물 연구의 효율성을 높이고, 천연물 기반 기능성 소재 개발을 가속화할 수 있는 새로운 연구 전략을 논의하고자 한다.

Development and application of next-generation organoid-based models for functional food evaluation

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ABSTRACT

Organoids are three-dimensional in vitro models that self-organize from stem cell- or tissue-derived cells and partially reproduce organ-specific structures and functions. They have emerged as promising human-relevant platforms that can complement conventional two-dimensional cell cultures and animal models. In functional food ingredient development, organoid-based models can support the evaluation of efficacy, mechanisms of action, safety, and potential human applicability before clinical studies. Among them, liver organoids are particularly useful for assessing liver health-related functions, including lipid metabolism, oxidative stress, inflammation, fibrosis, and detoxification. This presentation introduces the development and application of organoid-based functional evaluation models, with a focus on liver organoids. As an example, the protective effects of Rosa multiflora leaf(RML) extract were evaluated using a high-fat diet/Nε-(carboxymethyl)lysine(CML)-induced animal model and oleic acid/CML-treated human liver organoids(HLOs). RML reduced hepatic lipid accumulation, CML accumulation, RAGE expression, and lipogenesis-related markers in both animal and organoid models. In addition, kaempferol 3-O-β-D-glucuronide was identified as a candidate bioactive constituent and reduced lipid and CML accumulation in HLOs without affecting cell viability. These findings suggest that liver organoids can be used to evaluate functional ingredient efficacy, investigate mechanisms of action, and identify candidate active compounds. With further standardization and validation, organoid-based models are expected to serve as next-generation platforms for functional food ingredient development.

신기술 적용 기능성 소재의 개발과 규제 대응 전략

CURRICULUM VITAE



서 승 오

근무처
- 서울과학기술대학교 식품생명공학과

학력
- University of Illinois at Urbana-Champaign, Food Science, Ph.D.
- 서울대학교 식품생명공학 석사
- 성균관대학교 식품생명공학 학사

경력
- 현) 서울과학기술대학교 식품생명공학과 조교수, 부교수
- 전) 가톨릭대학교 식품영양학과 조교수
- 전) University of Minnesota Twin Cities, Biotechnology Institute, Postdoc

주요활동
- 전) 식약처 유전자변형식품등 안전성심사위원회 심사위원
- 전) (재)한국규제과학센터 규제과학 단기교육 (식품분야) 강사
- 전) 경기도 바이오 전문인력양성사업 첨단바이오 식의약품과정 강사
- 전) 농림부 농생명 그린바이오 소재부품 산업화 기술개발 사업 기획위원
- 전) 과기부 차세대바이오단 개방형 기획 협의체 기획위원
- 전) 산자부 바이오산업기술개발 사업 첨단바이오신소재 기획위원
- 현) 한국합성생물학발전협의회 기술산업분과 전문 집필위원

수상
- 2023. BBE Best Article Award

기타 (연구분야)
- 정밀발효 및 합성생물학 기반 고부가가치 바이오 소재 대량생산

ABSTRACT

최근 합성생물학(synthetic biology), 정밀발효(precision fermentation), 인공지능(AI) 등 바이오 분야의 신기술이 빠르게 발전하면서 기존의 식물 추출이나 화학적 합성에 의존하던 기능성 소재의 생산 방식에도 변화가 나타나고 있다. 특히 미생물의 대사경로를 설계하고 발효공정을 최적화하여 목적 물질을 생산하는 정밀발효 기술은 단백질, 아미노산, 비타민, 색소, 향미소재 등 식품원료 및 기능성 식품 소재의 지속가능한 생산을 가능하게 하는 차세대 바이오제조 기술로 주목받고 있다. 신기술을 활용한 기능성 소재의 성공적인 산업화를 위해서는 높은 생산성과 경제성을 갖춘 생산기술의 확보뿐만 아니라 소재의 특성에 적합한 안전성 평가와 규제 대응 전략이 함께 고려되어야 한다. 특히 유전자재조합 미생물(LMO) 또는 신규 미생물을 이용하여 생산된 소재는 생산 균주의 안전성, 유전자 변형 여부, 최종 제품 내 생산 균주 및 유전물질의 잔존 여부, 제조공정과 성분의 동등성 등에 따라 적용되는 규제와 요구자료가 달라질 수 있다. 또한 동일한 바이오 기반 소재라 하더라도 일반식품, 식품첨가물, 건강기능식품 등 최종 적용 분야와 기능성 표시·인정 여부에 따라 사업화 전략이 달라질 수 있으므로 연구개발 초기부터 최종 제품의 규제 경로를 고려한 개발 전략이 필요하다. 본 발표에서는 유전체 편집 기술과 정밀발효를 중심으로 신기술을 활용한 기능성 소재의 개발 동향과 주요 사례를 소개하고, 균주 개발에서 발효, 분리·정제 및 소재화로 이어지는 기술개발 과정에서 고려해야 할 주요 요소를 살펴보고자 한다. 아울러 신기술 기반 기능성 소재의 안전성 확보와 국내외 규제 환경을 검토하고, 연구개발 단계부터 생산공정, 안전성 평가 및 인허가를 연계하는 규제 대응 전략을 논의하고자 한다.

기조강연 2

장소 211호 좌장 김용노 (서울대학교)

11:30-12:10 | **연구는 제품이 되고, 안전은 문화가 된다.**
- 식품산업에서 보낸 35년의 여정-
조상우 (매일유업㈜)

연구는 제품이 되고, 안전은 문화가 된다.
– 식품산업에서 보낸 35년의 여정 –

CURRICULUM VITAE



조 상 우

근무처
- 매일유업㈜

학력
- 1993. 한국과학기술원 생명공학과 박사
- 1989. 한국과학기술원 생물공학과 석사
- 1986. 연세대학교 식품공학과 학사

경력
- 2023.11~현재. 매일유업주식회사 품질안전총괄
- 2010~2023. ㈜풀무원, 풀무원기술원 식품안전센터장~P&P개발2실장
- 2007~2010. 서울향료㈜ 바이오사업부 이사
- 1992~2007. ㈜두산, 두산기술원 책임연구원~수석연구원

주요활동
- 현) (사)한국식품위생안전성학회 외부부회장
- 현) (사)한국산업식품공학회 부회장
- 현) (사)한국급식외식위생학회 미래 전략사업 발굴 특별위원회
- 현) 한국식품연구원 기술기획자문위원회 위원 (2019.08~)
- 현) 식약처 식품위생심의위원회 위원 (2012.12~2014.8, 2016.8~)
- 현) 국가과학기술연구회 기획평가위원회 위원 (2017.10~)
- 현) 한국식품산업협회, 표시광고 자율심의위원회 위원 (2022.03~)
- 현) 농림식품기술기획평가원 사외이사 (2023.5~)

수상
- 2023.03. 국무총리 표창장 제221562호 (국무총리 한덕수)
- 2016.10. 식약처장 표창장 제2016-837호 (식약처장 손문기)
- 2015.06. (사)한국식품과학회 감사장, 제15-20호, 한국식품과학회 국문지/영문지 편집위원장

ABSTRACT

식품산업은 지난 수십 년간 과학기술의 발전과 소비자 요구의 변화에 따라 끊임없이 진화해 왔다. 식품공학을 전공하고 산업계에 첫발을 내디딘 이후 지난 35년 동안, 전반부에는 식품 연구개발과 바이오 분야에서 기술을 제품으로 구현하고 사업으로 연결하는 과정을 경험하였으며, 후반부에는 품질과 식품안전 분야에서 다양한 현장의 문제를 해결하고 보다 안전한 식품생산 시스템을 구축하는 데 참여해 왔다. 이러한 경험을 통해 연구개발과 식품안전은 서로 다른 영역이 아니라, 소비자에게 가치 있고 신뢰할 수 있는 식품을 제공한다는 하나의 목표로 연결되어 있음을 배울 수 있었다. 식품안전관리의 패러다임도 최종제품의 검사와 사후 대응에서 HACCP을 중심으로 한 예방관리로 발전하였으며, 이제는 공정·설비·환경·품질 데이터를 활용한 디지털 기반의 관리로 빠르게 전환되고 있다. 특히 인공지능(AI)의 발전과 AI transformation(AX)은 이러한 변화를 더욱 가속화할 것으로 보인다. 생산 현장에서 축적되는 다양한 데이터를 AI와 결합한다면 이상 징후와 잠재적 위해요인을 조기에 감지하고, 품질 및 식품안전 사고의 가능성을 예측하여 선제적으로 대응하는 predictive & preventive food safety로 발전할 수 있을 것이다.

그러나 기술만으로 식품안전이 완성되는 것은 아니다. 신뢰할 수 있는 데이터와 시스템, 현장의 경험과 사람의 판단, 그리고 안전을 우선하는 조직문화가 함께 작동해야 한다. 미래의 식품산업은 food science와 data science, AI와 human intelligence, technology와 safety culture가 서로 연결되는 방향으로 발전해야 할 것이다. 지난 35년간 식품산업 현장에서 연구개발과 식품안전 업무를 수행하며 경험한 변화와 배움을 몇 가지 사례를 통해 나누고, AI와 AX가 앞으로 식품산업과 식품안전관리의 패러다임을 어떻게 변화시켜 나갈 것인지 함께 생각해 보고자 한다. 이를 통해 '연구는 제품이 되고, 데이터는 지능이 되며, 안전은 문화가 되는' 미래 식품산업의 방향을 함께 고민해 보는 기회가 되기를 기대한다.

S9

정밀생명공학 기술을 통한 미래 식품소재 생산

공동개최: 강원대학교 IPET글로벌푸드테크 과제연구팀, 강릉앵커사업단

장소 211호 좌장 박성훈 (강원대학교)

13:20-13:50 | **Precision bioconversion for the production of high-value sugars and their derivatives**

김동현 (경북대학교)

13:50-14:20 | **Precision fermentation for the production of natural flavor and functional food ingredients**

김선기 (중앙대학교)

14:20-14:50 | **미래 식품 생산을 위한 차세대 유전자 조립 기반 합성생물학 플랫폼**

신종혁 (세종대학교)

Precision bioconversion for the production of high-value sugars and their derivatives

CURRICULUM VITAE



김 동 현

근무처
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학력
• 고려대학교 생명공학과 시스템식품생명공학전공 박사
• 부경대학교 식품공학과 학 · 석사

경력
• 2021~2022. 강릉원주대학교 해양식품공학과
• 2019~2021. 고려대학교 식품생의학안전연구소 연구교수
• 2020~2021. National Renewable Energy Laboratory, USA

주요활동
• 2021~현재. 한국수산과학회, 학술위원회 간사
• 2023~2025. 한국미생물생명공학회, e-생물산업지 간사

ABSTRACT

Carbohydrates are abundant and renewable feedstocks for the production of high-value food, pharmaceutical, and biochemical products. However, their selective conversion is often limited by unfavorable reaction equilibria, stereochemical complexity, and cofactor requirements. Precision bioconversion using rationally designed multienzyme cascades provides a promising strategy to overcome these limitations. This presentation introduces our recent studies on the conversion of biomass-derived D-xylose into D-ribose, a physiologically important pentose used as a dietary supplement and as a precursor for nucleoside synthesis. In a subsequent study, D-ribose was stereoinverted into enantiopure L-ribose, a key chiral building block for antiviral and anticancer L-nucleoside drugs. The cascade concept was further extended to the production of therapeutic deoxyribonucleoside analogs, which represent an important class of anticancer and antiviral agents, from simple and renewable feedstocks. Across these studies, enzyme specificity, thermodynamic driving forces, cofactor regeneration, and reaction kinetics were coordinated to selectively direct substrates toward the target products. Collectively, these results demonstrate that precision bioconversion can provide a versatile and sustainable platform for producing high-value sugars and nucleoside derivatives for applications in functional foods, pharmaceuticals, and biorefinery processes.

Precision fermentation for the production of natural flavor and functional food ingredients

CURRICULUM VITAE



김 선 기

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• 서울대학교 식품생명공학전공 농학사

경력
• 미국 조지아대학교 박사후연구원

주요활동
• 한국산업식품공학회 편집운영위원
• 한국식품과학회 사업운영위원
• Editor, Journal of Microbiology and Biotechnology

ABSTRACT

Food industries are increasingly interested in commercializing products formulated with ingredients derived from environmentally sustainable resources. Saccharomyces cerevisiae has been widely used in the food and pharmaceutical industries due to its generally recognized as safe(GRAS) status and well-established genetic engineering platforms. Owing to these advantages, S. cerevisiae has emerged as a promising host for precision fermentation to produce key food ingredients. This study highlights recent advances in metabolic engineering strategies for the production of flavor and protein ingredients, including vanillin, single cell protein, heme, and egg white proteins. We discuss pathway optimization, precursor supply enhancement, and strain engineering approaches that improve yield and productivity. These advances demonstrate the potential of yeast-based precision fermentation as a sustainable platform for next-generation food applications.

미래 식품 생산을 위한 차세대 유전자 조립 기반 합성생물학 플랫폼

CURRICULUM VITAE



신 종 혁

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학력

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- 2012~2014. 성균관대학교 생명공학과 이학석사
- 2009~2012. 성균관대학교 유전공학과 이학사

경력

- 2025.09~현재. 세종대학교 식품생명공학과 조교수
- 2025.03~2025.09. 한국생명공학연구원(KRIBB) 합성생물학연구센터 및 K-바이오파운드리 선임연구원
- 2022.11~2025.02. 한국생명공학연구원(KRIBB) 합성생물학연구센터 연구원
- 2022.07~2022.10. 미국 텍사스대학교 오스틴캠퍼스(University of Texas at Austin) 분자생명과학과 박사후연구원
- 2019.07~2022.06. 미국 일리노이대학교 어바나-샴페인(UIUC) Carl R. Woese Institute for Genomic Biology 박사후연구원

주요활동

- 합성생물학 및 정밀발효 분야 국제학술지 논문 다수 게재 (Nature Communications, Trends in Biotechnology, Metabolic Engineering, ACS Synthetic Biology 등)
- 국내 최초 공공 바이오파운드리 구축 사업인 K-바이오파운드리 베타 구축 및 합성생물학 자동화 워크플로 개발 참여
- 국내외 대학·연구기관 및 산업체와 합성생물학·바이오파운드리·정밀발효 분야 공동연구 수행

수상

- 한국생물공학회 신진연구자상, 2024
- 한국생물공학회 우수 포스터 발표상, 2017년 춘계학술대회, 2018년 춘계학술대회, 2018년 추계학술대회
- 제21회 삼성휴먼테크논문대상 Bio Engineering & Life Science 부문 장려상, 2014

ABSTRACT

The growing demand for sustainable food production has accelerated the development of microbial cell factories for producing food ingredients and other value-added bioproducts. Synthetic biology provides powerful tools for this purpose, but efficient strain development requires rapid construction and evaluation of increasingly complex metabolic pathways. To address this challenge, we developed a modular multigene assembly platform for Saccharomyces cerevisiae by integrating standardized DNA assembly, yeast homologous recombination, and biofoundry automation. This platform enables combinatorial assembly of promoters, coding sequences, and terminators, facilitating the rapid generation of diverse pathway variants and strain libraries. Its integration with automated workflows further supports parallel strain construction and screening within iterative Design–Build–Test–Learn(DBTL) cycles. The platform was applied to yeast engineering for carotenoid production and enhanced utilization of alternative carbon sources, demonstrating its versatility for both pathway optimization and feedstock expansion. Integrating advanced gene assembly and biofoundry automation provides a scalable strategy to accelerate microbial cell factory development and offers a promising foundation for sustainable production of future food ingredients through precision fermentation.

S10

식품 스마트제조 혁신과 산업화: 산학연 협력이 만드는 지역생태계

후원: 구미전자정보기술원, 경운대학교 앵커총괄사업단

장소 314호 좌장 서동호 (경운대학교)

13:20–13:50 | **AI 시대, 작은 공장의 큰 레시피: 데이터로 밑간하고 AI로 간을 맞추는 중소 식품공장**

차동호 (SK㈜ AX)

13:50–14:20 | **AI 기반 식품 스마트제조 혁신과 식품산업 혁신 생태계**

임정호 (한국식품연구원)

14:20–14:50 | **식품 스마트제조 공정의 품질관리 고도화 전략**

정영성 (경운대학교)

AI 시대, 작은 공장의 큰 레시피: 데이터로 밑간하고 AI로 간을 맞추는 중소 식품공장

CURRICULUM VITAE



차 동 호

근무처
- SK㈜ AX 매니저

학력
- 2013.02. 경희대학교 전자전파공학 박사 수료
- 2011.02. 경희대학교 전자전파공학 석사
- 2009.02. 경희대학교 전파통신공학 학사

경력
- 현) SK㈜ AX 매니저
- 전) 네이버시스템 수석연구원
- 전) 와이비텔·비투아시스템·티앤비전파기술 책임·수석연구원
- 전) 국립전파연구원 주임연구원

주요활동
- 평가·자문위원
- RRA, IITP, GERI, KETI 등 자문 및 평가위원

강의·강연
- SK㈜ AX 이동통신 분야 사내 전문강사
- KETI 6G(IMT-2030) 응용기술 세미나 초청 강연

수상
- 2026.04. SKMS 실천상 (SK㈜ AX)

기타
- 전자파 안전관리 대책기술 강사 양성과정 수료

ABSTRACT

식품 제조는 원료의 생물학적 가변성과 다품종 소량 생산이라는 특성상, 원료의 상태를 읽고 공정 조건을 조정하는 숙련자의 경험과 판단이 품질을 좌우하는 고도의 전문 산업이다. 그러나 숙련 인력의 확보와 기술 전수가 점차 어려워지면서, 이러한 경험을 지속 가능한 역량으로 이어가는 것이 중소 식품기업의 핵심 과제가 되고 있다. 본 발표는 숙련자의 경험을 데이터와 모델로 담아내고 AI가 그 판단을 보조한다는 관점에서, 석유화학, 반도체, 제약, 통신 등 공정 자율화를 먼저 경험한 산업의 표준과 아키텍처를 식품 제조에 접목하는 방향을 제시한다. 먼저 배치 제어 표준인 ISA-88(IEC 61512)의 레시피 개념을 바탕으로 레시피와 설비를 분리하는 구조를 소개하고, 통신 분야의 자율화 레벨을 참조한 식품 공정 자율화 단계를 제안한다. 다음으로 열처리 살균 공정을 사례로, 숙련자의 지식과 물리 모델을 데이터와 결합한 Physics-Informed AI(밑간)와 소프트센서 기반의 실시간 폐루프 제어(간 맞추기)를 통해 현장에서 공정을 조정하는 방법론을 설명하고, 폐루프 제어의 현장 적용을 가로막는 센서, 모델, 데이터, 검증의 네 가지 장벽을 분석한다. 이어 HACCP 인증은 가공식품 생산량의 90% 이상을 포괄하는 반면 스마트 HACCP 등록은 제조·가공 인증업소의 약 3%로 확산 초기 단계에 있다는 점에 주목하여, 구축·유지보수 부담이 큰 스마트 HACCP 시스템을 지역 거점이 공동 구축·운영하고 중소기업은 현장 연결만 담당하는 지원 체계를 경상북도 사례를 중심으로 제안하며, 이를 AI 기반 공정 제어로 확장하는 단계적 경로를 제시한다. 마지막으로 AI가 조정한 공정 조건의 검증 체계와 산학연 공동 연구 과제를 제언함으로써, 지역 생태계 차원의 공동 인프라가 중소 식품산업의 경쟁력과 체질을 강화하는 경로를 제시하고자 한다.

AI 기반 식품 스마트제조 혁신과 식품산업 혁신 생태계

CURRICULUM VITAE



임 정 호

근무처
- 한국식품연구원

학력
- 2000~2006. 경북대학교 식품공학과 박사
- 1998~2000. 경북대학교 식품공학과 석사

경력
- Principal Research Scientist, Korea Food Research Institute (2015–Present)
- Research Scholar, USDA/ARS USNPRC, USA (2019–2020)

주요활동
- IPET (다부처 연구개발 과제, 5G 식품안전생산 기술 개발; 2021~2025) 등 IPET 사업 10과제
- KIMST (신선유통 표준화 기술 개발; 2021~2025, 어류 수산부산물 부위별 분리 및 품질관리기술 개발, 2025~2029) 등 5개 과제
- IITP (산업적용을 위한 AI 기반 초분광 영상 실시간 분석 기술 개발, 2024~2026)
- NST (국가과학기술연구회) (융합연구, 전략연구사업 등 다수)
- 한국식품저장유통학회, 한국식품과학회 주요 운영위원

수상
- 농림축산식품부 장관상 (2010, 2021, 2025)
- 한국과학기술단체총연합회 우수논문상 (2023), 한국식품저장유통학회 학술진보상(2016)
- 한국식품연구원 우수직원상, 자랑스런 KFRI상, 특별상 다수

기타
- 농식품부 R&D 기획 및 검토 위원 (2023–2025)

ABSTRACT

식품산업은 원료의 생물학적 변동성, 인력 부족과 생산비 상승, 품질 편차 및 식품안전 리스크, 유통과정의 품질 저하 등 다양한 문제에 직면하고 있다. 이에 따라 기존의 노동·경험 중심 생산방식에서 벗어나, 데이터와 인공지능(AI)을 기반으로 품질과 안전을 실시간으로 예측·관리하고 생산공정을 최적화하는 지능형 제조체계로의 전환이 요구되고 있다. 특히 센서, IoT, 머신비전, 초분광영상, 빅데이터, 클라우드, 디지털 트윈, 로봇 등 첨단기술의 융합은 식품의 상태를 정량적으로 인식하고 공정을 예측·제어할 수 있는 스마트제조의 핵심 기반이 되고 있다. 식품 스마트제조는 단순 자동화를 넘어 데이터 수집·연결, AI 기반 품질 예측과 이상 진단, 공정 간 통합 최적화, 자율제어가 가능한 자율생산 체계로 발전하고 있다. 이를 위해 영상·분광·X-ray·THz·환경센서 등 다양한 데이터를 융합하는 멀티모달 AI, 현장 실시간 처리를 위한 Edge AI, 디지털 트윈 기반 공정 시뮬레이션, AI와 로봇이 연계된 피지컬 AI 기술의 중요성이 커지고 있다. 이러한 기술은 품질 균일화, 부적합품 자동 검출, 공정 효율 향상, 생산성 증대 및 식품안전 강화뿐 아니라 다품종·소량생산과 맞춤형 식품 제조에도 활용될 수 있다. 향후 식품산업의 혁신은 개별 기업 또는 단일 기술의 도입을 넘어, 지역 농어가의 원료·생산 데이터와 식품기업의 제조·품질 데이터, 연구기관과 대학의 AI·자동화 기술, 지자체의 정책·인프라 지원, 유통 플랫폼 및 창업기업의 사업화 역량을 연계하는 산업 생태계 구축이 중요하다. 이러한 산·학·연·관 협력체계는 기술개발–실증–사업화–확산을 연계하고, 지역 농수산자원을 고부가가치 제품과 서비스로 전환하는 기반이 될 수 있을 것이다.

식품 스마트제조 공정의 품질관리 고도화 전략

CURRICULUM VITAE



정 영 성

근무처
• 경운대학교 (스마트식품학부)

학력
• 경희대학교, 식품생명공학과, 이학박사
• 한국공학대학교 생명화학공학과, 공학석사
• 한국공학대학교 생명화학공학과, 공학사

경력
• 2026.09–현재. 경운대학교 스마트식품학부, 조교수
• 2026.03–2026.08. 코네티컷대학(미) 영양과학과, 방문연구원
• 2024.09–2026.02. 경희대학교, 학술연구교수
• 2020.06–2024.08. 한국식품연구원, 박사후연구원
• 2012.08–2015.08. ㈜뉴메드, 전문연구원

주요활동
• 식품 및 기능성 소재의 생리활성 평가, 성분 분석, 생체이용율 평가
• 등록 특허 3건, 기술이전 1건

수상
• 2023.09. 창의도전 아이디어 공모전 최우수상, 국가과학기술연구회

ABSTRACT

식품 스마트제조 공정의 확산과 함께 공정 전주기에 걸친 품질관리 고도화가 산업계의 핵심 과제로 부상하고 있다. 제조공정 전반에 걸친 체계적인 품질관리는 최종 생산품의 신뢰성을 높이기 위한 중요한 요인이다. 특히 다품종 소량생산 체계에서는 가공 중 생성되는 유해성분과 설비 관리 미흡에 따른 오염이 제품 안전성에 직접적인 영향을 미친다. 본 발표에서는 식품 제조설비의 세척 후 잔류오염 관리, 성분분석 자동화, 미량성분의 정밀 기기분석 및 가공 과정에서 발생할 수 있는 유해성분 분석을 중심으로 스마트 품질관리 전략을 제시한다. 특히 원료부터 반제품 및 최종제품 까지의 성분 변화를 신속하고 객관적으로 평가할 수 있는 분석체계와 분석 데이터의 축적·활용 방안을 살펴보고, 이를 제조공정의 품질관리와 연계하는 방향을 논의한다. 설비 오염 측면에서는 다품종 생산 환경에서의 알레르겐 교차오염 문제를 분석 관점에서 간략히 다룬다. 향후에는 세척제 및 살균제 잔류와 같은 공정 유래 위해요인의 분석까지 관리 범위를 확대하여 데이터 기반 선제적 품질관리를 목표할 수 있다.

S11

지속가능 식품포장 소재 기술의 현재와 미래

후원: ASPT, 한솔제지, 씨케이, ATP

장소 315호 좌장 도한솔 (이화여자대학교)

13:20-13:50 | **지속가능 식품포장 개발: 친환경 r-PET 용기 제품화 중심**
이윤석 (연세대학교)

13:50-14:20 | **ESG 공시 강화에 대응하는 포장재 지속 가능 전략**
안덕준 (SPC Pack)

14:20-14:50 | **Comparative life cycle assessment of reusable packaging systems for fresh food distribution: EPE-based foldable box and EPP-based injection-molded box**
강동호 (한국생산기술연구원)

지속가능 식품포장 개발: 친환경 r-PET 용기 제품화 중심

CURRICULUM VITAE



이 윤 석

근무처
• 연세대학교 패키징및물류학과

학력
• 2003. 미국 미시간주립대학교 박사

경력
• 2026~현재. 연세대학교 과학기술대학 학장
• 2025~2026. 연세대학교 패키징및물류학과 학과장
• 2024~2026. 태국 Chulalongkorn University 겸임교수
• 2018. (사)한국포장학회 회장
• 2005. 농촌진흥청 원예연구소 박사후연구원
• 2003. 미시간주립대학교 식품학과 박사후연구원

주요활동
• 현) 농림식품기술기획평가원 녹색인증 평가위원
• 현) KOICA 르완다농산물 가치사슬 스마트화 사업 교육위원
• 2023~2026. 한국식품클러스터 식품산업공동기획위원회 기획위원
• 2016~2018. 농촌진흥청 국립원예특작과학원 현장명예연구관
• 2015~2017, 2019. (사)한국포장학회편집위원회 위원장

수상
• 2022. (사)한국포장학회 학술대상
• 2021, 2022. 연세대학교 우수업적교수상 최우수 연구 논문상
• 2019, 2016. (사)한국포장학회 공로상

기타
• 식품패키징랩: https ://yonsei foodpkglab.com/

ABSTRACT

Plastics currently account for 30–40% of the packaging manufacturing industry, with the packaging and container sector generating 46.5% of total global plastic production. Most post-consumer plastic waste poses severe environmental challenges when incinerated or landfilled. In response to these demands, stringent global regulations—including mandatory r-PET usage thresholds in the EU and US and South Korea's goal to mandate higher minimum r-PET content by 2030—require proactive technological strategies to maintain export competitiveness, ensure material safety, and establish high-value recycling pathways. To address these needs, this study evaluated the quality characteristics and feasibility of incorporating recycled PET(r-PET) into food and beverage containers to meet environmental mandates and strengthen industrial competitiveness. Specifically, heat-resistant and atmospheric PET bottles were fabricated by incorporating r-PET chips at various blend ratios, followed by a systematic evaluation of their mechanical, optical, and thermal properties. The findings provide foundational data for establishing high-value domestic r-PET recycling technology, ensuring safety standards for food-contact materials, and enhancing global market competitiveness for packaging manufacturers.

ESG 공시 강화에 대응하는 포장재 지속 가능 전략

CURRICULUM VITAE



안 덕 준

근무처
- SPC Pack

학력
- 1995. 미국 뉴저지 주립대학교 식품포장학 박사
- 1993. 미국 뉴저지 주립대학교 식품포장학 석사
- 1989. 연세대학교 식품공학과 졸업

경력
- 전) CJ제일제당 선임연구원
- 전) 선문대학교 식품과학과 정교수
- 현) SPC팩 패키징사업부본부장/연구소장 (상무이사)

ABSTRACT

2026년 7월 발표된 지속가능성(ESG) 공시 제도화 강화 방안의 핵심은 공시 대상 기업의 범위를 연결 자산 5조 원 이상 상장사로 확대하고, 기존의 자율 공시에서 법정 공시로 전환하여 공시의 의무성을 높이는 한편, 공시 범위를 Scope 3(공급망 전체에서 발생하는 탄소배출량 등)까지 확대하는 데 있다. 이러한 ESG 공시 강화는 기업의 친환경 포장 전략에도 변화를 가져오고 있다. 과거에는 친환경 포장재의 도입이 환경 규제나 고객사의 요구에 대응하기 위한 소극적인 '순응'의 성격이 강했다면, 최근에는 기업의 지속가능경영을 실질적으로 실현하기 위한 적극적인 전략으로 변화하고 있다. 특히 친환경 포장재 개발을 단순한 플라스틱 사용량 감축 차원을 넘어, 제품의 품질과 생산성을 동시에 향상시키는 방향으로 확대하고 있다. 대표적인 사례가 필름의 두께 절감과 재생 수지의 재활용이다. 과거에는 필름의 두께를 줄이는 목적을 주로 플라스틱 사용량과 탄소배출량을 줄이는 데 두었다면, 최근에는 포장재 감량과 동시에 식품의 품질을 안정적으로 유지하는 것을 더욱 중요하게 고려하고 있다. 즉, 성공적인 필름 두께 감소는 단순히 기존 포장재와 동일한 수준으로 내용물의 품질을 유지하는 데 그치지 않고, 식빵 충진 과정에서 요구되는 포장재의 강도, 인장성, 열접착성 등 물리적·기계적 특성까지 기존 수준으로 유지하는 것을 의미한다. 이는 Scope 3 관점에서도 중요한 의미를 갖는다. 포장재의 감량으로 포장재 자체의 탄소배출량을 줄였더라도, 그 결과 내용물의 품질이나 포장 공정의 생산성이 저하된다면 폐기, 재포장, 생산 손실 등의 추가적인 환경 부담이 발생할 수 있다. 따라서 단순한 포장재 사용량 감소만으로 지속가능성을 판단하기보다는, 공급망 전체의 탄소배출량을 고려하면서 제품 품질과 생산 효율을 동시에 유지·향상시키는 방향으로 접근할 필요가 있다. 필름 생산 과정에서 발생하는 스크랩을 일정 비율 혼합하여 포장재 생산에 재활용하는 경우에도 마찬가지다. 재생 원료의 사용을 통한 탄소배출량 저감뿐 아니라 식품 포장재로서 요구되는 안전성을 확보하고, 신재를 사용했을 때와 동등한 수준의 기계적 물성을 유지하는 것이 필수적이다. 결국 재생 원료의 사용 여부 자체보다, 지속가능성과 품질을 동시에 만족할 수 있는 기술 확보가 핵심 경쟁력이 되고 있다. 인쇄 분야 역시 이러한 변화가 빠르게 나타나고 있다. 기존의 유성 잉크를 사용하는 인쇄 방식에서 에탄올계 용제를 사용하는 방식으로 전환이 빠르게 진행되고 있으며, 최근에는 한 단계 더 나아가 물을 용제로 사용하는 수용성 인쇄 방식으로 전환하기 위한 기술 개발과 적용이 확대되고 있다. 이러한 인쇄 방식의 전환은 탄소배출량 저감뿐만 아니라 작업 환경 개선과 식품 포장재의 안전성 향상에도 기여할 수 있다는 점에서 주목받고 있다. 특히 수용성 인쇄를 비롯한 새로운 인쇄 기술의 시장 적용이 빠르게 확대될 수 있었던 중요한 이유는 지속가능성만을 강조한 것이 아니라, 기존 인쇄 방식과 동등하거나 그 이상의 인쇄 품질을 확보하고 생산성 향상을 통해 가격 경쟁력까지 확보했기 때문이다. 이는 지속가능한 포장재의 시장 확산을 위해서는 환경적 가치만으로는 충분하지 않다는 점을 보여준다. 앞으로의 지속가능한 포장재 기술은 '친환경'이라는 하나의 목표에 머무르는 것이 아니라, 탄소배출량 저감, 제품 품질, 생산성, 식품 안전성 및 가격 경쟁력을 동시에 확보하는 방향으로 발전해야 한다. ESG 공시 제도화의 강화는 이러한 변화를 더욱 가속화하는 계기가 될 것이며, 결과적으로 지속가능성이 포장산업의 새로운 기술 경쟁력으로 자리 잡게 될 것으로 판단된다.

Comparative life cycle assessment of reusable packaging systems for fresh food distribution: EPE-based foldable box and EPP-based injection-molded box

CURRICULUM VITAE



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• ~2025. 한국생산기술연구원 패키징기술센터 수석

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• 한국전과정평가학회 편집위원
• ISO TC130 전문위원
• 부천시 4차 산업혁명위원회 위원

수상
• 부천시 공로상
• 한국생산기술연구원 공로상

ABSTRACT

The increasing demand for fresh food distribution has led to growing interest in reusable packaging systems as an alternative to conventional single-use packaging. This study conducts a comparative life cycle assessment(LCA) of two reusable packaging systems used for fresh food distribution: an expanded polyethylene(EPE)-based foldable box with an aluminum-laminated layer assembled using hook-and-loop fasteners, and an expanded polypropylene(EPP)-based injection-molded box. The system boundary includes raw material production, packaging manufacturing, transportation, use, return, cleaning, reuse, and end-of-life treatment. An equivalent fresh food distribution service was defined as the functional unit to ensure consistent comparison between the two packaging systems. Key parameters, including material composition, packaging weight, manufacturing process, service life, reuse frequency, and reverse logistics, were considered in the assessment. Particular attention was given to the environmental trade-offs between the lightweight and foldable structure of the EPE-based system and the durability and extended reusability of the EPP-based system. The contribution of each life cycle stage to the overall environmental impact was analyzed, and sensitivity analysis was conducted according to different reuse scenarios. The results provide quantitative insights into how material selection, structural design, and reuse conditions influence the environmental performance of reusable packaging systems. This study can support the development and operation of environmentally optimized reusable packaging for fresh food distribution.

UC

2026 KSFE 학생 제품개발 경진대회

장소 211호 좌장 한정우 (경희대학교), 박현우 (고려대학교)

15:00~15:25 | **식물성 육포형 스낵 “Mush-Chew (머쉬츄)”**
팀명 Born-Up (본업) 소속 건국대학교

15:25-15:50 | **솜닭**
팀명 FPE 소속 충남대학교

15:50-16:15 | **콩란큐브[콜드체인프리 식물성 식사형 계란큐브]**
팀명 미담 소속 건국대학교

16:15-16:40 | **IN2FU**
팀명 TENOVA(TENebrio+NOVA) 소속 경희대학교

YS

차세대 식품공학의 연구 동향

장소 314호 좌장 김현수 (경상국립대학교)

15:00-15:20 | AI-based SEM image analysis for predicting physicochemical properties of enzyme-hydrolysed protein powders and their exploratory association with in vitro myogenic differentiation
현지민 (국립부경대학교)

15:20-15:40 | Development of meat products formulated with plant-based lipids
이지선 (경상국립대학교)

15:40-16:00 | Engineering high-moisture meat analog structure: from protein functionality to process control
최현우 (가톨릭대학교)

16:00-16:20 | Micro/Nanoengineering technologies for the production of alternative foods
박상배 (서울대학교)

16:20-16:40 | 현미경 이미지 딥러닝 기반 식품 미생물 신속분석법 개발: YOLO 모델의 성과와 한계 및 foundation model 기반 zero-shot 탐지 체계로의 확장
김정헌 (한국식품연구원)

AI-based SEM image analysis for predicting physicochemical properties of enzyme-hydrolysed protein powders and their exploratory association with in vitro myogenic differentiation

CURRICULUM VITAE



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- 2016.07~2017.01. ㈜마린바이오프로세스 사원

연구분야
- 해양 유래 기능성 소재 개발 및 노인성 근감소증 개선
- 수산 부산물 식품 가공 기반 자원화 및 산업 스케일업
- 리피도믹스·대사체 기반 푸드오믹스 및 기능성 기전 규명
- 다중분광 이미징(MSI) 활용 수산물 비파괴 품질평가
- 인체적용시험 기반 기능성 소재 유효성 검증

기타(대표실적 등)
- 논문: SCI(E) 34편(주저자 23편), 주저자 논문 총 26편
- 특허: 국내 등록 5건, 출원 2건
- 과제: 한국연구재단 세종과학펠로우십 연구책임자 (2024~2029, 5억원)
- Hyun J. et al. (2025) Food Research International, 204, 115931 (IF 8.8)
- Hyun J. et al. (2024) Aging and Disease, 15(6), 2813 (IF 9.6)
- Hyun J. et al. (2022) Chemosphere, 293, 133602 (IF 8.1)
- 국제학회 구두발표 5건 (ISNFF, KoSFoST, APMBC, IMBC, KFN)

ABSTRACT

Spray-dried protein powders look alike. Under an electron microscope, each particle carries a different surface grain. That such texture relates to function is established. So is the finding that hydrolysed peptides aid myogenic differentiation and atrophy recovery. Linking the two through an image is not. A practical question stays open. Among the many proteins available for muscle, which one serves it? Comparisons have stayed within a single lineage, so they cannot guide choices across lineages. We built a six-protein panel: laver, olive flounder and tuna from the sea, and soy, chicken and beef from the land, pairing a plant, a white-meat and a red-meat source on each side. All six were hydrolysed and spray-dried under identical conditions, so surface differences trace to the raw material. The endpoint was pre-specified as recovery from induced atrophy, not absolute differentiation. SEM images were quantified for particle size, shape and surface intricacy, then set against measured physicochemical properties. Smooth, convex particles held less oil. Rough, intricate surfaces carried stronger antioxidant activity. Elongated particles emulsified better. Two intricacy descriptors, independently derived, agreed. In C2C12 myotubes with dexamethasone-induced atrophy(4 μg/mL; protein 100 μg/mL; days 2 and 6; n=3), all six held myotube coverage above the atrophy control. Antioxidant capacity tracked recovery most closely(Spearman ρ=−0.94). Surface intricacy, antioxidant capacity and recovery ordered the six almost identically. Marine and livestock proteins fell alternately within that order, though with three per lineage no absence of a lineage effect can be claimed. Six proteins also cannot separate a mediated path from a direct one, and most correlations give q>0.1. Non-destructive imaging may nonetheless place a protein within a ranking of differentiation recovery.

Development of meat products formulated with plant-based lipids

CURRICULUM VITAE



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연구분야
- Encapsulation
- Emulsion gel

기타(대표실적 등)
- Lee et al., 2025. Food Chemistry. 475, 141630.
- Absalimova, M., Lee, J., et al., 2025. Food Research International . 208, 116261.
- Lee et al., 2025. Food Science of Animal Resources. 45, 2, 535-552.
- Lee et al., 2025. Food Science of Animal Resources. 45, 5, 1341-1355.
- Lee et al., 2025. Foods. 14, 2625.

ABSTRACT

This study investigated the effects of an oil-in-water(O/W) emulsion as an animal fat substitute on the physicochemical and sensory properties of plant-based meat patties. Vegetable oils(peanut, coconut, and medium-chain triglyceride(MCT) oils) and liquid additives(water, oil, and surfactant; emulsion) were used to prepare the patties. Tween® 80 and soy protein isolate(SPI) were used to prepare the emulsion. The emulsion droplet size and ζ-potential were analyzed before mixing with the textured vegetable protein batter. The physicochemical, rheological, and sensory properties of the resulting plant-based meat patties were analyzed. The emulsion droplet sizes were approximately 5–10 μm, with a surface charge of >40 or 18 mV upon Tween® 80 or SPI addition, respectively. For patties containing MCT oil, cooking loss and hardness were reduced when using water, oil, Tween® 80, and emulsion samples. Additionally, these samples exhibited high liquid holding capacity, which affected tenderness. The creep recovery and viscoelasticity of the batters were unaffected by the oil type but generally higher in surfactant-containing batters. The L* value decreased irrespective of the type of oil or treatment, and the color difference was low in the sample containing Tween® 80. Moreover, based on the sensory test, MCT oil mixed with Tween® 80 resulted in patties with the highest levels of tenderness, juiciness, and overall acceptance. In conclusion, incorporating MCT oil and pre-manufactured emulsion as an animal fat substitute can improve the juiciness, liquid-holding capacity, and overall palatability of plant-based meat products.

Engineering high-moisture meat analog structure: from protein functionality to process control

CURRICULUM VITAE



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연구분야
• 식물성 단백질 기반 미래식품 개발
• 고수분 압출성형 및 대체육 구조화 기술
• 3D 식품 프린팅 및 맞춤형 식품 설계
• 식품 레올로지 및 텍스처·미세구조 분석

기타(대표실적 등)
• Hyun Woo Choi, Ji-Eun Bae, Jungwoo Hahn, "Oil-type-dependent modulation of soy protein structuring in high-moisture meat analogs: contrasting effects of coconut and flaxseed oils", Food Hydrocolloids, (2027)
• Hyun Woo Choi, Afif Aziz Daffa Alauddin, Sang Gil Lee, Ji-Eun Bae, Jungwoo Hahn, "Structural organization and printability of soy protein isolate-pectin inks: roles of mixing, conjugation, and methoxylation", Food Hydrocolloids, (2027)
• Ji-Eun Bae, Sang-Cheol Lee, Sang Gil Lee, Hyun Woo Choi, Jungwoo Hahn, "Soy protein-maltodextrin conjugates as rheologically tuneable structuring agents for extrusion-based 3D food printing inks", Food Hydrocolloids, (2027)
• Hyun Woo Choi, Jungwoo Hahn, Young Jin Choi, "Protein network density and fibrous structure control of soy protein isolate-based high-moisture meat analogs using yeast or rice protein isolates with distinct glass transition temperatures", Food Hydrocolloids, (2026)

ABSTRACT

High-moisture extrusion is widely used to produce plant-based meat analogs with anisotropic, fibrous structures; however, controlling the relationship between protein functionality, gelation, and flow-induced alignment remains challenging. This presentation introduces a stepwise approach to understanding and engineering the structuring of high-moisture meat analogs(HMMA) through rheological prediction, thermal control, and mechanical flow modification. First, the structuring potential of plant proteins was investigated using soy protein isolate(SPI) blended with faba bean protein concentrate(FPC). Increasing FPC content weakened the viscoelastic network, reduced gel stability, and disrupted protein alignment, which was reflected in lower hardness and texturization index of the corresponding HMMA. These results demonstrated that rheological behavior can provide useful information for predicting the structural performance of plant protein blends during extrusion. Second, the role of cooling-die temperature was examined by applying different temperature gradients during high-moisture extrusion. Higher cooling-die temperatures delayed gelation and reduced gel strength and hardness, but simultaneously increased the texturization index and promoted fibrous alignment. This indicates that rapid network solidification and directional structuring are distinct phenomena and that maintaining molecular mobility during cooling can facilitate protein alignment. Finally, a disruptor plate was installed upstream of the cooling die to mechanically regulate melt flow. Increasing plate compactness intensified localized shear and extensional deformation, resulting in higher fiber alignment and texturization indices despite reduced bulk hardness and cohesiveness. These structural changes were accompanied by increased β-sheet structure and disulfide bonding, supporting a flow-induced protein realignment mechanism. Overall, these findings demonstrate that HMMA structuring can be systematically controlled by integrating material functionality with thermal and mechanical process engineering. The proposed framework highlights rheological prediction, gelation control, and directional flow regulation as complementary strategies for designing plant-based meat analogs with tailored texture and fibrous architecture.

Micro/Nanoengineering technologies for the production of alternative foods

CURRICULUM VITAE



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경력
• 2024.03~현재. 서울대학교 바이오시스템공학과 조교수
• 2023.03~2024.02. 전남대학교 융합바이오시스템기계공학과 학술연구교수
• 2022.03~2023.02. 서울대학교 농업생명과학연구원 선임연구원

연구분야
• 마이크로/나노공학 기반 식품 소재 가공
• 3D 프린팅 기반 식물성 대체식품 개발
• 세포배양식품 적용을 위한 기능성 지지체 개발

기타(대표실적 등)
• H. Lee†, YS. Choi†, HS. Choi, R. Tae, J. Kang, D. Kang, W. Jung, K. Han, M. Cho, S. Chung, YR. Kim, S. Park*, S. Shin*. Rheologically Synchronized Protein and Fat-Emulsion Inks for High-Throughput Multimaterial Printing of Edible Soft Composites. *ACS Applied Materials & Interfaces*. 2026
• J. Seoul, J. Kim, Y. Hong, M. Cha, S. Park*, KJ. Jang*, SJ. Kim*, HI. Son*. Toward intelligent 3D food printing: a review on the perspective of materials, fabrication, monitoring, and control. *Critical Reviews in Food Science and Nutrition*. 2025.
• S. Park†, Y. Hong†, S. Park, W. Kim, Y. Gwon, H. Sharma. KJ. Jang, J. Kim. Engineering Considerations on Large-Scale Cultured Meat Production. *Tissue Engineering: Part*. B. 2024.

ABSTRACT

The increasing need to establish sustainable protein production systems has stimulated extensive research into alternative foods, particularly plant-based meat analogs and cultivated meat. Although these products are produced through distinct technological routes, both are intended to emulate the sensory, nutritional, and functional characteristics of conventional meat while mitigating the environmental burdens associated with livestock production. Micro- and nanoengineering technologies provide a versatile platform for addressing these challenges through the precise regulation of material composition, structure, and physicochemical functionality. This presentation introduces recent advances in fabrication technologies, including 3D printing, electrospinning, microfluidics, and other bottom-up assembly strategies for next-generation alternative protein foods. These approaches can be used to construct hierarchical and anisotropic structures, tailor texture and juiciness, and spatially incorporate plant proteins, lipids, and bioactive ingredients in plant-based products. In cultivated meat systems, related engineering principles enable the development of edible scaffolds and microenvironments that support cell attachment, proliferation, alignment, and myogenic differentiation. By connecting food engineering with biomaterials, tissue engineering, and advanced manufacturing, micro- and nanoengineering can provide a common technological foundation for diverse alternative food platforms.

현미경 이미지 딥러닝 기반 식품 미생물 신속분석법 개발: YOLO 모델의 성과와 한계 및 foundation model 기반 zero-shot 탐지 체계로의 확장

CURRICULUM VITAE



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연구분야
- Physics 기반 가상 식품 제조/가공 시스템(디지털 트윈) 개발 및 현장 적용
- 딥러닝을 이용한 새로운 식품 품질 분석법 개발 및 검증

기타(대표실적 등)
- Kim, J., Choi, Y.-M., Lyu, J. S., Lee, J.-S., & Han, J. (2025). Rapid artificial-intelligence-based detection of antimicrobial cationic ion activities against *Escherichia coli*. LWT, 239, 118901. https://doi.org/10.1016/j.lwt.2025.118901
- Kim, J., Jang, H., Lee, J.-S., Lyu, J. S., Choi, I., & Han, J. (2026). Multi-ion zeolite-based antimicrobial LDPE films for active food packaging: Ion combinations and performance in real food systems. *Journal of Food Science, 91(5)*, e71144. https://doi.org/10.1111/1750-3841.71144
- Kim, J., Choi, Y.-M., Lee, J.-S., Choi, I., & Han, J. (2026). Microcolony-based instance segmentation framework for rapid quantification of antimicrobial susceptibility in *Staphylococcus aureus*. *Food Bioscience, 82*, 109386. https://doi.org/10.1016/j.fbio.2026.109386

ABSTRACT

식품 미생물의 정량과 항균 소재 효능 평가는 배양 후 육안 콜로니 계수에 의존하며, 일반적으로 18시간에서 24시간이 소요된다. 이는 식품 안전 관리와 미생물의 대량 스크리닝 시 병목으로 작용한다. 본 연구는 광학현미경 이미지와 딥러닝으로 배양 초기 마이크로콜로니를 검출·정량·판별하는 신속분석법을 개발하고, 이를 zero-shot 탐지 체계로 확장하였다. 선행연구에서는 YOLO 알고리즘 기반 instance segmentation으로 배양 2-3 h의 마이크로콜로니를 검출하고 마스크된 콜로니의 픽셀 수를 표준곡선(R^2>0.99)으로 log CFU/mL로 환산하여, *E. coli*와 *S. aureus*에서 총 12건의 항균제 MIC·MLC 판정이 기존 평판계수법과 일치함을 확인하였다. 그러나 이러한 선행연구 방식은 균종을 추가할 때마다 대량의 이미지에 대한 폴리곤 라벨링과 모델 전체 재학습이 필요하며, AI 모델의 탐지 근거가 블랙박스라는 한계가 있다. 이를 해결하기 위해 foundation model인 Segment Anything Model 3(SAM3)를 이용한 zero-shot 분할 체계를 구축하였다. 저신뢰 단일 마스크로 반환되는 원시 출력을 3단계 보정으로 개별 마이크로콜로니를 마스크로 예측하고, human in the loop 검토 기능을 추가하였다. 그 다음 콜로니마다 형태학적 특징 10종, 질감 19종의 해석 가능한 특징을 추출하고 이를 AutoML로 학습하여 균종을 판별하는 분류기로 사용하였다. 그 결과 현미경 이미지 1,517장에서 분할용 수작업 라벨 없이 마이크로콜로니 284,401개를 분할하였고, *E. coli*와 *S. aureus*를 각각 0.94 이상의 정확도로 판별하였다. 특징 중요도 상위 10개 중 9개가 질감 특징으로, *E. coli*와 *S. aureus*의 내부 배열 차이가 두 균주 판별의 주된 근거로 해석된다. 이 방식으로 실제 균주 정량, 식품에서의 오염, 항균효과를 검증한 결과 기존의 YOLO 모델, 평판계수법과 차이가 없는 것으로 확인하였다. 결과적으로 본 연구를 통해 균종 추가에 따른 라벨링·재학습에서 프롬프트 확인·AutoML 분류기 재학습으로 전환하여, 다균종 판별·식품 매트릭스 적용으로 확장 가능한 라벨링 병목 없는 식품 미생물 신속분석 플랫폼의 기반을 제시한다.

POSTER
SESSION

P-1

PLA-based active food packaging films with sustained-release antimicrobial agents for extended shelf life

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P-2

Flower-like magnetic starch microparticles coupled with gold nanostars for synergistically enhanced SERS detection

Dong-Gook Kang*, Young-Rok Kim
Department of Food Science and Biotechnology, Kyung Hee University, Korea

P-3

Effects of addition timing and post-sonication of OSA-modified starch on oil-in-water emulsion formation and stability

Hyun-Soo Kang[1*], Ji-Hyun Kwak[1], Min-Seok Kim[1], Sung-Won Choi[2], Moo-Yeol Baik[1]
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P-4

Hyperspectral imaging-based prediction of cooked-rice hardness under different cooking and storage conditions

Youngjae Koo*, Mingyo Ha, Hyun-Jung Chung
Department of Food and Nutrition, Chonnam National University, Korea

P-5

In situ plasma-activated water treatment for the microbial decontamination and deodorization of brewer's spent grain

Il Ryeong Kwon*, Sea Cheol Min
Department of Food Science and Biotechnology, Seoul Women's University, Korea

P-6

Influence of protein source and powder-processing history on protein–lactose powder properties and O/W emulsion stability

Han-Gyeol Gwon*, Yeon-Ji Jo
Department of Food Processing and Distribution, Kangwon National University, Korea

P-7

Physicochemical quality analysis of fruit juices following thermal and LED treatments

Na-Kyung Kim*, Ji-Yoon Lee, Myong-Soo Chung
Department of Food Science and Biotechnology, Ewha Womans University, Korea

P-8

반응압출성형공정을 이용한 글루텐프리 제빵용 쌀 소재 개발 및 특성 규명

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P-9

Effects of reactive extrusion conditions on the gel and rheological properties of phosphorylated pre-gelatinized floury rice powder

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P-10

Variation in flour and starch properties and noodle quality among Korean wheat cultivars

Do Young Kim*, Myeong Yoon Nam, Dong-Hwa Cho, Hyun-Jung Chung
Department of Food and Nutrition, Chonnam National University, Korea

P-11

Monitoring of heavy metals in bracken ferns distributed in Korea using ICP-MS

Do-Hyeon Kim*, Chang-Hee Baek, Dae-Hwan Cho
Department of Food Safety Lab, CJ Freshway, Korea

P-12

Physicochemical properties and cookie quality of rice flours with different amylose contents

Dohun Kim*, Sungmin Jeong
Department of Marine Bio-Food Science, Chonnam National University, Korea

P-13

Interfacial activity and emulsion-stabilizing properties of shellac as functions of pH and concentration

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P-14

Texturization of plant proteins using shear cell and high-moisture extrusion systems: effects of dietary fiber type and concentration

Min Sung Kim[1*], Eun Seok Mun[1], Hyun-Seok Kim[1,2], Jungwoo Hahn[1,2]
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P-15 **Structural, thermal, and rheological characterization of soy protein concentrate from Korean soybeans**

Minjo Kim*, Chanmin Sagong, Ayeong Seung, Jinmo Kang, Suyong Lee
Department of Food Science & Biotechnology, Sejong University, Korea

P-16 **Effects of hydrocolloid type and concentration on the properties of *Tenebrio molitor* defatted powder gels for dysphagia diet applications**

Kim Minji*, Han Hyebin, Hahn Jungwoo
Department of Food Science and Biotechnology, College of Life Sciences, Kyung Hee University, Korea

P-17 **압출 및 효소 처리에 따른 밀 제분 부산물의 반죽 특성 및 결정 구조 변화**

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[3]전주대학교 식품영양학과

P-18 **Machine learning-assisted interpretation of volatile flavor compounds for cultivar classification of pear pomace**

Sunyoung Kim*, Jonggab Yim, Kiwon Lee, Donghyun Paik, Bomi Park, Ilbum Park
Research & Business Development Center, Kwangdong Pharmaceutical Co., Ltd., Korea

P-19 **Quality characteristics and biological activities of fermented vinegar produced from Geochang pear (*Pyrus pyrifolia*)**

Seon Jeong Kim*, YeongIn Choe, JiHo Lee, SoHee Im, YoungSook Kil
Industrial Materials Team, Gyeongnam Anti-Aging Research Institute, Korea

P-20 **Effects of xanthan gum–locust bean gum concentration and aqueous-phase location on electrolyte release, physical stability, and sensory properties of gel-in-oil-in-gel double emulsions**

Si Yeon Kim[1*], Mi-Jung Choi[2]
[1]Department of Food Science and Biotechnology of Animal Resources, Konkuk University, Korea
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P-21 **Sequence-controlled ion assembly regulates Na^+/K^+ availability in gellan gum-based NaCl–KCl particles for enhanced saltiness and reduced KCl-associated bitterness**

Yeongyeong Kim[1*], Eun Hye Cho[1], Mi-Jung Choi[2]
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P-22 **Effect of $W_1/O/W_2$ double-emulsion encapsulation on LAB viability and physicochemical stability of dongchimi during frozen storage**

Ye won Kim[1,2*], Sung Hee Park[1], Yun-Jeong Choi[1], Mi-Jung Choi[3], Mi-Ai Lee[1]
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P-23 **Modification of granular cold-water swelling rice flour by heat-moisture and pressure-moisture treatments to improve digestive resistance**

Ye-won Kim[1*], Seung-Min Lee[1], Min-Seok Kim[1], Sung-Won Choi[2], Moo-Yeol Baik[1]
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P-24 **Non-destructive monitoring of plant-based milk residue cleaning via multi-sensor fusion and machine learning**

Jiin Kim*, Woo-Ju Kim
Department of Food Science and Biotechnology, Seoul National University of Science and Technology, Korea

P-25 **Moisture-dependent glass transition and lipid thermal behavior of freeze-dried nanoparticle powders with different lipid compositions and wall-matrix states**

Chang-Young Kim[1*], Mi-Jung Choi[2]
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[2]Major of Food Engineering School of Animal & Food Sciences and Marketing, Konkuk University, Korea

P-26 **Puffing-induced structural and phytochemical changes and their associations with biological activities in grapefruit (*Citrus paradisi*) peel**

Cho-A Kim[1*], Min-Seok Kim[1], Sung-Won Choi[2], Moo-Yeol Baik[1]
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P-27 **Optimization of decolorization process for seaweed polysaccharide extraction residue and exploration of Its potential as a novel plant-based protein**

Taein Kim[1*], Juhyun Bae[1], Euijin Kim[1], Seogwang Kim[2], Hyun-Seok Kim[1,2]
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P-28 **Application and raw material expansion of reflux extraction process for securing high-quality flavor extracts**

Haet Tteum Kim*, Tae Seok Kim, Hwangbo Hark, Yoon Tae Hwang, Sang Won Jung, Chan Yong Lee, Hyeon Gyu Yang
Global Meal Creation Production Technology Center, Pulmuone Co., Ltd., Korea

P-29 **Construction of $O_1/W/O_2$ double emulsions for plant-based butter alternatives: role of soybean protein isolate concentration and oleogel mass fraction**

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P-30 **Differences in component partitioning during freeze concentration in complex alcoholic beverage matrices**

Hyun-Cheol Kim*, Kitae Kim
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Department of Polar Sciences, University of Science and Technology (UST), Korea

P-31 **Comparative analysis of wavelength-dependent LED inactivation in *Shigella sonnei*, *Bacillus subtilis*, and *Saccharomyces cerevisiae*: mechanistic insights from cellular damage responses**

Hye-Yeon Kim*, Ji-Yoon Lee, Myong-Soo Chung
Department of Food Science and Biotechnology, Ewha Womans University, Korea

P-32 **Development and characterization of a pH-responsive chitosan-cinnamaldehyde schiff base for active food packaging**

Evariste Niringiyimana[1*], Sihyun Kim[1], Haeri Choi[2], Dowan Kim[1,2]
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P-33 **Temperature-modulated kinetic control of short-chain glucan self-assembly to generate diverse hierarchical nanostructures**

Hyo-bin Ryu*, Taesoo Hwang, Sang-mook You
School of Food Science and Biotechnology, Kyungpook National University, Korea

P-34 **Formation and characterization of chicken-like texture by a combined compression-thawing process of frozen tofu**

Eun Seok Mun[1*], Jungwoo Hahn[1,2], Hyun-Seok Kim[1,2]
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P-35 **Engineering tilapia proteins through surimi processing for enhanced texture and gel functionality**

Sojeong Park*, Junghee Jung, Jaeha An, Bomi Kim, Hyojin Yoo, Jung-Soo Lee
Department of Food Science and Nutrition, Pusan National University, Korea

P-36 **Spectral dependence of *Escherichia coli* inactivation by LED irradiation: action spectrum characterization and evaluation of pulsed treatment conditions**

So-Jung Park*, Hye-Jae Choi, Myong-Soo Chung
Department of Food Science and Biotechnology, Ewha Womans University, Korea

P-37 **Concentration-dependent structuring and structure–function relationships of mycoprotein – κ-carrageenan gels**

Yejin Park*, Heeyeon Choi, Chaehee Yeon, Seungmin Baek, Gaeun Son, Yeon-Ji Jo
Department of Food Processing and Distribution, Kangwon National University, Korea

P-38 **Structural modification of chickpeas by tempering-roasting for enhanced β-carotene delivery via nanoemulsion impregnation**

Jaeeun Park[1*], Mi-Jung Choi[2]
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P-39 **Temporal organization of fat- and emulsion-related oral sensations across mayonnaise formulation matrices**

Ji-Soo Park*, Hye-Seong Lee
Department of Food Science and Biotechnology, Ewha Womans University, Korea

P-40 **Preparation of anisotropic starch particles using γ-valerolactone-mediated anti-solvent precipitation: Morphological transition and mechanistic insights**

Ji-Won Park*, Sang-Mook You
School of Food Science and Biotechnology, Kyungpook National University, Korea

P-41 **Physicochemical properties of short-chain glucan aggregates (SCGA) modified by pressure annealing treatment**

Yu-Jeong Bae[1*], Min-Seok Kim[1], Sung-Won Choi[2], Moo-Yeol Baik[1]
[1]Department of Food Science and Biotechnology, Kyung Hee University, Korea
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P-42 **국내 사과 소비 촉진 목적 가공식품 개발을 위한 소비자 선호도 조사**

배재혁*, 이효영, 임재길, 이재희, 이기연, 김두은, 노희선, 권혜정
강원특별자치도농업기술원 농식품연구소

P-43 **Evaluation of physicochemical properties and stability for selecting the optimal composition of boswellia nanoemulsions**

Seungmin Baek*, Han-Gyeol Gwon, Gaeun Son, Chaehee Yeon, Yejin Park, Yeon-Ji Jo
Department of Food Processing and Distribution, Kangwon National University, Korea

P-44 **Temperature-dependent pressure dynamics in kimchi and a simple fermentation model**

Sangoh Kim*, Jihyun Byun, Minji Choi, Wookwon Lee
Department of Food Science and Engineering, Dankook University, Cheonan, Korea

P-45 **Machine learning-based discrimination of Korean wheat flours using complementary instrumental analyses**

Chanmin Sagong*, Sang-jin Ye, Suyong Lee
Department of Food Science & Biotechnology, Sejong University, Korea

P-46 **Effects of plant protein composition on structural formation and textural properties of chicken-like multilayer protein structures**

Chae Eun Seol[1*], Eunseok Mun[1], Hyun-Seok Kim[1,2]
[1]*Department of Food Science and Biotechnology, Graduate School, Kyung Hee University, Korea*
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P-47 **Multimodal analysis of physical properties in commercial conventional and plant-based mayonnaise**

Gaeun Son*, Heeyeon Choi, Seungmin Baek, Yejin Park, Chaehee Yeon, Yeon-Ji Jo
Department of Food Processing and Distribution, Kangwon National University, Korea

P-48 **Evaluation of fatty acid-fatty alcohol binary oleogels as shortening replacers in cookies**

Byeonguk Son*, Suyong Lee
Department of Food Science and Biotechnology, Sejong University, Korea

P-49 **Machine learning-based prediction of cultivar composition and blending ratios of Korean wheat flour using GlutoPeak analysis**

Ayeong Seung*, Suyong Lee
Department of Food Science & Biotechnology, Sejong University, Korea

P-50 **Tailoring the surface chemistry and functional properties of chitosan-derived carbon nanodots through hydrothermal synthesis conditions and urea supplementation**

Ji In Shin[1*], Yu Ji Ye[1], Min Hyeock Lee[1,2]
[1]*Department of Biotechnology, College of Life Sciences and Biotechnology, Korea University, Korea*
[2]*Department of Food Bioscience and Technology, College of Life Sciences and Biotechnology, Korea University, Korea*

P-51 **TEMPO-oxidized cellulose nanofiber oleogels as structural mimetics of pork adipose tissue**

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P-52 **Optimization of precursor composition for potato-like flavor development using response surface methodology (RSM)**

Gaeun Yang*, Youngmog Kim, Yangbong Lee
Department of Food Engineering, Pukyong National University, Korea

P-53 **Consumer-perceived sensory direction in grape tomatoes: cross-format convergence and paired-descriptor response patterns**

Si-Yoon Yang*, Na-hyung Koo, Gyu-seo Choi, Hye-Seong Lee
Department of Food Science & Biotechnology, Ewha Womans University, Korea

P-54 **Thermorheological, gelation, and textural characteristics of thermosetting and thermoplastic plant protein complexes**

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P-55 **Characterization of spray-dried pyropia protein concentrate–plant protein mixtures: effects of protein type on physicochemical and rheological properties**

Chaehee Yeon*, Han-Gyeol Gwon, Yejin Park, Gaeun Son, Seungmin Baek, Yeon-Ji Jo
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P-56 **Evaluation of the physiological activities of functional puffed chips**

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P-57 **Comparative analysis of bioactive properties of hot water and ethanol extracts from sesame, perilla, and ginger by-products**

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P-58 **Development of a functional spread using apple, ginger and cinnamon: evaluation of antioxidant and nitrite-scavenging activities**

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P-59 **Comparison of subcritical water extraction and ultrasound-assisted extraction for punicalagin and antioxidant activities from pomegranate peel (*Punica granatum L.*)**

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P-60 **Comparison of response surface methodology, machine learning, and RSM-ML hybrid models for optimizing subcritical water extraction of polyphenols from apple pomace**

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P-61 **Effects of high hydrostatic pressure levels on the preparation and physicochemical properties of granular cold-water swelling rice flour (GCWSRF)**

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P-62 **Optimization of calcium lactate pretreatment and block fabrication conditions to enhance texture and sensory quality of freeze-dried food**

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P-63 **Genome-based AI prediction of lactic acid bacterial β-glucosidase activity and enhanced ginsenoside bioconversion of puffed ginseng by *Lactiplantibacillus plantarum* KFOM0044**

Hyeong-Rak Yoon*, Chan-Il Bae, Yoon-Soo Gwak, Moo-Yeol Baik, Mi-Ju Kim
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P-64 **Integrated characterization of bitterness in structurally distinct food flavonoids: Analytical verification, sensory evaluation, and receptor-level structural context**

Nawon Lee*, U-Ju Chang, Yeeun Park, Jin-Byung Park, Hye-Seong Lee
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P-65 **Machine learning-based hyperspectral imaging analysis for rapid and non-destructive starch classification**

Da Eun Lee*, Suyong Lee
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P-66 **Evaluation of physical properties of emulsion gels based on sodium alginate and low-acyl gellan gum for animal fat replacement**

Dong-Heon Lee*, Seo-Yeon Jeong, Ye-Won Kwon, Sei Lim, Se-Won Cheon, Dong-Gu Lee, Geon-Ha Kim, Ji-Hyun Seol, Se-Ho Jeong, Dong-Un Lee
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P-67 **Food by-product-derived carbon dots with antibacterial and antioxidant activities for active food packaging**

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P-68 **Effects of xylitol on KCl bitterness and sensory properties in aqueous and oil-in-water emulsion systems**

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P-69 **Freeze-thaw tofu as a scaffold for culturing chicken fibroblasts (DF-1)**

Seo Yeong Lee*, Jisu Choi, Unhyeok Lee, Seulbi Lee, Jiyeong Lee, Choongjin Ban
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P-70 **OSA-modified starch microspindles with different morphologies for HIPPE formation and pork fat replacement**

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P-71 **Controlled synthesis of glutathione-derived carbon dots: Effects of precursor ratio and temperature on formation, surface chemistry, and antioxidant activity**

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P-72 **Influence of discharge voltage on the inactivation of *Bacillus subtilis* vegetative cells and endospores under equivalent total fluence in a pilot-scale IPL system**

Subin Lee[*], Hye-Jae Choi, Myong-Soo Chung
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P-73 **Thermoresponsive alginate–GTPS composite emulsion gels as porcine back fat mimetics for reduced-fat meat products**

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P-74 **Effects of candelilla wax and palm stearin contents on the physical properties of hybrid bigels as butter alternatives**

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P-75 **Hydrogenated soybean lecithin-containing reduced-fat mayonnaise: formulation characteristics, subjective fullness, and subsequent energy intake**

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P-76 **Chitosan-based stabilization and characterization of liposomal formulations containing a high content of plant extract complex**

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P-77 **Understanding the role of hydrocolloids in the quality characteristics of zein-based gluten-free bread**

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P-78 **Wavelength-dependent mechanisms of bacterial inactivation by LED irradiation**

Ji-Yoon Lee[*], Myong-Soo Chung
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P-79 **Fabrication of fiber-like starch nanostructures from short-chain glucans through anisotropic growth**

Ji-Hyeon Lee[*], Young-Rok Kim
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P-80 **Quantitative prediction of wheat blend ratios using NIR spectroscopy and machine learning**

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P-81 **Analysis of dielectric heating characteristics of home meal replacement (HMR) model foods during microwave heating**

Chanho Lee[*], Jun Bo Shim, Seon Min Kim, Youngsu Kim, Heeju Choi, Sung Hee Park
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P-82 **Effects of the physicochemical properties of K-sauces on microbial inactivation**

Chae-Eun Lee[*], Jong Won Lee, Jungyeon Park, Hanwool Lee, Geun-Pyo Hong
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P-83 **Volatile flavor profiling of freeze-dried (FD) instant coffee based on bean variety, origin and roasting degree using HS-SPME-GC-MS**

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P-84 **Effects of alginate-based additives on the physicochemical properties of rice cakes during refrigerated and frozen storage**

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P-85 **Exploring edible snail protein as a sustainable animal-derived protein resource: optimization of alkaline extraction via Box–Behnken design and characterization of Its gelation properties**

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Department of Food Science and Biotechnology, Seoul National University of Science and Technology, Korea

P-86 **펙틴 가수분해물을 이용한 가루쌀 분말 및 가루쌀 전분의 열전환(pyroconversion)에 따른 물리화학적 및 소화특성**

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P-87 **Agricultural waste valorization and development of multifunctional food packaging materials with antimicrobial, antioxidant, and antifouling performance**

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P-88 **Intermediate oil-phase modulation by β-sitosterol in $W_1/O/W_2$ double emulsions stabilized by heat-ultrasound-treated faba bean protein isolate**

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P-89 **Upcycling hemp seed cake into high-moisture meat analogs: influence on thermal gelation, secondary structure, and texturization**

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P-90 **Evaluation of meaty flavor profiles and volatile pattern changes in a plant-based meat flavor system using electronic nose analysis**

Sang Won Jung*, Tae Seok Kim, Hark Hwangbo, Yoon Tae Hwang, Haet Tteum Kim, Hyeon Gyu Yang, Ji Su Ko
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P-91 **Effect of layer-wise 5-methylfurfural incorporation on the physicochemical properties and flavor retention of multilayer emulsions**

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P-92 **Effects of alkaline agents on the formation and rheological properties of neutralized curdlan gels**

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P-93 **Biphaisc co-encapsulation of piperine and curcumin in O/W nanoemulsion and 4-α-glucanotransferase-treated potato starch for enhanced bioaccessibility and dysphagia-oriented delivery**

In-Geun Jung[1,2*], Shin-Jae Lee[1,2], Yong-Ro Kim[1,2,3,4]
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P-94 **Engineering meat-like anisotropic structures in pea protein gels via bacterial cellulose-assisted unidirectional freezing**

Junghee Jung*, Sojeong Park, Jaeha An, Bomi Kim, Hyojin Yoo, Jung-Soo Lee
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P-95 **Synthesis of *Lactobacillus plantarum*-derived carbon dots and their antiviral efficacy against norovirus and SARS-CoV-2 surrogates**

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P-96 **Direct steam injection investigation for thermal treatment of the oyster sauce**

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P-97 **Effects of fermentation time on functional components of sweet potato distillery by-products and their retention after maltodextrin encapsulation**

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P-98 **Shrimp shell washing using *in-situ* plasma-activated water for microbial decontamination and deodorization**

Eun Joon Joe*, Sea Cheol Min
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P-99 **Sequential extraction of pectin and cellulose from apple pomace by optimized acid and alkaline treatments**

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P-100 **그래핀 중적외선 열원에 대한 닭가슴살 가열 특성**

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P-101 **Modulation of precursors and dopants for tailoring the functional properties of carbon nanodots**

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P-102 **Comparison of single- and dual-transducer configurations for real-time monitoring in CIP systems**

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P-103 **Fucoxanthin alleviates Alzheimer's disease-related protein aggregation and neuroinflammation in APP/PS1 mice**

Go Eun Choi[1*], So Young Lee[1], Chi Rac Hong[1], Yong-Tae Kim[1], Seung-Yong Lim[1], Jung-Kil Seo[1], Ju-Hyeong Jung[2], Sung-Chul Hong[1]
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P-104 **Digital twin of a microwave based on deep learning for real-time endpoint control during steamed egg cooking**

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P-105 **맥피 종류 및 효소 처리에 따른 인산염 처리 압출 쌀가루의 이화학적 특성 비교**

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P-106 **Comparison of lignan content, antioxidant activity, and protective effects against scopolamine-induced damage in SH-SY5Y cells among sesame cultivars**

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P-107 **Thiol-ene reaction induction using cold plasma for linseed oil-based bio-polyol synthesis: Application of the bio-polyols to quail egg packaging foam preparation**

Ye Seul Choi*, Sea Cheol Min
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P-108 **Freeze-drying process fabrication of smart absorbent pads integrating antibacterial activity and real-time colorimetric monitoring for food packaging and freshness indication**

Jinmyung Choi*, Hansu Kim, Hyeonmo Yang, Jun Kyun Oh
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P-109 **Comparative evaluation of UV-B light sources for bacterial inactivation: process efficiency and inactivation mechanisms**

Hye-Jae Choi*, So-Jung Park, Myong-Soo Chung
Department of Food Science and Biotechnology, Ewha Womans University, Korea

P-110 **Matrix- and surfactant-dependent properties of spray-dried milk phospholipid-rich extract powders: reconstitution stability and *In vitro* lipid digestion**

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P-111 **Effects of microwave reheating time on the quality characteristics of refrigerated cooked rice**

Minjin Pyo*, Mingyo Ha, Hyun-Jung Chung
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P-112 **Ionized gas-assisted epoxide ring-opening of epoxidized waste cooking oil for bio-based polyurethane foam production**

Ye Eun Ha*, Sea Cheol Min
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P-113 **Henry's law analysis of temperature-dependent CO_2 solubility in aqueous lysine solutions at atmospheric pressure**

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P-114 **pH-dependent phase behavior of shellac in aqueous systems**

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P-115 **Optimization of oleogels with improved creaming properties by response surface methodology and machine learning: Evaluation as a butter replacer in pound cake**

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P-116 **Signaling pathway involved in DNA damage induced by food additive titanium dioxide**

Do-Ah Ham*, Bo-Hyun Kim, Soo-Jin Choi
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P-117 ***In vitro* polyphenol-mediated effects on titanium dioxide-induced genotoxicity and oxidative stress**

Do-Ah Ham*, Soo-Jin Choi
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P-118 **Characteristics of ginseng and red ginseng powder using subcritical water and spray drying integrated process**

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P-119 **AI-driven screening and experimental characterization of putative lipase candidates**

Chi Rac Hong[1*], So Young Lee[1], Go Eun Choi[1], Yong-Tae Kim[1], Kwon-Sam Park[1], Na-Young Lee[1], Ju-Hyeong Jung[2], Sung-Chul Hong[1]
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P-1

PLA-based active food packaging films with sustained-release antimicrobial agents for extended shelf life

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To develop sustainable multifunctional packaging for food preservation, PLA-based films were fabricated using rice husk (RH) and β-cyclodextrin (β-CD)-encapsulated cinnamon essential oil (CEO). The β-CD/CEO inclusion complex enabled sustained CEO release while reducing the initial burst release in various food simulants. The developed film exhibited antimicrobial activity against foodborne *Escherichia coli* and food-handling-associated Staphylococcus epidermidis, producing inhibition zones larger than 1 cm within 24 h. In biodegradation tests, the final film showed approximately 5% greater weight loss than neat PLA after 10 weeks, indicating enhanced degradability. In food preservation tests, cheese packaged with the final film showed delayed mold growth and an extended shelf life of 8 days. The sustained release of natural antimicrobial compounds effectively suppressed microbial spoilage and prolonged food shelf life. By integrating agricultural by-product valorization, controlled antimicrobial delivery, enhanced degradation, and effective real-food preservation, PLA/RH-based films demonstrate significant potential as next-generation food packaging materials.

P-2

Flower-like magnetic starch microparticles coupled with gold nanostars for synergistically enhanced SERS detection

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Sensitive analysis of trace contaminants in complex food matrices requires materials capable of both target enrichment and strong signal amplification. Here, flower-like magnetic starch microparticles were fabricated through ethanol-induced reorganization of short-chain glucans. Particle morphology was strongly dependent on seed size, with 200–300 nm, 1–2 μm, and >2 μm seeds producing rod-like, flower-like, and spherical structures, respectively. Magnetic nanoparticles were incorporated onto starch templates prior to structural reorganization, allowing the resulting flower-like particles to retain magnetic responsiveness. Silver nanoparticles were subsequently formed on the hydroxyl-rich surface by *in-situ* reduction, generating abundant plasmonic hotspots. When combined with gold nanostars (GNSs) pre-deposited on a wafer, the Ag-coated particles produced a pronounced synergistic SERS enhancement, substantially improving detection sensitivity. This integrated platform combines magnetic enrichment and plasmonic amplification for sensitive detection of trace analytes in complex food matrices.

P-3

Effects of addition timing and post-sonication of OSA-modified starch on oil-in-water emulsion formation and stability

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Octenyl succinic anhydride (OSA)-modified starch has been widely used as a stabilizer for oil-in-water (O/W) emulsions through interfacial adsorption and continuous-phase thickening. Although numerous studies have investigated the effects of starch concentration, oil content, and homogenization conditions on emulsion stability, limited information is available on stabilizer addition timing as a processing variable. Therefore, this study evaluated the effects of OSA-modified starch addition timing and post-sonication on O/W emulsion formation and stability. An aqueous dispersion of OSA-modified starch was used to prepare emulsions containing 2% (w/v, dry basis) starch and 30% (v/v) oil. The three processing sequences consisted of simultaneous addition (SA), post-addition (PA), and post-addition followed by sonication (PAS) were performed. Light microscopy (LM) revealed no distinct differences in apparent droplet size or distribution among the samples. Despite their similar microscopic appearances, SA exhibited the highest emulsifying activity index (EAI) and emulsion stability index (ESI), followed by PAS and PA. The superior EAI and ESI values of SA and PAS may reflect more effective adsorption of OSA-modified starch at the oil–water interface. These findings indicate that OSA-modified starch addition timing and post-sonication may be critical to modulate O/W emulsion formation and stability.

P-4

Hyperspectral imaging-based prediction of cooked-rice hardness under different cooking and storage conditions

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Hardness of cooked rice is a key determinant of eating quality and increases during refrigerated storage as a result of starch retrogradation. This study evaluated the feasibility of hyperspectral imaging (HSI) for nondestructive prediction of cooked-rice hardness across different cooking conditions and storage periods. Rice was cooked in an electric rice cooker under non-pressure or high-pressure conditions, or autoclaved at 0.15, 0.20, or 0.25 MPa. The cooked samples were stored at 4°C for up to 7 days. Hyperspectral images were acquired over 900-1700 nm, and hardness was measured by texture profile analysis (TPA) using a texture analyzer. Overall hardness was 10.56±2.30 N (coefficient of variation, 21.79%). Hardness tended to increase with increasing storage period in all treatments. Among regression models using raw spectra, ridge regression gave the most accurate predictions in 5-fold cross-validation (R^2=0.72; RPD=1.90). Using Savitzky-Golay second-derivative spectra, the ExtraTrees model achieved higher cross-validated performance (R^2=0.76; RPD=2.02). Uninformative variable elimination selected seven informative wavelengths for hardness prediction (971, 1071, 1164, 1168, 1171, 1175, and 1325 nm). These results demonstrate that HSI combined with chemometric modeling enables nondestructive prediction of cooked-rice hardness under varying cooking and storage conditions.

P-5

In situ plasma-activated water treatment for the microbial decontamination and deodorization of brewer's spent grain

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This study optimized in situ plasma-activated water (iPAW) treatment to improve the microbiological safety of brewer's spent grain (BSG) and evaluated changes in microbial community composition, major off-flavor compounds, and quality characteristics. iPAW treatment was performed by introducing ionized gas generated from atmospheric dielectric barrier discharge plasma at 600–1400 W into a mixture of BSG and distilled water for 5–20 min, and the antimicrobial effect against indigenous mesophilic aerobic bacteria was evaluated using response surface methodology. Changes in volatile compounds at 400–1400 W for 20 min were analyzed using gas chromatography with headspace solid-phase microextraction. The optimal condition of 1400 W for 20 min achieved 4.3 log CFU/g bacterial inactivation. iPAW treatment altered the relative abundance within the microbial community and decreased the Shannon diversity index during 3 days of storage at 4°C. iPAW treatment also decreased the peak areas of three major off-flavor compounds, with the extent of the decrease varying depending on discharge power. iPAW washing increased moisture content by 14.1 percentage points and decreased ABTS radical scavenging activity by 9.1 percentage points without significantly affecting color. These results demonstrate the potential of iPAW as a non-thermal treatment for simultaneous microbial decontamination and off-flavor reduction in BSG.

P-6

Influence of protein source and powder-processing history on protein–lactose powder properties and O/W emulsion stability

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This study investigated how protein source and powder-processing history affect the physicochemical properties of protein–lactose powders and the stability of oil-in-water (O/W) emulsions. Whey protein isolate (WPI), soy protein isolate (SPI), or pea protein isolate (PPI) was mixed with lactose (3:2, w/w) in phosphate buffer (pH 7.0; 10% total solids) and subjected to different drying and storage treatments. Powder morphology and crystallinity were evaluated, while moisture sorption behavior was assessed for spray-dried powders. The powders were reconstituted and used to prepare O/W emulsions containing medium-chain triglycerides (MCT) or palm oil (10% oil). Freeze-dried WPI and SPI formed large, irregular, plate-like particles, whereas spray-dried powders were smaller and spherical, and RH-treated spray-dried powders showed pronounced aggregation and caking. Moisture uptake increased sharply above 60–70% RH. XRD patterns were predominantly amorphous, whereas PPI-RSD showed distinct crystalline peaks, suggesting humidity-induced formation of crystalline domains. WPI-based emulsions had smaller droplets than SPI- and PPI-based emulsions, and all emulsions exhibited ζ-potentials below -30 mV. WPI emulsions also showed low sensitivity to powder-processing treatments, although their physical stability varied with oil type. These findings demonstrate that the effects of powder-processing history on subsequent emulsion performance are dependent on both protein source and oil type.

P-7

Physicochemical quality analysis of fruit juices following thermal and LED treatments

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Microbial inactivation processes for fruit juices should ensure microbial safety while minimizing changes in physicochemical quality. This study evaluated the effects of thermal treatment and LED irradiation on the physicochemical properties of apple, muscat grape, and pear juices inoculated with *Escherichia coli.* Juices were subjected to thermal treatment at 90°C or LED irradiation at 265, 405, and 850 nm. Following treatment, pH, °Brix, and color parameters (L*, a*, and b*) were measured to assess quality changes under different processing conditions. pH and °Brix remained relatively stable after both thermal and LED treatments across all three juices. In terms of color, thermal treatment tended to decrease L* values across all three juice types. At 265 nm, apple and pear juices showed little change in color, whereas muscat grape juice exhibited more noticeable changes. At 405 nm, relatively modest color changes were observed in all juices. At 850 nm, greater color changes were observed in all juices, likely due to the long irradiation time and high fluence. Overall, pH and °Brix were relatively well maintained, whereas color parameters varied depending on both wavelength and juice type. Thermal treatment resulted in larger color differences than 265 nm irradiation in apple and pear juices. These findings highlight the importance of considering both wavelength and juice type when applying LED-based processing to fruit juices.

P-8

반응압출성형공정을 이용한 글루텐프리 제빵용 쌀 소재 개발 및 특성 규명

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본 연구는 반응압출성형 공정조건에 따라 제조된 인산화 알파미분의 겔 및 유변학적 특성을 분석하고 글루텐프리 식품 소재로서의 적용 가능성을 식빵을 대상으로 평가하였다. 반응압출성형 공정조건 (pH, 배럴 온도, 스크류 회전속도)를 달리하여 제조한 인산화 알파미분의 저항전분 함량 및 동적 유변학적 특성과 인산화 알파미분 겔의 미세구조, texture profile analysis (TPA), stress relaxation 시험 및 냉·해동 안정성을 분석하였다. 제조된 인산화 알파미분의 저항전분 (resistant starch, RS) 함량, 유변학적 특성, 알파미분으로부터 제조된 겔의 미세구조와 질감 특성은 반응압출성형 공정조건에 유의적인 영향을 받았다. 한편 인산화 알파미분의 RS 함량과 겔 경도 및 부착성에 기초한 4종의 시료를 선발하여 가루쌀 (DMAF) 대조군과 8:2 (w/w)로 혼합하여 글루텐프리 식빵을 제조하고 물리적, 질감 및 외관 특성을 평가하였다. 반응압출성형 인산화 알파미분 첨가군은 대조군 (가루쌀 100%)보다 낮은 경도와 부착성을 나타냈다. 또한 식빵 외관에 있어 crust의 결함이 감소하였고, 대조군과 유사한 비용적을 유지하면서 대조군보다 낮은 경도와 부착성을 나타내었다. 결과적으로 반응압출성형을 통한 인산화 알파미분은 글루텐프리 베이커리 제품의 구조적, 질감적 및 유변학적 특성을 조절할 수 있는 밀가루 대체 또는 쌀가루 물성 개선 소재로의 잠재력이 높은 것 같다.

P-9

Effects of reactive extrusion conditions on the gel and rheological properties of phosphorylated pre-gelatinized floury rice powder

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This study investigated the gel and rheological properties of phosphorylated pre-gelatinized floury rice powder prepared under different reactive extrusion conditions. Reactive extrusion was conducted at pH 6–10, barrel temperatures of 130–170°C, and screw speeds of 120–160 rpm. Gel appearance, texture profile analysis (TPA), stress relaxation, dynamic rheological properties, freeze-thaw stability, and microstructure were evaluated. Screw speed significantly affected hardness, springiness, gumminess, and chewiness (p<0.05), while hardness and adhesiveness showed different response patterns depending on the processing conditions. Percentage stress relaxation (%SR) varied significantly with barrel temperature (p<0.05). Dynamic rheological analysis showed elastic-dominant behavior (G′>G″) at low strain and differences in frequency- and temperature-dependent responses among samples. Power-law analysis confirmed shear-thinning behavior, with flow behavior indices (n) of 0.107–0.242 and consistency indices (K) of 278.3–540.1 Pa·s^n. Syneresis remained below 2% after seven freeze-thaw cycles, indicating high freeze-thaw stability. SEM revealed porous microstructures in the freeze-dried gels. Overall, reactive extrusion conditions resulted in distinct textural, stress relaxation, and rheological properties, providing a basis for selecting phosphorylated pre-gelatinized floury rice powder for different food applications.

P-10

Variation in flour and starch properties and noodle quality among Korean wheat cultivars

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Comparative information on flour and starch properties and noodle quality among Korean wheat cultivars remains limited. Kernel microstructure, flour protein and gluten properties, physicochemical properties of isolated starch, and cooked-noodle quality were evaluated in ten Korean wheat cultivars. Flour protein and gluten properties varied widely among cultivars (protein, 9-14%; wet gluten, 30-47%), as did the amylose content (26-32%) and pasting properties of the isolated starches. Among the cultivars examined, Hwanggeumal starch exhibited higher peak and breakdown viscosities, but its gel showed a lower storage modulus. In contrast, Hanmyeon starch exhibited a higher pasting temperature and lower breakdown viscosity, and its gel showed a higher storage modulus. Cooked noodles also differed in textural properties among cultivars; those prepared from Jeokjoong flour exhibited higher hardness but lower cohesiveness and resilience. The wide variation observed in flour, gluten, and starch properties among the ten cultivars was accompanied by clear differences in cooked-noodle texture, providing useful information for selecting Korean wheat cultivars for noodle products with specific textural characteristics.

P-11

Monitoring of heavy metals in bracken ferns distributed in Korea using ICP-MS

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Bracken fern (*Pteridium aquilinum*) is a perennial fern widely consumed in East Asia, including Korea, and is known for its ability to accumulate arsenic (As). This study investigated lead (Pb) and cadmium (Cd) contamination in 64 bracken fern samples purchased online and offline in Korea between 2023 and 2026. Samples were digested with nitric acid using a microwave digestion procedure according to the Korean Food Standards and Specifications and analyzed by ICP-MS. Calibration curves showed excellent linearity ($R^2 \geq 0.999$), and the limits of detection were 0.718 μg/kg for Pb and 1.090 μg/kg for Cd. Pb-208 and Cd-111 were quantified using Bi-209 and In-115 as internal standards, respectively. Pb and Cd concentrations ranged from 0.00 to 0.06 mg/kg and 0.00 to 0.21 mg/kg, respectively. All samples complied with the Pb standard, whereas some exceeded the Cd standard. In 2026, several samples showed Cd concentrations of 0.06-0.10 mg/kg, exceeding the regulatory limit. Moreover, both compliant and non-compliant samples were observed in the same collection area, indicating that compliance could not be determined solely by collection area. These findings highlight the need to evaluate variations associated with production area, collection area, and country of origin and may provide a scientific basis for assessing the appropriateness of current regulatory standards for bracken fern.

P-12

Physicochemical properties and cookie quality of rice flours with different amylose contents

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Amylose content is an important factor affecting the physicochemical and processing properties of rice flour. In this study, the physicochemical properties of rice flours with different amylose contents were characterized and their relationships with cookie quality were investigated. The rice flours had similar moisture and total starch contents, whereas amylose content varied considerably among cultivars (5.53–36.65%). Particle size distribution also differed, with Dodam showing the narrowest distribution. Water hydration properties varied among cultivars, and Dodam showed particularly low water absorption index and swelling power. Rice flours generally exhibited higher solvent retention capacity (SRC) than wheat flour, with differences among cultivars and solvents. Within the low-to-intermediate amylose range, final and setback viscosities generally increased with amylose content. In contrast, Dodam, with the highest amylose content, exhibited exceptionally low viscosities throughout the pasting profile, accompanied by low swelling power. Cookie quality also differed among cultivars, with Geumgang1 showing the highest spread factor, followed by Hanareum4 and Saeilmi, which also showed lower L* values. Overall, amylose content and related physicochemical properties were associated with the hydration, pasting, and cookie-making properties of rice flour.

P-13

Interfacial activity and emulsion-stabilizing properties of shellac as functions of pH and concentration

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Shellac is an insect-derived polyester resin with amphiphilic and pH-responsive properties that may replace synthetic food emulsifiers. This study evaluated the effects of pH and concentration on the interfacial activity and emulsifying and foaming properties of shellac. Shellac was dissolved in 0.1 M NaOH, adjusted with HCl, and analyzed for surface tension by the Wilhelmy plate method. Oil-in-water emulsions containing 0.1% shellac were evaluated for emulsifying activity index (EAI), emulsion stability index (ESI), 7-day creaming index, particle size, and zeta potential. Surface tension decreased with increasing shellac concentration up to 0.05% and then remained at 41-42 mN/m, indicating a critical aggregation concentration of approximately 0.05%. Similar concentration-dependent trends were observed at pH 7 and 12.9. Titration determined an apparent pKa of approximately 6.44, whereas turbidity increased during storage below pH 4.5, indicating particle aggregation. Shellac improved EAI under high-oil conditions; at 20% oil, EAI was 0.080 m^2/g, approximately 3.8-fold higher than that of the control. After 7 days, the creaming index of shellac-containing emulsions (1.0-4.5%) was lower than that of controls (4.0-19.2%). Foaming capacity increased with concentration, but foam stability was low. These results demonstrate pH- and concentration-dependent interfacial adsorption of shellac and support its potential as a natural emulsifier, particularly for high-oil emulsions.

P-14

Texturization of plant proteins using shear cell and high-moisture extrusion systems: effects of dietary fiber type and concentration

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The demand for plant-based meat analogues is increasing because of growing concerns about sustainability and health. To mimic the texture of whole-muscle meat, plant proteins must be texturized using technologies such as thermoplastic extrusion, high-moisture extrusion (HME), 3D printing, and shear cell (SC) technology. This study investigated and compared the effects of dietary fiber type and concentration on the texturization of plant proteins using a semi-pilot-scale SC and HME systems. A blend of soy protein isolate (SPI), pea protein isolate (PPI), and wheat gluten (WG) at a ratio of 47.3:15.7:37.0 (w/w) was used as the plant protein source. Sodium alginate (as a control), soy fiber, pea fiber and citrus fiber were used as binders. The plant protein blend was mixed with each binder at concentrations of 1%, 2%, 4%, and 6% (w/w), based on the dry weight of the proteins. The mixtures were hydrated with deionized water to obtain a final moisture content of 70% and then subjected to SC and HME treatment. The hardness and cutting strength of the texturized protein blocks prepared using both systems increased with increasing binder concentrations, and this effect was more pronounced in the HME-treated blocks. This difference may be attributed to distinct structure formation mechanisms. During HME, the proteins align under directed flow and subsequently form and stabilize denser, fibrous, and layered structures as they pass through the cooling die. These findings indicate that differences in protein flow, alignment, and fixation lead to greater structural continuity and resistance to deformation in HME-treated samples.

P-15

Structural, thermal, and rheological characterization of soy protein concentrate from Korean soybeans

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The global demand for plant-based proteins continues to rise, yet the domestic food industry heavily relies on imported protein sources. From a food security perspective, there is a critical need to develop plant-based protein ingredients derived from domestic soybeans. Thus, in this study, soy protein concentrate (SPC) was directly extracted from Korean soybeans via sequential defatting and alkaline extraction processes. Its structural, thermal, and rheological properties were characterized and then compared with those of imported protein concentrates from different sources. Various functional properties, including water hydration and interfacial properties, exhibited distinct characteristics depending on the protein type. FTIR analysis revealed characteristic absorption peaks associated with protein structures, while SEM analysis further demonstrated differences in the microstructure among the protein samples. Furthermore, rheological analysis by a rheometer demonstrated shear-thinning behavior and frequency-dependent viscoelastic properties across all protein samples. Overall, the findings of this study provide fundamental insights into the physicochemical and functional properties of Korean soy protein concentrate.

P-16

Effects of hydrocolloid type and concentration on the properties of *Tenebrio molitor* defatted powder gels for dysphagia diet applications

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Tenebrio molitor larval protein (TMP) is a promising sustainable protein source. Hydrocolloids differ in gelation characteristics, network-forming behavior, and interactions with proteins, which can affect protein gel texture and stability. This study evaluated hydrocolloid type and concentration in 15% (w/w) defatted TMP gels based on self-supporting gel formation, low hardness, and suppression of phase separation and syneresis. Agar, low-acyl gellan gum (LA-gellan), κ-carrageenan, ι-carrageenan, and locust bean gum (LBG) were screened at 1% and 2%. Self-supporting gels formed with 2% agar, 1% LA-gellan, and 2% κ-carrageenan. Among them, 2% κ-carrageenan showed the lowest hardness (7.25 N) without phase separation and was selected for optimization. To obtain a softer texture suitable for dysphagia diets, κ-carrageenan was reduced to 1%. However, phase separation and syneresis occurred, indicating insufficient network stability. LBG (0.25–1.00%) was subsequently incorporated based on its synergistic interaction with κ-carrageenan to improve network and water stability. The 1% κ-carrageenan–0.75% LBG gel exhibited the lowest hardness (2.88 N) while maintaining springiness and cohesiveness, with shear-thinning and elastic-dominant behavior (G′>G″). These results indicate that hydrocolloid type, concentration, and mixed-gel interactions are important for balancing softness and structural stability in TMP-based gels for dysphagia diets.

P-17

압출 및 효소 처리에 따른 밀 제분 부산물의 반죽 특성 및 결정 구조 변화

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본 연구에서는 밀 제분 부산물인 등외품 밀가루와 밀기울의 압출 처리 및 압출·효소 병행 처리에 따른 Mixolab 반죽 특성과 XRD 결정 구조를 분석하고, 선행연구에서 확인된 이화학적 및 구조적 특성과의 연관성을 고찰하였다. 선행연구에서는 압출 처리에 따라 보수력 및 용해도가 증가하였고, Celluclast BG 효소 처리군에서 상대적으로 높은 팽윤력이 관찰되었다. RVA 분석에서는 압출 처리에 따라 전반적인 점도가 감소하였으며, 특히 Celluclast BG 효소 처리 후 압출한 시료에서 상대적으로 낮은 setback 값을 나타냈다. DSC와 SEM 분석을 통해 각각 호화 피크의 소실과 입자 구조의 파괴가 확인되었다. 본 연구의 Mixolab 분석 결과, 압출 처리군의 반죽 안정도(stability time)는 대조군에 비해 뚜렷하게 감소하였으며, 호화 관련 토크(C3) 역시 낮아지는 경향을 나타냈다. 반면 수분 흡수 및 반죽 형성과 관련된 토크(C1)는 대조군에 비해 처리군에서 높은 값을 나타냈으며, 이는 선행연구에서 관찰된 보수력 증가 및 입자 구조 변화와 함께 압출 처리에 따른 반죽 형성 특성의 변화와 관련된 것으로 판단된다. 또한 노화 관련 토크(C5)는 Celluclast BG 효소 처리군에서 상대적으로 낮게 나타났으며, RVA 분석에서도 동일 처리군의 setback 값이 낮게 나타나는 유사한 경향을 보여 전분의 노화 특성 변화 가능성을 시사하였다. XRD 분석 결과, 대조군에서는 전형적인 A-형 회절 패턴이 나타난 반면 압출 처리군에서는 V-형 회절 패턴이 관찰되어 압출 과정에서 아밀로오스-지질 복합체가 형성되었을 가능성을 시사하였다. 또한 상대결정도(relative crystallinity, RC)는 대조군에 비해 압출 처리군에서 크게 감소하였다. 이러한 상대결정도의 감소와 선행 DSC 분석에서 관찰된 호화 피크의 소실은 압출 과정에서 기존의 전분 결정 구조가 변화하였음을 나타낸다. 종합적으로, Mixolab 및 XRD 분석을 통해 확인된 반죽 특성과 결정 구조의 변화는 선행연구에서 관찰된 수화, 호화 및 미세구조 특성의 변화와 연관될 가능성을 시사하였으며, 이러한 결과는 압출 및 효소 처리에 의한 밀 제분 부산물의 물리화학적 특성 변화와 식품 소재로서의 활용 가능성을 이해하기 위한 기초자료로 활용될 수 있을 것으로 기대된다.

P-18

Machine learning-assisted interpretation of volatile flavor compounds for cultivar classification of pear pomace

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Pear pomace, the core, skin, and residual flesh byproduct of juice processing, remains understudied for aroma potential despite industrial importance. This study analyzed volatile profiles of pomace from three pear cultivars—Sandolbae (*Pyrus ussuriensis* Maxim.), Shingobae (*Pyrus pyrifolia*), and Baekwoonbae (*Pyrus ussuriensis* var. *hakunensis*)—using HS-SPME/GC-MS, semi-quantitative technique, to discriminate cultivar signatures using machine learning. Fifty-eight volatile compounds were identified across samples. Principal component analysis demonstrated clear separation (PC1 49.5%, PC2 43.9%; cumulative 93.3%): Sandolbae featured high ester content, Shingobae yielded green-note aldehydes, and Baekwoonbae produced fermentation and almond-like compounds. Both Random Forest and XGBoost achieved 100% classification accuracy. SHAP analysis highlighted 1-hexanol, trans-2-hexenol, and ethanol as top discriminating markers, differing from classic fresh pear esters and reflecting processing effects on volatile composition. These results confirm explainable machine learning effectively resolves cultivar-specific aroma profiles in pear pomace, offering strategic insights for valorizing industrial fruit waste into flavor-differentiated functional ingredients.

P-19

Quality characteristics and biological activities of fermented vinegar produced from Geochang pear (*Pyrus pyrifolia*)

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This study investigated the physicochemical properties and biological activities of fermented vinegar produced from *Pyrus pyrifolia* cultivated in Geochang, Gyeongsangnam-do, Korea. The pear was enzyme-treated for 60 days, followed by alcoholic fermentation for 30 days with *Saccharomyces cerevisiae* and acetic acid fermentation for 30 days with *Acetobacter*. Samples were designated as PPE, PPAF, and PPV for enzyme-treated, alcoholically fermented, and fermented vinegar samples, respectively, with apple cider vinegar (ACV) used as a commercial control. The pH decreased from 3.18±0.03 in PPE to 2.93±0.01 in PPV, while acidity increased from 2.83±0.01% to 3.65±0.01%. Soluble solids decreased from 45.90±0.10 to 10.87±0.06°Bx. Acetic acid, lactic acid, malic acid, and citric acid were the predominant organic acids. Total organic acid content decreased from 3,268.74 mg/mL in PPE to 2,339.07 mg/mL in PPAF and increased to 10,415.86 mg/mL in PPV. Asn, Ala, and Glu were the predominant free amino acids, with total free amino acid content increasing from 33.68 mg/100 mL in PPE to 45.21 mg/100 mL in PPAF and 70.31 mg/100 mL in PPV. Compared with ACV, PPV showed higher total polyphenol content (14.2±0.9 mg GAE/100 mL) and ABTS radical-scavenging activity (15.73±0.54~34.48±1.15%). PPV also inhibited NO production by 28.40±3.28%, indicating antioxidant and anti-inflammatory activities. These results suggest that fermentation of *P. pyrifolia* alters its physicochemical properties and bioactive components, supporting the potential of PPV as a value-added functional food ingredient.

P-20

Effects of xanthan gum–locust bean gum concentration and aqueous-phase location on electrolyte release, physical stability, and sensory properties of gel-in-oil-in-gel double emulsions

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This study investigated the effects of xanthan gum/locust bean gum (XG/LBG) concentration and aqueous-phase location on the structure, electrolyte release, physical stability, and sensory properties of gel-in-oil-in-gel double emulsions. KCl or NaCl was incorporated into the inner aqueous phase (G_1), while the XG/LBG concentration was varied in either G_1 or the outer aqueous phase (G_2), with that in the other phase fixed at 0.3%. Increasing XG/LBG generally reduced particle size and K^+ and Na^+ release while increasing encapsulation efficiency. NaCl formulations generally showed larger particles and greater electrolyte release than KCl formulations. At 0.5 and 1.0% XG/LBG, increasing XG/LBG in G_1 suppressed electrolyte release more effectively than increasing it in G_2, whereas particle-size differences between locations were small. Turbiscan analysis showed the greatest optical destabilization when XG/LBG was absent from G_2, highlighting the importance of continuous-phase structuring for bulk stability. Higher XG/LBG generally decreased saltiness, bitterness, metallic taste, and creaminess while increasing thickness, although location effects varied by formulation and sensory attribute. Correlation and principal component analyses further clarified relationships among structural, release, and sensory properties. Overall, G_1 structuring primarily restricted electrolyte transport, whereas G_2 structuring primarily improved bulk physical stability.

P-21

Sequence-controlled ion assembly regulates Na^+/K^+ availability in gellan gum-based NaCl–KCl particles for enhanced saltiness and reduced KCl-associated bitterness

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Partial replacement of sodium chloride (NaCl) with potassium chloride (KCl) reduces sodium content, but KCl bitterness limits its application. This study examined whether salt addition sequence could regulate K^+ release via gellan gum (GG) interactions and improve the saltiness–bitterness balance. Powders containing 2.5% (w/v) each of NaCl and KCl and 0—0.2% (w/v) GG were spray-dried after simultaneous, NaClfirst, or KClfirst addition. Field-emission scanning electron microscopy (FESEM) revealed that GGcontaining samples formed fine hollow particles with significantly reduced sizes (p<0.05). Xray diffraction (XRD) showed weaker peaks while the characteristic NaCl and KCl crystalline phases were retained, indicating altered crystal organization. In KClfirst samples, preferential GGK^+ interactions were associated with the greatest delay in initial K^+ release and the lowest bitterness, while relatively high Na^+ availability maintained saltiness comparable to the NaCl control. Conversely, limited Na^+ availability in NaCl-first samples resulted in the lowest saltiness (p<0.05). In fried peanut seasoning, GGcontaining particles showed greater adhesion, and the favorable sensory characteristics of KClfirst samples were retained. These findings show that salt addition sequence regulates ion availability and improves the saltiness–bitterness balance without changing the final composition, supporting the development of low-sodium seasonings.

P-22

Effect of $W_1/O/W_2$ double-emulsion encapsulation on LAB viability and physicochemical stability of dongchimi during frozen storage

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This study evaluated the effects of $W_1/O/W_2$ double-emulsion encapsulation on the LAB viability and the physicochemical properties of dongchimi during frozen storage. Double emulsions containing *L. mesenteroides* were formulated using xanthan gum (XG) or carrageenan (CA) at 0.05 and 0.10% and applied to dongchimi. Lactic acid bacteria (LAB), total aerobic bacteria, pH, titratable acidity, total soluble solids, and salinity were monitored over a 4-week frozen-storage period. Initial LAB populations were 7.47 log CFU/mL in the control and 8.33–8.52 log CFU/mL in the emulsion-treated groups. After 4 weeks of frozen storage, LAB populations declined to 5.80 log CFU/mL in the control, whereas the treated groups retained 7.43–7.83 log CFU/mL. Among the formulations, CA treatments maintained LAB populations of 7.72–7.83 log CFU/mL, compared with 7.43–7.57 log CFU/mL for XG treatments. Total aerobic bacterial populations remained relatively stable across treatments. The pH decreased slightly from 5.55–5.60 to 5.40–5.44, while titratable acidity remained within 0.070–0.075%. Overall, $W_1/O/W_2$ double-emulsion encapsulation reduced the loss of LAB viabililty during frozen storage, particularly in CA-containing formulations, while causing minimal changes in the physicochemical properties of dongchimi. These findings suggest the potential of double-emulsion encapsulation for stabilizing beneficial LAB in frozen fermented-food systems.

P-23

Modification of granular cold-water swelling rice flour by heat-moisture and pressure-moisture treatments to improve digestive resistance

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Granular cold-water swelling rice flour (GCWSRF) develops viscosity in cold water without conventional cooking, making it suitable for instant and cold-prepared food applications. However, disruption of ordered starch structures required for cold-water swelling may increase enzyme accessibility and accelerate starch digestion. Since rapid starch digestion can accelerate glucose release, increasing digestive resistance while retaining cold-water functionality is desirable. This study investigated heat-moisture treatment (HMT) and pressure-moisture treatment (PMT) as post-treatments to achieve this balance. GCWSRF was prepared by treating rice flour in 40% aqueous ethanol at 80°C for 20 min, followed by ethanol washing and drying. Samples were subjected to HMT at 80–120°C for 12–20 h or PMT at 400–600 MPa for 10–60 min at 15–25% moisture. Morphology, thermal properties, pasting behavior, and *in vitro* starch digestibility were evaluated. Cold-water viscosity was decreased in HMT samples but retained in PMT samples. On the other hand, rapidly digestible starch (RDS) was decreased but slowly digestible starch (SDS) and resistant starch (RS) were increased in both treatments compared to native GCWSRF. Consequently, both HMT and PMT increased digestive resistance, while PMT effectively preserved cold-water viscosity, suggested that PMT provides a better balance between cold-water functionality and reduced starch digestibility.

P-24

Non-destructive monitoring of plant-based milk residue cleaning via multi-sensor fusion and machine learning

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Although the growing plant-based milk market demands optimized Clean-in-Place (CIP) operations, current protocols remain resource-intensive and over-designed due to a lack of intelligent real-time monitoring. This study proposes a machine learning-driven approach utilizing a multi-sensor framework—integrating non-destructive ultrasonic sensing with real-time electrical conductivity and turbidity measurements—to evaluate the cleaning efficacy of plant-based milk (soy and oat) residues. A comprehensive dataset was generated from laboratory-scale CIP experiments conducted on stainless steel surfaces. NaOH (Sodium hydroxide) was used as a cleaning agent. Continuous time-series data from multiple sensors were acquired and correlated with gravimetric analysis results, providing a reference for accurately quantifying the continuous removal of surface residues and tracking effluent quality. Then, regression models based on machine learning were developed. By optimizing feature selection and algorithm performance, the model is designed to continuously predict remaining residue levels and autonomously track the real-time progression from fouled to cleaned states. Ultimately, this non-destructive, multi-sensor system provides decision support for CIP optimization, helping ensure food safety while reducing water and chemical consumption.

P-25

Moisture-dependent glass transition and lipid thermal behavior of freeze-dried nanoparticle powders with different lipid compositions and wall-matrix states

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This study examined moisture sorption, glass transition temperature (T_g), and thermal behavior of freeze-dried lipid nanoparticles with varying solid/liquid lipid ratios and wall states. Solid lipid nanoparticles (SLN), nanostructured lipid carriers ($NLC_{7:3}$/$NLC_{5:5}$), and nanoemulsions (NE) were prepared at palm stearin/MCT oil ratios of 10:0, 7:3, 5:5, and 0:10 and mixed with lactose-WPI (amorphous) or lactose-mannitol-WPI (crystalline). At 0.53 a_w, lactose crystallization released water more slowly at higher solid-lipid fractions. BET (Brunauer-Emmett-Teller) and Gordon-Taylor models described sorption and T_g-water data. In amorphous-wall powders, monolayer water content (X_m) was lower in SLN and $NLC_{7:3}$ (4.41–5.03) than in $NLC_{5:5}$ and NE (9.61–15.94), whereas BET constant (C) was higher in SLN and $NLC_{7:3}$ (1.27–1.61) than in $NLC_{5:5}$ and NE (0.27–0.47), suggesting stronger monolayer water binding at higher solid-lipid fractions. Crystalline-wall powders showed opposite trends in X_m and C. Gordon-Taylor k values were higher in crystalline (6.93–10.23) than amorphous walls (5.62–7.39), indicating greater water-induced T_g depression. DSC and MDSC showed lower ΔH_m in amorphous walls after drying (30.18–38.47 and 51.87–57.11 J/g solid lipid) and at 0.11 a_w (2.44–7.42 and 3.43–8.30 J/g). At 0.23–0.33 a_w, this reversed as T_g depression caused matrix relaxation to overlap lipid melting. Thus, lipid composition and wall state modulated water uptake, mobility, T_g, and thermal behavior.

P-26

Puffing-induced structural and phytochemical changes and their associations with biological activities in grapefruit (*Citrus paradisi*) peel

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This study investigated whether puffing could improve the utilization of grapefruit peel by modifying its structure and phytochemical composition and thereby altering its biological activities. Grapefruit peels were puffed at 500–1300 kPa and evaluated for structural, compositional, and functional changes. Puffing promoted structural disruption and pore formation and generally increased extraction yield. With increasing puffing pressure, major flavonoid glycosides decreased, whereas the aglycone naringenin increased. The content of hesperidin, another flavonoid glycoside, markedly increased after puffing. Total phenolic content (TPC), total flavonoid content (TFC), and Maillard reaction products (MRPs) also increased with puffing pressure. These compositional changes were accompanied by enhanced antioxidant activities (DPPH, ABTS, and FRAP), NO suppression and pancreatic lipase inhibition, particularly at higher puffing pressures. Major furanocoumarins were substantially reduced, while CYP3A4 activity decreased at pressures of 700 kPa or higher. Pearson correlation analysis and PCA further demonstrated close relationships between compositional and functional changes. Collectively, these findings demonstrate that puffing can simultaneously modify the structure, phytochemical profile, and functional properties of grapefruit peel, highlighting its potential as a processing strategy for the value-added utilization of citrus by-products.

P-27

Optimization of decolorization process for seaweed polysaccharide extraction residue and exploration of Its potential as a novel plant-based protein

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Currently, livestock-based protein sources like meat and dairy face sustainability, environmental, and ethical challenges, making the development of plant-based proteins essential. Seaweeds and their processing by-products are promising plant protein sources due to high protein content. However, their high concentrations of intrinsic pigments limit food applications. This study aimed to establish a decolorization process designed to minimize protein denaturation in seaweed polysaccharide extraction residue and evaluate its potential as a plant protein when blended with other plant proteins. Laver polysaccharide extraction residue (laver residue) was decolorized based on a Box-Behnken design with reaction pH (2–4), NaClO concentration (2–8%), and solid-to-liquid ratio (1:5–1:15). ANOVA and response surface analysis showed that all properties except total color difference fitted quadratic models (p<0.01, r^2≥0.9032). Lightness increased with higher NaClO levels and liquid ratios, with significant interaction effects on redness and total color difference (p<0.05). Furthermore, the decolorized residue maintained a high crude protein content ranging from 45% to 51%. Blending pH 3 decolorized residue with SPI and PPI produced the highest G′ and strong gel formation, though the gel structure was vulnerable to continuous deformation. Consequently, this decolorization process successfully bleaches laver residue, enhancing its potential as an upcycled food ingredient.

P-28

Application and raw material expansion of reflux extraction process for securing high-quality flavor extracts

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With the rapid growth of the home meal replacement (HMR) market, various extraction technologies have been developed and applied to enhance food flavor. Although conventional long-time hot water extraction and new techniques such as high-pressure extraction cooking (HPEC) and ohmic heating are widely used, these novel methods primarily focus on improving efficiency by shortening extraction time, presenting limitations in quality enhancement. In contrast, the reflux extraction process simultaneously performs hot water immersion and the capture and condensation of volatile flavor compounds, significantly upgrading the sensory and aromatic quality of the extract. Therefore, this study aims to apply reflux extraction technology to enhance the sensory quality of katsuo (bonito) extracts and expand its application to new raw materials (anchovy, kelp, and dried kuruma prawn) to secure high-quality diverse extracts.

P-29

Construction of $O_1/W/O_2$ double emulsions for plant-based butter alternatives: role of soybean protein isolate concentration and oleogel mass fraction

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This study investigated the effect of soybean protein isolate (SPI) concentration and oleogel mass fraction on $O_1/W/O_2$ double emulsions developed as plant-based butter alternatives. Primary O1/W emulsions were prepared by dispersing rice bran oil in an aqueous phase containing konjac glucomannan (KGM) and SPI (2, 4, and 6%). External oleogel phase consisted of candelilla wax (CW), rice bran oil and polyglycerol polyricinoleate (PGPR). Primary emulsions were combined with oleogel phase at oleogel mass fractions of 50, 60, 70, and 80% and homogenized to form $O_1/W/O_2$ double emulsions. At 6% SPI, droplet size of primary emulsion was significantly reduced to 2.16 μm (p<0.05) while maintaining a negative ζ-potential (-29 mV). CLSM confirmed uniform entrapment of O_1/W droplets in a continuous CW crystalline network. Increasing oleogel mass fraction up to 80% increased storage modulus (G'), attributed to a denser wax crystal network. Temperature sweep test revealed that higher oleogel mass fractions delayed structural breakdown upon heating, indicating enhanced thermal stability. DSC analysis showed higher melting points as oleogel mass fraction increased. This suggested the structured wax network immobilized oleogel phase and restricted phase transitions. These findings demonstrated that controlling SPI concentration and oleogel mass fraction effectively tailored physicochemical properties of $O_1/W/O_2$ double emulsions for potential application as plant-based butter alternatives.

P-30

Differences in component partitioning during freeze concentration in complex alcoholic beverage matrices

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Freeze concentration enriches food constituents by separating water as ice, but solute partitioning may vary in complex alcoholic beverages. This study examined individual component partitioning during suspension freeze concentration of cheongju. Concentrate and ice fractions were separated by centrifugation. Organic compounds were analyzed by nontargeted liquid chromatography–mass spectrometry (LC–MS), and inorganic components by inductively coupled plasma optical emission spectrometry (ICP–OES). After blank correction, concentrate-to-original and ice-to-concentrate peak-area ratios were calculated for about 50 tentatively identified compounds. Inorganic components were preferentially retained in the concentrate. Most organic compounds showed higher signals in the concentrate, but enrichment and ice retention varied considerably among compounds, including within organic acid and amino acid classes. The overall retention of solutes in the concentrate agreed with previous studies, whereas the extent and relative order of compound retention differed. Enrichment was not clearly associated with simple molecular properties. Thus, partitioning may reflect matrix composition, constituent interactions, and physical entrapment as well as molecular properties. These findings provide a basis for designing freeze-concentration processes tailored to target compounds.

P-31

Comparative analysis of wavelength-dependent LED inactivation in *Shigella sonnei*, *Bacillus subtilis*, and *Saccharomyces cerevisiae*: mechanistic insights from cellular damage responses

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Light-emitting diode (LED) irradiation enables wavelength-selective microbial control. However, comparisons of inactivation and cellular damage across LED wavelengths and microbial species remain limited. This study compared the effects of 265, 308, 365, and 405 nm LEDs on *Shigella sonnei, Bacillus subtilis*, and *Saccharomyces cerevisiae*. Inactivation was evaluated from viable counts and fluence-response curves. Cellular damage was assessed by neutral comet assay, H_2O_2 and dsDNA/protein leakage analyses, and TEM. Required fluence increased with wavelength, and resistance and survival-curve patterns differed among species. Tail DNA (%) was higher at 265/308 nm than at 365/405 nm in all species. At 265 nm, greater increases in Tail DNA relative to untreated controls were associated with higher susceptibility to LED treatment. In contrast, relative H_2O_2 levels increased 16.82–32.80-fold at 365 nm. At 365/405 nm, dsDNA and protein leakage increased in *S. sonnei* and *S. cerevisiae*, whereas *B. subtilis* showed limited changes. This suggests species-dependent cellular damage responses. TEM showed relatively preserved morphology at 265/308 nm and pronounced structural alterations at 365/405 nm. Overall, the results indicate wavelength-dependent cellular damage patterns, with greater DNA damage responses at 265/308 nm and greater oxidative stress responses at 365/405 nm. These findings may support rational wavelength selection and combined treatment strategies for microbial control.

P-32

Development and characterization of a pH-responsive chitosan-cinnamaldehyde schiff base for active food packaging

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Active food packaging has shifted toward sustainable alternatives to replace synthetic additives and prolong shelf life. While incorporating natural antimicrobial such as essential oils into biopolymers and compostable polymers offers great potential, conventional antimicrobial systems often suffer from uncontrollable burst or sluggish release. To address this limitation, environment-responsive antimicrobial platforms capable of on-demand release triggered by metabolites of packaged foods are gaining attraction. In this study, a pH-responsive chitosan-cinnamaldehyde (Cs-Cin) Schiff base was synthesized via the condensation reaction between the primary amines of chitosan and the carbonyl groups of cinnamaldehyde. Chitosan was reacted with varying volumes of cinnamaldehyde under continuous stirring, precipitating with sodium hydroxide, isolated by centrifugation, washed thoroughly with deionized water and ethanol, and dried for 12 h. The formation of the dynamic imine bond allows stable immobilization of the antimicrobial agent under neutral conditions and targeted release via imine hydrolysis in acidic conditions. Therefore, this CS-Cin Schiff base serves as an sustainable active packaging material capable of extending food shelf-life through controlled, environment responsive antimicrobial activity.

P-33

Temperature-modulated kinetic control of short-chain glucan self-assembly to generate diverse hierarchical nanostructures

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The self-assembly of short-chain glucans (SCGs), driven by intermolecular hydrogen bonding and glucan chain association, provides a versatile route for constructing starch-based nanostructures with tunable physicochemical properties. However, precise regulation of SCG assembly pathways and the resulting particle morphology remains challenging. Herein, we demonstrate that self-assembly temperature can be used to modulate SCG assembly in a bio-derived γ-valerolactone (GVL)-based medium, enabling the formation of distinct hierarchical nanostructures. With increasing self-assembly temperature, the morphology of SCG assemblies evolved from smooth spherical nanoparticles to bumpy hierarchical nanostructures, suggesting temperature-dependent secondary association of primary SCG assemblies. These findings identify temperature as a simple process parameter for directing the structural evolution of SCGs and provide insights into the design of glucan-based nanostructures with tunable morphologies for diverse applications.

P-34

Formation and characterization of chicken-like texture by a combined compression-thawing process of frozen tofu

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This study reinterpreted the thawing step of frozen tofu not as a simple temperature recovery process, but as an active structuring process for designing the anisotropy and mechanical properties of plant protein tissues, and aimed to develop a chicken-like fibrous structure through compression-thawing (CT). When CT treatments with different thawing histories were applied, the patterns of water redistribution and protein network rearrangement in tofu varied markedly, resulting in distinct differences in texture and anisotropic structure formation. In particular, CT5, which involved rapid thawing, formed the most compact matrix and exhibited the highest textural properties and disulfide bond content, whereas CT7, which underwent annealing treatment, showed an aligned channel structure and the highest texturization index. FT-IR, disulfide bond, and intermolecular interaction analyses demonstrated that these differences in macroscopic properties were closely associated with the ordering of protein secondary structures and changes in the balance of covalent and non-covalent interactions. These findings suggest that CT can overcome the limitations of conventional thawing processes, which often cause microstructural damage and quality deterioration in tofu, and can be used to design a chicken-like texturization pathway in tofu.

P-35

Engineering tilapia proteins through surimi processing for enhanced texture and gel functionality

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Tilapia (*Oreochromis niloticus*) is a high-protein, low-fat white-fleshed fish with growing potential as a health-oriented protein resource. To expand its utilization across a wider range of processed foods in the food industry, effective processing strategies are needed to transform native muscle into structured protein matrices with desirable texture and water retention. This study investigated how surimi processing reorganizes tilapia muscle proteins and enhances their gel functionality. Tilapia fillets and surimi were characterized for microstructure, color, moisture-related properties, gel-forming ability, and texture following thermal treatment. Surimi processing markedly transformed the native muscle structure into a denser and more homogeneous protein network, accompanied by improved water-holding capacity and gel integrity. These structural changes were further reflected in increased hardness and chewiness, demonstrating that protein network reorganization directly contributes to enhanced macroscopic texture. Collectively, the results show that surimi processing effectively upgrades tilapia muscle into a functional protein matrix with improved structural and textural performance, highlighting its potential for broader application in high-quality processed seafood and next-generation structured protein foods.

P-36

Spectral dependence of *Escherichia coli* inactivation by LED irradiation: action spectrum characterization and evaluation of pulsed treatment conditions

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This study investigated wavelength-dependent inactivation of *Escherichia coli* ATCC 25922 under continuous light-emitting diode (LED) irradiation and evaluated pulsed irradiation conditions. Suspensions were exposed to 11 wavelengths from 255 to 415 nm. Irradiance was corrected using Petri, reflection, divergence, and water factors, and fluence-response curves were fitted with log-linear, Weibull, and double-Weibull models. The double-Weibull model provided the best fit for most wavelengths ($R^2 \geq 0.97$; RMSE≤0.22). The fluence required for a 4-log reduction (4D) was determined, and relative inactivation effectiveness was calculated as the reciprocal of 4D normalized to 265 nm (265 nm=1). The 4D values at 265, 305, 365, and 415 nm were 4.14 mJ/cm², 116.70 mJ/cm², 27.19 J/cm², and 158.38 J/cm², respectively, indicating lower effectiveness at longer wavelengths. At 305 nm and 173.1 mJ/cm², continuous irradiation produced a 6.43-log reduction, whereas pulsed irradiation at 50% duty cycle produced 6.50, 6.43, and 6.61 log reductions at 10, 50, and 100 Hz. At 10 Hz and 154.0 mJ/cm², increasing duty cycle from 50% to 75% enhanced inactivation from 5.39 to 6.55 log. Pulse frequency had little effect, whereas duty cycle influenced inactivation. These findings provide quantitative reference data for wavelength selection and pulse optimization, supporting broader application of LED-based nonthermal microbial control and development of food processing technologies.

P-37

Concentration-dependent structuring and structure–function relationships of mycoprotein – κ-carrageenan gels

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Mycoprotein (MYP) is a sustainable alternative protein source with a naturally fibrous structure. This study investigated formulation conditions and concentration-dependent network formation in MYP–κ-carrageenan gel systems. The concentrations of κ-carrageenan (0.6-1.0%) and KCl (0.25-2.0%) were initially screened to establish suitable gelation conditions, and 0.8% (w/w) κ-carrageenan and 0.5% (w/w) KCl were selected for subsequent experiments. Under these conditions, gels containing 10–20% (w/w) MYP were prepared to evaluate the effect of MYP concentration on structure–function relationships. Texture profile analysis (TPA), water-holding capacity (WHC), rheological measurements, scanning electron microscopy (SEM), confocal laser scanning microscopy (CLSM), and Fourier-transform infrared spectroscopy (FTIR) were used for characterization. Increasing MYP concentration enhanced hardness, chewiness, springiness, WHC, and viscoelasticity. SEM and CLSM showed denser and more interconnected networks at higher MYP concentrations, while FTIR suggested enhanced intermolecular interactions. Overall, MYP concentration was a key factor controlling network formation and functional properties, providing a basis for tailoring mycoprotein-based structured foods.

P-38

Structural modification of chickpeas by tempering-roasting for enhanced β-carotene delivery via nanoemulsion impregnation

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Tempering and roasting are commonly used to modify chickpea physicochemical and structural properties for subsequent processing. This study investigated how tempering moisture and roasting temperature alter chickpea structure and whether these changes could facilitate incorporation and retention of a β-carotene-loaded nanoemulsion. Chickpeas tempered to 20, 25, and 30% moisture were roasted at 260, 280, and 300°C for 3 min, followed by vacuum impregnation and freeze-drying (VI-FD). The nanoemulsion had a droplet size of 165.40±2.91 nm, PDI of 0.13±0.01, and encapsulation efficiency of 97.95±0.34%. Tempering-roasting promoted structural expansion, reducing bulk density (0.76 to 0.49–0.60 g/mL) and increasing the puffing index (up to 1.54), with the highest expansion at 30% moisture. SEM and micro-CT revealed moisture-dependent internal crack and void formation. Impregnation degree increased from 56–73% at 20% to 81–84% at 30% tempering moisture, while the effect of roasting temperature varied with moisture level. CLSM showed oil-phase fluorescence along cracks and cotyledon regions, suggesting that these pathways facilitated nanoemulsion penetration. Pretreatment increased β-carotene content from 8.35 to 48.09 μg/g d.m. and retention efficiency from 16.48% to 72.44%. Tempering-roasting and VI-FD also produced a more fragile, snack-like texture. These findings highlight tempering-roasting as a strategy for β-carotene fortification and texture development in chickpea snacks.

P-39

Temporal organization of fat- and emulsion-related oral sensations across mayonnaise formulation matrices

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Fat-related oral perception in emulsion-based foods is shaped not only by fat content but also by structural changes occurring during oral processing. However, whether formulation-induced structural modifications translate directly into changes in temporal sensory perception remains unclear. This study investigated the temporal organization of oral sensations across mayonnaise matrices differing in oil content, egg-yolk inclusion, and emulsifier system.

Six laboratory-prepared formulations were evaluated by 57 consumers using Temporal Check-All-That-Apply (TCATA) over 180 s, with standardized swallowing at 60 s. Nine sensory attributes exhibited distinct temporal profiles (Attribute×Window, $p<0.001$) and changed significantly across swallowing. Thickness declined relatively rapidly after swallowing, whereas Oily, Mouth-coating, Rich taste, and Saliva-forming persisted into the post-swallow period. Lysolecithin-associated modification significantly reduced particle size across all three formulation matrices, with D[4,3] reductions of 30.9–68.8%.

Despite these pronounced structural changes, none of the 27 predefined within-matrix Product×Window interactions remained significant after correction. These findings indicate that structural modification does not translate uniformly into temporal sensory changes, highlighting an attribute- and process-dependent relationship between emulsion structure and oral perception.

P-40

Preparation of anisotropic starch particles using γ-valerolactone-mediated anti-solvent precipitation: Morphological transition and mechanistic insights

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Antisolvent precipitation is widely used as a simple and rapid bottom-up approach for the fabrication of starch particles (SPs). However, conventional organic antisolvents may raise concerns regarding residual-solvent safety and environmental sustainability, particularly for food and biomedical applications. Here, γ-valerolactone (GVL), a bio-derived dipolar aprotic solvent with low volatility and favorable environmental characteristics, was employed as antisolvent to prepare GVL-mediated starch particles (GSPs) with tunable anisotropic morphologies. Increasing the GVL fraction induced a distinct morphological transition from spherical to teardrop-like and rice-like GSPs, accompanied by increased crystallinity and enhanced internal lamellar organization. Comparative experiments using acetone and tetrahydrofuran, together with Hofmeister-salt perturbation tests, indicated that solvent polarizability and hydrogen-bonding interactions jointly govern the morphological evolution of GSPs. These results are consistent with a mechanism in which GVL alters glucan solvation followed competing with glucan–glucan hydrogen bonding, thereby modulating molecular association and anisotropic growth during precipitation. This study provides mechanistic insights into green solvent-mediated starch particle formation and establishes a versatile strategy for engineering shape-controlled starch materials with tunable structural and resistant-starch properties for functional food applications.

P-41

Physicochemical properties of short-chain glucan aggregates (SCGA) modified by pressure annealing treatment

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This study evaluated the effects of pressure annealing treatment (PAT) at 400–600 MPa on short-chain glucan aggregates (SCGA) in comparison with conventional heat annealing treatment (HAT). Short-chain glucan aggregates (SCGA) are starch nanoparticles with low digestibility and small particle size. Conventional HAT modifies SCGA properties but requires high energy input and long processing times, making PAT a time-efficient non-thermal alternative. Although all samples retained spherical morphology and B-type crystallinity, PAT induced pressure-dependent particle size variations and non-linear shifts in relative crystallinity and melting enthalpy (ΔH). These shifts suggest partial double-helix disruption and reorganization, unlike the molecular ordering and dense packing driven by heat annealing. Pressure annealing appeared to induce a competition between domain breakdown and chain rearrangement; higher pressures potentially suppressed loose floc formation, thereby improving colloidal dispersion stability (peaking at 600 MPa). This structural reorganization also seemed to modify hydration behavior, likely by lowering hydrophilic site accessibility and thus reducing moisture sorption. High-pressure conditions at 400 and 600 MPa elevated slowly digestible starch (SDS) and resistant starch (RS) contents, presumably by limiting enzyme accessibility. Overall, PAT serves as a promising non-thermal strategy to tailor the structural, physical, and digestive properties of SCGA.

P-42

국내 사과 소비 촉진 목적 가공식품 개발을 위한 소비자 선호도 조사

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강원특별자치도농업기술원 농식품연구소

전국 사과 재배면적은 2016년 33,300 ha에서 2025년 33,212 ha로 소폭 감소한 반면, 강원지역은 같은 기간 831 ha에서 1,953 ha으로 증가하였다. 전국 생산량 또한 576,369 ton에서 2025년 447,953 ton으로 감소했으나, 강원지역은 같은 기간 5,778 ton에서 21,875 ton으로 증가하였다. 이는 기후변화에 따른 사과 재배지의 북상과 강원지역 사과 생산 기반의 확대를 시사한다. 따라서 국내 사과 소비 확대와 지역 생산량 증대에 대응하기 위해서는 원물 소비 중심의 이용형태를 다변화하고, 소비자 요구를 반영한 가공식품 개발이 필요하다. 본 연구는 국내 사과 소비 촉진을 위한 가공식품 개발 방향을 설정하고자 소비자 선호도 조사를 실시하였다.

조사는 농촌진흥청 농업경영혁신과 소비자 패널 495명을 대상으로 2026년 5월 8일부터 11일까지 온라인으로 실시하였다. 조사 내용은 사과의 건강·기능성 인식, 사과 가공식품 구매 및 맛 선호, 보관·유통 특성, 선호 제품 유형 및 국산 사과 사용 제품에 대한 추가 지불의사 등이었다.

응답자의 82.9%는 사과를 식감이 좋고 장 건강에 도움이 되며 섭취가 간편한 건강·기능성 식품으로 인식하였다. 연령대별로 저연령층은 섭취 편리성과 다이어트 관련 특성을, 60대 이상은 장 건강 관련 특성을 상대적으로 중요하게 인식하였다. 사과 가공식품을 선호하거나 구매하는 주요 이유는 맛 (60.2%)이었으며, 가장 선호하는 맛은 단맛과 신맛의 조화 (52.5%)로 나타났다. 저연령층은 단맛을, 고령층은 신맛 또는 상큼한 향을 상대적으로 선호하는 경향을 보였다. 또한 섭취 편리성을 구매 이유로 선택한 비율은 22.2%였다.

사과 가공식품의 보관 방식으로는 냉장 보관 (65.3%)과 상온 보관 (34.3%)이 선호되었으며, 유통기한은 1~3개월 (43.6%)과 1개월 이하 (28.3%)를 선호하는 것으로 조사되었다. 선호 제품 유형은 잼류 (18.8%), 조미식품류 (16.6%), 음료류 (16.2%), 과자류 (14.9%), 빵류 (8.7%) 순으로 나타났다. 또한 국산 사과를 원료로 사용한 가공식품에 대해 응답자의 49.5%가 추가 비용을 지불할 의향이 있다고 응답하였다.

이상의 결과는 사과 가공식품 개발 시 맛을 우선적으로 고려하되, 연령대별 맛과 건강 기능성 인식 차이를 반영할 필요가 있음을 보여준다. 특히 단맛과 신맛의 균형, 섭취 편의성, 품질 및 영양 보존성을 고려한 단기 유통형 제품 개발과 잼류, 조미식품류 및 음료류를 중심으로 한 제품군 확대가 효과적인 사과 소비 촉진 전략이 될 수 있다고 판단된다.

P-43

Evaluation of physicochemical properties and stability for selecting the optimal composition of boswellia nanoemulsions

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Boswellia extracts contain poorly water-soluble bioactive compounds, limiting their formulation stability and delivery. This study aimed to select an optimal Boswellia nanoemulsion based on physicochemical properties, encapsulation efficiency, microstructure, and oxidative stability. Nanoemulsions containing 10% Boswellia extract were prepared by high-speed homogenization followed by ultrasonication using MCT oil. Oleic acid (OA: 0–16%, w/w), Tween 80 (T: 0.2–0.8%, w/w), and lecithin (Lec: 13–33%, w/w) contents were varied in separate formulation series as an oil-phase modifier, surfactant, and phospholipid emulsifier, respectively. Particle size, PDI, and zeta potential were monitored during storage, and morphology was examined by TEM. Boswellia extracts were analyzed by HPLC, and encapsulation efficiency was evaluated. Oxidative stability was assessed using conjugated diene and TBARS assays. Increasing oleic acid content resulted in a decrease in PDI and an increase in the magnitude of zeta potential, whereas increasing lecithin content tended to decrease oxidative stability. Among the tested formulations, the OA16 formulation showed the most favorable dispersion characteristics, with a relatively low PDI and a high magnitude of zeta potential, and was selected as the optimal formulation. These results suggest that the oil-phase composition and emulsifier system play important roles in determining the physicochemical and oxidative stability of Boswellia nanoemulsions.

P-44

Temperature-dependent pressure dynamics in kimchi and a simple fermentation model

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Pressure generated during kimchi fermentation is commonly associated with microbial gas production, particularly carbon dioxide (CO_2); however, the measured pressure may also be influenced by the retention, transport, and release of gases within the complex structure of kimchi. This study investigated how fermentation temperature and kimchi tissue structure affect pressure dynamics by comparing kimchi with a simple fermentation model (SFM) consisting of water, glucose, and yeast. Kimchi and SFM were fermented at 4, 10, and 25°C, and internal pressure was continuously monitored using an ESP32-C3-based pressure monitoring system coupled with a custom-designed sealed acrylic chamber. Changes in pH and salinity were evaluated to characterize fermentation progress, while microstructural changes in kimchi cabbage tissue were examined using scanning electron microscopy (SEM). Distinct temperature-dependent pressure profiles were observed between kimchi and SFM. At 25°C, both systems exhibited rapid pressure increases and reached their maximum pressure within approximately 1–1.5 days, followed by a marked decrease. At 10°C, SFM showed a relatively simple single-peak profile, whereas kimchi exhibited a more complex pattern with an additional pressure increase during the middle stage of fermentation. At 4°C, pressure development occurred gradually over an extended period. SEM observations revealed progressive disruption of cabbage tissue structure with increasing fermentation temperature, with the greatest loss of cellular integrity at 25°C. Together, these findings indicate that pressure dynamics during kimchi fermentation are not solely determined by microbial gas production but are also associated with temperature-dependent gas retention and release within the heterogeneous kimchi structure. This study provides a basis for interpreting pressure signals in complex fermented foods and for improving continuous monitoring of fermentation behavior.

P-45

Machine learning-based discrimination of Korean wheat flours using complementary instrumental analyses

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The increasing consumption of wheat-based foods in Korea, together with the country's low domestic wheat self-sufficiency rate, highlights the need for reliable and efficient wheat quality assessment methods. This study established a machine learning-based classification approach using instrumental analyses, including Rapid Visco Analyzer (RVA), Fourier-transform infrared spectroscopy (FTIR), and GlutoPeak. Eight Korean wheat cultivars and two imported flours were analyzed, and representative features were selected for model development. Among the individual instrumental datasets, RVA achieved the highest classification accuracy (~0.95), followed by GlutoPeak and FTIR. Principal component analysis (PCA) also demonstrated clearer separation among cultivars in the RVA dataset, supporting its superior discriminatory capability. Notably, the combined RVA and GlutoPeak dataset yielded the highest classification performance, reaching an accuracy of up to 0.98. This improvement suggests that integrating complementary information on starch gelatinization and gluten aggregation enhances the discrimination of wheat cultivars. In contrast, FTIR contributed relatively little to overall classification performance. These results indicate that combining complementary instrumental analyses with machine learning can improve the discrimination of Korean wheat flours and provide a rapid, objective, and data-driven approach for wheat quality assessment.

P-46

Effects of plant protein composition on structural formation and textural properties of chicken-like multilayer protein structures

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Plant-based meat alternatives have gained attention as sustainable protein sources, but reproducing the fibrous structure and texture of whole-cut meat remains challenging. This study investigated the effects of plant protein composition on chicken-like multilayer protein structures. Wheat gluten (WG) was combined with chickpea protein isolate (CP80), pea protein isolate (PPI), or soy protein concentrate (SPC), and CP80-SPC and PPI-SPC blends were prepared. The doughs were mechanically elongated into sheets, treated with microbial transglutaminase (mTG), and layered to form directional multilayer structures. CP80 sheets showed the highest tensile force, whereas PPI showed the highest elongation. Hardness was high in CP80 and PPI but significantly decreased in their SPC blends (p<0.05), while the texturization index (TI) remained above 1, indicating preserved fibrous structures. Water retention capacity (WRC) was lowest in CP80 and higher in SPC-containing samples (p<0.05), with a marked increase in CP80-SPC compared with CP80. CP80 showed a higher β-sheet and lower random coil proportion, whereas CP80-SPC showed decreased β-sheet and increased random coil proportions. CP80 also showed relatively high ionic, hydrogen-bonding, and hydrophobic interactions, whereas PPI-SPC had lower disulfide bond content (p<0.05). These results suggest that SPC blending can modify protein networks and reduce excessive texture strength while maintaining fibrous structures.

P-47

Multimodal analysis of physical properties in commercial conventional and plant-based mayonnaise

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This study aimed to compare the physical properties of commercial conventional and plant-based mayonnaise products using a multimodal analytical approach. Three conventional and three plant-based mayonnaise products were evaluated for viscosity, viscoelasticity, structural recovery, texture, and tribological properties using a rotational viscometer, rheometer, texture analyzer, and tribological measurement. Pearson correlation analysis was performed to examine relationships among physical-property parameters, particularly viscosity- and texture-related parameters, and to evaluate consistency among different measurement methods. Because the measured parameters differed in units and scales, the data were standardized using Z-scores prior to principal component analysis (PCA) and heatmap analysis. PCA was used to identify the major parameters contributing to differences among mayonnaise products, while heatmap analysis was used to visualize overall physical-property profiles across samples. Yield-related parameters were identified as major variables contributing to the differences among mayonnaise products in the PCA. This integrated statistical approach enabled comparison of the multidimensional physical characteristics of conventional and plant-based mayonnaise and provided a basis for identifying product-specific differences in physical-property profiles.

P-48

Evaluation of fatty acid-fatty alcohol binary oleogels as shortening replacers in cookies

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Solid fats contribute to the structure and texture of bakery products, but their high saturated fatty acid content has increased the demand for healthier alternatives. Oleogelation can structure liquid vegetable oils without chemical modification. In this study, binary oleogels were prepared using fatty alcohol (stearyl alcohol, SOH) and fatty acid (stearic acid, SA) at various mass ratios in seven vegetable oils, and their physicochemical properties were characterized. The flaxseed oil-based SOH:SA (70:30) oleogel exhibited the highest hardness and the lowest melting point, suggesting a synergistic eutectic interaction between the two oleogelators. These findings were consistent with the solid fat content and oiling-off results. The selected oleogel was then evaluated as a shortening substitute in cookies. Cookies prepared with the SOH:SA (70:30) oleogel showed a higher spread ratio than those prepared with shortening, consistent with the temperature-dependent viscoelastic properties of the cookie dough. Furthermore, the saturated fatty acid content of the cookies decreased from 32.05% to 15.73%. These results suggest that SOH–SA binary oleogels can be used as functional solid fat substitutes in bakery products while improving their nutritional profiles.

P-49

Machine learning-based prediction of cultivar composition and blending ratios of Korean wheat flour using GlutoPeak analysis

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The end-use quality of wheat flour is highly influenced by flour blending, and the blending ratio can affect its rheological properties. However, objective analytical methods to estimate blending conditions remain limited despite their widespread use in the food industry. Therefore, this study explored the potential of combining GlutoPeak analysis with machine learning to predict the blending composition of Korean wheat flours based on their gluten aggregation behavior. Six Korean wheat cultivars were blended into 15 combinations at ratios of 1:1, 1:3, and 3:1, and their rheological properties were evaluated using a GlutoPeak analyzer. These experimental results were then used as a dataset for various machine learning algorithms including decision tree, random forest, k-nearest neighbor, support vector machine, and CatBoost methods. Among the evaluated models, ensemble-based models such as CatBoost showed relatively higher performance, with a multilayer perceptron model in particular demonstrating the highest predictive performance. These results suggest that GlutoPeak profiles contain information related to cultivar composition and blending ratios and that machine learning-based analysis may offer a potential approach for estimating blending conditions of Korean wheat flour.

P-50

Tailoring the surface chemistry and functional properties of chitosan-derived carbon nanodots through hydrothermal synthesis conditions and urea supplementation

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Chitin is the second most abundant natural polysaccharide, and its deacetylated derivative, chitosan, can be obtained from crustacean processing waste. Owing to its ionizable functional groups and pH-dependent charge behavior, chitosan represents a promising sustainable precursor for the production of carbon nanodots (CNDs). In this study, CNDs were synthesized hydrothermally from chitosan with or without urea supplementation as an additional nitrogen source under different reaction conditions to investigate their effects on surface chemistry and functional properties. The elemental composition and chemical states of the resulting CNDs were characterized by XPS and FT-IR spectroscopy. pH titration and the Kaiser test were further employed to evaluate ionizable surface groups and accessible primary amine groups, respectively. Particle morphology and size were examined by TEM, while UV–vis absorption and FL spectroscopy were used to characterize the optical properties. In addition, the antioxidant potential of the CNDs was evaluated using ABTS and DPPH radical scavenging assays. This study aims to elucidate how hydrothermal synthesis conditions and urea supplementation modulate the surface functional-group characteristics of chitosan-derived CNDs and how these changes are associated with their physicochemical and functional properties. The findings will provide a basis for the rational surface engineering of biomass-derived CNDs for tailored functional applications.

P-51

TEMPO-oxidized cellulose nanofiber oleogels as structural mimetics of pork adipose tissue

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Animal adipose tissue has a compartmentalized structure in which lipid-rich regions are supported by a continuous matrix, making these characteristics difficult to reproduce with conventional structured fats. In this study, solvent-exchanged oleogels based on TEMPO-oxidized cellulose nanofibers (TOCNFs) were developed as structural mimetics of pork adipose tissue. A macroporous TOCNF hydrogel was prepared by freezing, thawing, and gelation in citric acid solution, and its internal aqueous phase was sequentially replaced with ethanol and medium-chain triglyceride (MCT) oil to obtain MCT oil oleogel (MCT-OG). MCT oil was replaced with coconut oil to produce coconut oil oleogel (CO-OG) with a solid lipid phase at room temperature. Nile red staining and oil-content analysis confirmed oil incorporation, while confocal laser scanning microscopy revealed large oil-rich compartments surrounded by the TOCNF network, showing microstructural resemblance to pork adipose tissue. Coconut oil replacement significantly increased pre-cooking hardness, although most textural properties remained different from pork adipose tissue. After heating, CO-OG retained its structure despite melting of the coconut oil phase. These results demonstrate that solvent exchange can produce TOCNF-based oleogels with high oil incorporation and a compartmentalized lipid–network architecture resembling adipose tissue, while further optimization is required to improve mechanical similarity.

P-52

Optimization of precursor composition for potato-like flavor development using response surface methodology (RSM)

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This study optimized the generation of a potato-like reaction flavor via the Maillard reaction using response surface methodology(RSM). Through a Plackett Burman design(PBD), three key independent variables-glucosamine, IMP+GMP, glucose-were identified as significant precursors influencing flavor development. Subsequently, a Box-Behnken design(BBD) was established with absorbance at 420 nm as the dependent variable to construct the optimization model. Analysis of variance demonstrated high model adequacy, with a coefficient of determination R^2 of 0.99 and a p-value of 0.01. The optimal formulation consisted of 0.27 g of IMP+GMP, 0.16 g of glucosamine, and 0.69 g of glucose, in combination with the other six precursors, in a 10 mL reaction system at 90°C for 150 min. Under the optimized condition, validation experiments revealed a low error rate of 1.83% between predicted and experimental values, confirming strong model accuracy and reproducibility. GC-MS analysis of the optimal formulation identified key volatile compounds, including methional (the primary potato flavor component), methanethiol, dimethyl disulfide, and dimethyl trisulfide. These findings establish a solid scientific foundation for the industrial scale-up and commercialization of high-value potato flavor ingredients.

P-53

Consumer-perceived sensory direction in grape tomatoes: cross-format convergence and paired-descriptor response patterns

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Relative product rankings indicate which cultivar is sweeter or firmer, but not whether consumers perceive it toward a particular sensory direction. A total of 180 female grape-tomato consumers evaluated nine cultivars using 11 paired descriptors with both Double-Faced Applicability (DFA) and semantic differential scaling (SDS). Cultivar-level DFA d'_A estimates were compared with SDS estimates, while DFA applicability responses were summarized as Low-only, Both, Neither, and High-only states. Both formats detected cultivar differences for all 11 attributes, and cultivar rankings were strongly aligned across all attributes (Spearman's ρ=0.867–0.983). Across 99 cultivar–attribute combinations, directional classifications agreed in 81.8%, while opposite classifications occurred in only 1.0%. DFA showed opposing endorsement tendencies for all 11 descriptor pairs. However, independent evaluation also revealed Both and Neither responses, indicating that overall opposition did not imply mutually exclusive applicability. For flesh firmness, joint Soft–Hard endorsement remained relatively frequent across the SDS continuum rather than being restricted to its midpoint. Cultivar-level convergence between DFA d'_A and SDS coexisted with attribute-specific descriptor-applicability patterns. Examining independent pole responses alongside integrated sensory direction therefore provided complementary information on the response composition underlying consumer-perceived sensory directions.

P-54

Thermorheological, gelation, and textural characteristics of thermosetting and thermoplastic plant protein complexes

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This study investigated the effects of blending on the thermorheological, gelation, and textural properties of thermosetting and thermoplastic plant protein complexes to develop plant protein-based binders for restructured meat analogues. Nine commercial proteins—soy (SPI, SPC), pea (PPI, PPC), faba bean (FBI, FBC), potato (PTI), chickpea (CP80), and pumpkin seed (PKC)—were analyzed. The crude protein and sulfur contents of proteins ranged from 53.5% to 97.5% and from 0.4 to 1.1%, respectively. Based on thermorheological profiles, PPC, FBC, PTI, and PKC were classified as thermosetting, whereas SPI, SPC, PPI, FBI, and CP80 were thermoplastic. To investigate interactions between proteins and estimate a binding ability, thermosetting and thermoplastic proteins were mixed at ratios of 1:3, 1:1, and 3:1 (w/w), and their rheological properties were investigated using thermorheological tests. Among them, five combinations (SPI-FBC, SPI-PTI, SPI-PKC, SPC-PTI, and SPC-PKC) that exhibited superior thermal stability based on their G' were selected for further evaluation. The gels prepared from five combinations were evaluated using TPA, stress relaxation test, and freeze-thaw stability test. The 3:1 SPI-PKC blend exhibited the greatest hardness and elasticity, along with the lowest syneresis. Consequently, the blending of thermosetting and thermoplastic proteins effectively overcomes the physical, rheological, and textural limitations of individual proteins.

P-55

Characterization of spray-dried pyropia protein concentrate–plant protein mixtures: effects of protein type on physicochemical and rheological properties

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Marine-derived proteins have gained increasing attention as sustainable protein resources, and *Pyropia spp*. represent a promising source of marine protein. This study aimed to characterize spray-dried mixtures of *Pyropia* protein concentrate (PPC) and different plant proteins and to evaluate the effects of plant protein type on their physicochemical and rheological properties. PPC was prepared by treating *Pyropia spp*. with 0.5% citric acid at 80°C for 3 h, followed by centrifugation and freeze-drying of the recovered pellet. PPC was individually mixed with soy protein isolate (S), pea protein isolate (P), mung bean protein isolate (M), or rice protein isolate (R) at a 1:1 ratio, followed by homogenization and spray drying. The resulting powders were designated as S50, P50, M50, and R50, respectively. S50 showed the highest crude protein content and solubility among the samples. The rheological properties of the redispersed mixed protein powders were strongly affected by pH. These findings demonstrate that plant protein type and pH influenced the physicochemical and rheological properties of PPC–plant protein mixtures, providing useful information for developing functional marine–plant protein ingredients.

P-56

Evaluation of the physiological activities of functional puffed chips

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This study aimed to evaluate the physiological activities of functional puffed chips formulated with yam, pepper, pollen, and soybean paste, compared to plain rice chips. All samples were extracted using 95% ethanol, and total polyphenol content was measured. Functional chips showed higher polyphenol contents than rice chips, with pepper (24.3 mg/g) and pollen (34.6 mg/g) chips exhibiting the highest values. Antioxidant activities were assessed via DPPH, ABTS, nitrite scavenging ability, and reducing power, with pepper and pollen chips demonstrating superior effects. Anticoagulant activities were evaluated by measuring thrombin time (TT), prothrombin time (PT), and activated partial thromboplastin time (aPTT). At 5 mg/mL, pollen and soybean paste chips extended aPTT more than the rice chip, and notably, the soybean paste chip showed a 1.49-fold increase, comparable to 1.5 mg/mL aspirin (1.55-fold). Antidiabetic activity was assessed using α-glucosidase inhibition. While the rice chip showed 11% inhibition, the yam, pepper, and pollen chips exhibited higher inhibition (13.1–18.5%), with pepper being the most effective. No hemolytic activity was observed in any sample at the tested concentrations. These results suggest that functional puffed chips possess enhanced health-promoting properties and could be used to develop value-added rice-based snacks.

P-57

Comparative analysis of bioactive properties of hot water and ethanol extracts from sesame, perilla, and ginger by-products

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Food processing generates considerable amounts of by-products that may cause disposal and economic burdens, while still retaining valuable components with potential for further utilization. This study evaluated sesame cake, perilla cake, and ginger residue as value-added food materials by comparing hot-water and 95% ethanol extracts. Physicochemical properties, total polyphenol content (TPC), DPPH and ABTS radical scavenging activities, reducing power, nitrite scavenging activity, α-glucosidase inhibition, coagulation parameters, and hemolytic activity were evaluated. Antioxidant activities varied depending on the by-product and extraction condition. Perilla cake showed relatively high antioxidant activities in the hot-water extract, whereas the 95% ethanol extract of ginger residue exhibited high TPC and antioxidant activities. Ginger residue also showed α-glucosidase inhibitory activity, while no pronounced anticoagulant activity was observed based on TT, PT, and aPTT. All extracts showed negligible hemolytic activity, suggesting safety under the tested conditions. Overall, sesame cake, perilla cake, and ginger residue showed potential for utilization as value-added food materials.

P-58

Development of a functional spread using apple, ginger and cinnamon: evaluation of antioxidant and nitrite-scavenging activities

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This study aimed to develop a low-sugar functional spread using apple, ginger, and cinnamon (AGC) and to evaluate its physicochemical, functional, sensory, textural, and economic properties in comparison with three commercial apple jams. AGC spreads were formulated with apple powder, ginger powder, and cinnamon powder, and the formulations were optimized by adjusting ingredients affecting texture and spreadability. The final AGC formulations showed a soluble solid content of 24°Brix, which was considerably lower than those of the commercial apple jams (40–60°Brix). Functional properties were evaluated based on total polyphenol content, antioxidant activities, nitrite-scavenging activity, and α-glucosidase inhibitory activity. The AGC spreads exhibited antioxidant and nitrite-scavenging activities, demonstrating their potential as functional spread products. Among the formulations, AGC Spread 8-2 showed favorable sensory characteristics, particularly in texture and spreadability, and exhibited distinctive textural properties in texture analysis compared with the commercial products. Furthermore, the estimated ingredient cost of AGC Spread 8-2 was approximately 379.6 KRW/100 g, suggesting the feasibility of cost-effective production. Overall, these results indicate that AGC Spread 8-2 has potential as a low-sugar functional spread with desirable functionality, sensory acceptability, textural properties, and economic feasibility.

P-59

Comparison of subcritical water extraction and ultrasound-assisted extraction for punicalagin and antioxidant activities from pomegranate peel (*Punica granatum L.*)

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This study applied eco-friendly subcritical water extraction (SWE) and ultrasound-assisted extraction (UAE) to discarded pomegranate peel to determine optimum conditions for each process and compare the extraction efficiency. SWE utilizes the temperature-dependent dielectric constant of water below the critical point (374°C, 22 MPa), and was performed at 110-200°C, 5-15 min. UAE employs cavitation-induced cell wall disruption and enhanced intracellular elution, and was performed at 500 W maximum power, 20-100% amplitude, 5-15 min. In SWE, ABTS (367.9±97.09 mg TE/g) and DPPH (213.6±29.17 mg TE/g) radical scavenging activities, as well as punicalagin (PG, 100.45±17.48 mg/g), were maximal at 110°C, 10 min. In UAE, ABTS (250.79±13.74 mg TE/g) was highest at 100%, 10 min, while DPPH (204.91±5.09 mg TE/g) and PG (138.56±1.44 mg/g) were maximized at 100%, 5 min. In SWE, PG decreased with increasing extraction temperature. This is attributed to PG degradation due to thermal instability at high temperatures. UAE's physical disruption mechanism is less susceptible to thermal degradation than SWE, and a higher PG content was observed. In UAE, increased amplitude improved matrix disruption and solvent penetration. In conclusion, applying these eco-friendly extraction techniques to discarded pomegranate peel aimed to establish a foundation for sustainable by-product valorization and process development.

P-60

Comparison of response surface methodology, machine learning, and RSM-ML hybrid models for optimizing subcritical water extraction of polyphenols from apple pomace

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Apple pomace, the principal by-product of juice processing, remains an underused source of polyphenols. This study optimized subcritical water extraction (SWE) of polyphenols from apple pomace prepared with three pretreatments (untreated, incubated, and solid-state fermented with *Aspergillus luchuensis* 74-5), comparing response surface methodology (RSM), machine learning (ML), and an RSM-ML residual hybrid for predicting procyanidin, total flavonols, and ABTS, DPPH, and FRAP antioxidant activities. Across a central composite design (100-200°C, 3-37 min, 13.2-46.8 mL/g), extraction temperature dominated all responses, and the benefit of fermentation pretreatment was confined to ≤150°C. Under leakage-free cross-validation, the apparently well-fitted RSM lost its predictive power for ABTS (Q^2=–0.075), whereas coupling the reduced RSM with a random-forest residual learner yielded the most reliable predictions for every response (Q^2=0.926-0.950). The hybrid approach thus offers an interpretable yet flexible route to trustworthy SWE optimization for apple pomace valorization.

P-61

Effects of high hydrostatic pressure levels on the preparation and physicochemical properties of granular cold-water swelling rice flour (GCWSRF)

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Rice flour has limited applications in instant and cold-water food products because of its poor hydration and viscosity development in cold water. This study investigated the direct production of granular cold-water swelling rice flour (GCWSRF) using high hydrostatic pressure (HHP) and evaluated the effects of pressure levels on its structural and functional properties. Rice flour suspensions were treated at 300–600 MPa for 20 min. HHP treatment disrupted the crystalline and ordered structures of starch while retaining the granular morphology. At 550–600 MPa, birefringence and the endothermic peak disappeared, indicating complete gelatinization and successful formation of GCWSRF. The resulting GCWSRF showed enhanced cold-water swelling and viscosity, with the highest values at 600 MPa, whereas oil absorption capacity was highest at 550 MPa. The 550 and 600 MPa-treated samples also showed different viscosity responses under acidic conditions, indicating pressure-dependent functional properties. Pearson correlation and principal component analyses showed close relationships between the loss of structural order and the development of cold-water functional properties. Overall, HHP was an effective non-thermal approach for directly producing GCWSRF from rice flour while retaining its granular morphology. These findings demonstrate the potential of HHP for producing clean-label rice flour ingredients with cold-water functionality for cold-water applied instant food systems.

P-62

Optimization of calcium lactate pretreatment and block fabrication conditions to enhance texture and sensory quality of freeze-dried food

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In the food industry, freeze-drying technology minimizes thermal damage, thereby preserving the original taste, flavor, and nutrients of raw materials. Furthermore, it ensures excellent long-term storage stability through a high moisture removal rate of over 98%, making it an increasingly popular alternative to conventional slow-freezing techniques that degrade texture by destroying tissue structures. Based on the optimal formulation of the freeze-dried product derived from a previous study, this study aims to investigate the calcium lactate pretreatment process to enhance the product's texture and the fabrication conditions of freeze-dried blocks to reinforce the sensory properties of the raw material.

P-63

Genome-based AI prediction of lactic acid bacterial β-glucosidase activity and enhanced ginsenoside bioconversion of puffed ginseng by *Lactiplantibacillus plantarum* KFOM0044

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Panax ginseng contains ginsenosides responsible for its pharmacological activities, with deglycosylated minor forms exhibiting higher bioavailability than major forms. Ginsenoside bioconversion by lactic acid bacteria (LAB) is highly strain-dependent, so efficient selection of functional strains remains important. In this study, a genome-based AI classification model was developed using 105 LAB strains to predict ginsenoside bioconversion potential. In parallel, experimentally selected LAB strains were applied to raw and puffed ginseng fermentation for bioconversion evaluation. The developed classification model achieved an AUROC of 0.960±0.034 under nested cross-validation with species-level grouping. Experimental screening identified *Lactiplantibacillus plantarum* KFOM0044 and KFOM0427 and *Lactococcus cremoris* KFOM0261 as promising strains. Among the ginseng fermentation treatments, puffed ginseng fermented with KFOM0044 showed the highest ginsenoside bioconversion, with increased contents of deglycosylated ginsenosides such as Rg3 and Rh1 and enhanced antioxidant capacity compared to non-fermented raw ginseng. Comparative genomic analysis revealed β-glucosidase-related GH1 and GH3 genes in all three strains, together with strain-specific glycoside hydrolase profiles. These findings demonstrate the potential of genome-based AI model for β-glucosidase activity prediction and of combined puffing and LAB fermentation for enhanced ginsenoside bioconversion strategies.

P-64

Integrated characterization of bitterness in structurally distinct food flavonoids: Analytical verification, sensory evaluation, and receptor-level structural context

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Bitterness limits the application of bioactive flavonoids in foods and functional products. This study characterized bitterness differences among structurally distinct flavonoids via analytical verification, sensory evaluation, and molecular docking analysis. Epigallocatechin gallate (EGCG), quercetin, and nobiletin were selected as representative flavonoids differing in structure and receptor profiles. Samples were verified by UV-Vis analysis to confirm prepared concentrations and short-term concentration retention during sensory evaluation.

Sensory evaluation used the generalized Labeled Magnitude Scale (gLMS) and a two-alternative-choice (2-AC)-based dual-reminder A-Not A (DR A-Not A) procedure across relevant concentrations. UV-Vis analysis confirmed close agreement with targets (recovery, 99.9-101.7%), though retention differed among compounds. Nobiletin was more bitter than EGCG at 0.1 mM and remained more bitter across 0.1-0.3 mM, with differences increasing at higher levels, whereas quercetin-EGCG results were less consistent. Ethanol-containing medium increased bitterness background, but matched-control-adjusted EGCG bitterness did not differ between media.

Molecular docking and MM-GBSA using TAS2R14, TAS2R46, and TAS2R39 provided subtype-specific structural context without establishing sensory causality. Flavonoid bitterness must be interpreted with molecular structure, stimulus state, concentration, and preparation context to inform bitterness control in foods.

P-65

Machine learning-based hyperspectral imaging analysis for rapid and non-destructive starch classification

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The quality and functionality of starch-based food products largely depend on the source of the starch. However, conventional methods for identifying these starches are still time-consuming and destructive. This study thus investigated the feasibility of hyperspectral imaging (HSI) combined with four machine learning algorithms (decision tree, random forest, k-nearest neighbor, and support vector machine) for the rapid and non-destructive classification of six starch samples under different preprocessing conditions. The hyperspectral spectra of all starches exhibited major reflectance features around 1200 and 1450 nm, with overall similar spectral patterns except for potato starch. Classification performance was evaluated under two preprocessing variables: particle size and moisture content. Under varying particle sizes, the KNN model achieved the highest test accuracy of 90.8% at 100 mesh. Under varying moisture content levels, the highest classification accuracy of 97.1% was obtained at 50% moisture content. These results demonstrate that the integration of HSI with machine learning provides a robust, rapid, and non-destructive approach for starch identification across diverse preprocessing conditions, with potential for practical implementation in food quality control.

P-66

Evaluation of physical properties of emulsion gels based on sodium alginate and low-acyl gellan gum for animal fat replacement

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Emulsion gels provide a strategy for structuring plant-based oils, and their application as fat replacers requires consideration of the physical properties of animal fat. In this study, emulsion gels were prepared with different mixing ratios of sodium alginate (SA) and low-acyl gellan gum (GG), which exhibit distinct gelling characteristics, to modulate emulsion gel properties. Their potential as animal fat replacers was evaluated in comparison with pork backfat (PBF). Hardness and springiness of the emulsion gels were modulated by the SA:GG ratio and showed similar ratio-dependent trends after cooking. The emulsion gel with an SA:GG ratio of 5:5 exhibited textural properties comparable to those of PBF. Water holding capacity (WHC) increased with increasing SA proportion. The emulsion gels maintained their structural integrity after cooking and exhibited lower cooking loss than PBF, with cooking loss decreasing at higher SA proportions. These findings suggest that the emulsion gels have potential as animal fat replacers. Thus, adjusting the hydrocolloid mixing ratio could serve as an effective strategy for modulating emulsion gel properties for animal fat replacement.

P-67

Food by-product-derived carbon dots with antibacterial and antioxidant activities for active food packaging

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Carbon dots (CDs) are nanomaterials whose antibacterial, antioxidant, and fluorescence properties can be tuned by the carbon precursor and by surface modification. Their synthesis from food by-products provides an opportunity to upcycle food-processing waste into high-value-added materials for active packaging. In this study, sixteen CDs were hydrothermally synthesized from eight food by-products, each prepared with or without chitosan as a nitrogen-rich co-precursor. Freeze-dried CDs were screened by broth microdilution against *Escherichia coli* O157:H7, *Listeria monocytogenes*, and *Pseudomonas fluorescens*, a psychrotrophic spoilage organism, and minimum inhibitory concentrations (MICs) were determined. The chitosan-modified mango peel CD (MPC) was the most effective, with MICs of 5 mg/mL against *E. coli* O157:H7 and 2.5 mg/mL against both *L. monocytogenes* and *P. fluorescens*. In the DPPH radical scavenging assay, MPC showed approximately 99% DPPH radical-scavenging activity at 2.5 mg/mL. MPC is currently being incorporated at 3% (w/w, based on polymer) into gelatin- and sodium caseinate-based films by solution casting, and the mechanical, barrier, antioxidant, and antibacterial properties of the films are being characterized. These findings suggest that by-product-derived CDs are promising multifunctional additives for active food packaging and support the sustainable valorization of food-processing by-products.

P-68

Effects of xylitol on KCl bitterness and sensory properties in aqueous and oil-in-water emulsion systems

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Xylitol may mitigate the bitterness of KCl, a common substitute for NaCl, through sweetness–bitterness interactions. This study evaluated the effects of xylitol on sensory properties of NaCl, KCl, and NaCl–KCl aqueous systems and its applicability to oil-in-water (O/W) emulsions. Aqueous solutions containing 0.5% (w/w) NaCl, 0.5% (w/w) KCl, or both at 0.5% (w/w) each were prepared with 0—1.0% (w/w) xylitol for sensory evaluation. O/W emulsions were prepared with aqueous phases containing 0.5% (w/w) each of NaCl and KCl and 0 or 0.5% (w/w) xylitol. Sensory evaluation of aqueous solutions showed that increasing xylitol decreased NaCl saltiness and KCl bitterness, consistent with sweetness-induced mixture suppression. In NaCl-KCl solutions, xylitol significantly reduced bitterness at 0.5% and above, while sweetness increased and saltiness and preference decreased. Based on these results, 0.5% xylitol was selected for evaluation in O/W emulsions as the lowest concentration showing bitterness reduction while minimizing changes in other sensory properties. In O/W emulsions, sensory evaluation showed that 0.5% xylitol significantly reduced bitterness (p<0.05), while saltiness, sweetness, and preference remained relatively stable. These results show that 0.5% xylitol reduced KCl bitterness in both aqueous and O/W emulsion systems. This suggests that these findings may provide a basis for further studies on sensory improvement in sodium-reduced emulsion systems containing KCl.

P-69

Freeze-thaw tofu as a scaffold for culturing chicken fibroblasts (DF-1)

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The development of low-cost food-grade scaffolds is important for cultured meat production. In this study, two tofu types, high- and low-density tofu, were evaluated as edible scaffolds for culturing DF-1 cells. Frozen-thawed tofu was prepared by controlling freezing period or freeze-thaw cycles. Its pore structure, porosity, texture, moisture properties, and density were analyzed. Also, protein and mineral release into the syneresis drip during freeze-thaw processing was evaluated. Freeze-thaw processing formed porous structures in both tofu types, and increasing freezing period shifted the pore size distribution from micropores of ~50 μm toward macropores of ~400 μm, while porosity remained comparable. Longer freezing increased hardness and decreased adhesiveness, and protein and mineral release into the drip increased with longer freezing period and repeated freeze-thaw cycles, indicating the greater syneresis of soluble components during thawing. After 7 days of culture, DF-1 cells attached onto and grew well in tofu scaffolds, with gelatin coating providing more favorable cell distribution. These results suggest that frozen-thawed tofu can serve as a low-cost edible scaffold for cultured meat.

P-70

OSA-modified starch microspindles with different morphologies for HIPPE formation and pork fat replacement

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Pickering emulsions offer a promising approach for structuring liquid oils as alternatives to solid animal fats. Octenyl succinic anhydride (OSA)-modified waxy maize starch was debranched using different concentrations of pullulanase, followed by ethanol precipitation to produce OSA-modified starch microspindles (OSMS). Increasing pullulanase concentration shifted OSMS morphology from elongated, narrow microspindles to shorter and broader structures, which were designated as long OSMS (LOSMS) and short OSMS (SOSMS), respectively. These morphological differences were associated with distinct centrifugal stability of the emulsions: LOSMS showed visible particle sedimentation, whereas SOSMS remained associated with the cream phase without apparent sedimentation. Based on this stability, an SOSMS-stabilized emulsion was used to form a high-internal-phase Pickering emulsion (HIPPE) containing approximately 78% oil. The resulting HIPPE exhibited solid-like viscoelasticity and shear-thinning behavior. When incorporated into pork patties as a pork-fat replacer, the SOSMS-stabilized HIPPE improved cooking yield, suppressed lipid oxidation during refrigerated storage, and maintained hardness and cohesiveness closer to those of the pork-fat control than sunflower oil. Overall, these results indicate that OSMS morphology plays an important role in HIPPE formation and support the potential application of OSMS-stabilized HIPPE as an animal-fat replacer.

P-71

Controlled synthesis of glutathione-derived carbon dots: Effects of precursor ratio and temperature on formation, surface chemistry, and antioxidant activity

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Carbon dots (CDs) were hydrothermally synthesized using glutathione (GSH) as a nitrogen- and sulfur-containing precursor and citric acid (CA) as a carbon source to investigate how synthesis conditions affect CD formation, surface chemistry, and functionality. Because the thiol groups of GSH are thermally labile and readily decompose at elevated temperatures, conditions favorable for CD formation may conflict with those required to preserve sulfur-containing functionalities. Therefore, the CA-to-GSH molar ratio (5:1 and 2:1) and synthesis temperature (120, 150, and 180°C) were systematically varied to examine their effects on CD formation and surface characteristics. The resulting CDs were characterized by UV–vis absorption, fluorescence, and FTIR spectroscopy to evaluate optical properties and surface functional groups. Antioxidant activity was assessed using ABTS and DPPH radical scavenging assays and compared with free GSH to determine the extent to which antioxidant functionality was retained after CD formation. The results show that precursor composition and synthesis temperature significantly influence CD formation, surface chemistry, and antioxidant activity. In particular, balancing carbonization with the preservation of sulfur-containing groups is important for tailoring the properties of GSH-derived CDs. These findings provide a basis for the controlled synthesis and surface functionalization of multifunctional CDs for bioactive compound delivery.

P-72

Influence of discharge voltage on the inactivation of *Bacillus subtilis* vegetative cells and endospores under equivalent total fluence in a pilot-scale IPL system

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Intense pulsed light (IPL) is a promising non-thermal sterilization technology enabling rapid microbial inactivation using high-intensity, broad-spectrum light pulses. *Bacillus subtilis* was selected to compare IPL resistance between vegetative cells and endospores. This study investigated inactivation responses and damage characteristics of *B. subtilis* following pilot-scale IPL treatment. Vegetative cells and endospores were exposed to IPL at 1000–1800 V with a fixed sample-to-lamp distance of 14 cm under equivalent fluence conditions, and the fluence required for a 4-log reduction (4D value) was estimated. IPL-induced damage was evaluated by Live/Dead staining and ROS analysis in vegetative cells, while dipicolinic acid (DPA) content and germination ability were assessed in endospores. At 0.7 J/cm², IPL treatment resulted in 4.7–6.2 log reductions in vegetative cells, whereas endospores showed only 1.0–1.5 log reductions, indicating higher resistance. The 4D values were 0.24–0.37 J/cm² for vegetative cells and 5.08–7.31 J/cm² for endospores. Live/Dead staining revealed membrane damage in vegetative cells, while ROS analysis indicated limited involvement of oxidative stress. IPL treatment reduced DPA content and germination ability in endospores, suggesting structural and functional damage. Overall, these findings provide insights for optimizing IPL conditions and developing efficient non-thermal microbial control strategies for food safety applications.

P-73

Thermoresponsive alginate–GTPS composite emulsion gels as porcine back fat mimetics for reduced-fat meat products

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Replacing animal fat in reduced-fat meat products remains challenging due to its temperature-dependent softening during cooking. Alginate-based emulsion gels effectively immobilize liquid oil but lack thermal softening functionality. Thermoresponsive composite emulsion gels were developed by incorporating 4-α-glucanotransferase-treated potato starch (GTPS) into alginate oil-in-water emulsion gels via $CaCO_3$/GDL-mediated internal gelation as porcine back fat mimetics. GTPS-derived glucan chains formed reversible physical associations that dissociated upon heating and re-formed during cooling, imparting thermoresponsiveness. Increasing GTPS concentration effectively preented excessive oil leakage and enhanced water-holding capacity, demonstrating its potential as a highly juicy fat replacer. Among formulations, the 15% GTPS gel (GTPS15) exhibited the most pronounced thermoresponsiveness, with its storage modulus (G') dropping to approximately one-tenth of its initial value during heating and recovering over thermal cycles. In model pork patties, complete (100%) replacement of porcine back fat with GTPS15 caused no significant differences in texture profile analysis (TPA) parameters relative to the control, while reducing estimated total fat by 54.5% and lowering calories, saturated fat, and cholesterol. These findings demonstrate that alginate–GTPS composite emulsion gels are promising thermoresponsive fat mimetics for reduced-fat meat products.

P-74

Effects of candelilla wax and palm stearin contents on the physical properties of hybrid bigels as butter alternatives

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This study evaluated how combining candelilla wax (CLW) and palm stearin (PS), which have different structuring properties, affected the physical properties of bigels as potential butter alternatives. The study included five formulations, consisting of four combinations of 6 and 8% CLW with 0 and 12% PS and one intermediate formulation containing 7% CLW and 6% PS. Bigels were prepared at 65°C by homogenizing the oleogel and hydrogel at an 8:2 ratio. The oleogel contained CLW, PS, and 1% soybean lecithin, while xanthan gum and guar gum were added to the hydrogel at 0.15% and 0.05%. At 15°C, the bigels containing 12% PS had approximately 30% higher hardness and 20% higher spreading work than the corresponding CLW-only bigels. All bigels showed elastic-dominant behavior, with the storage modulus exceeding the loss modulus. At 8% CLW, adding 12% PS produced a 174% increase in the storage modulus at 1 rad/s and broadened the temperature range of elastic behavior. Differential scanning calorimetry showed an additional PS-associated crystallization peak at 12–18°C and a main CLW-associated peak at 40–45°C. At 6% CLW, confocal laser scanning microscopy revealed smaller hydrogel droplets with a more uniform distribution following PS addition. These findings indicate that PS acted primarily as a reinforcing structurant in CLW-based bigels, increasing mechanical and elastic strength and resistance to spreading while modifying thermal behavior and microstructure.

P-75

Hydrogenated soybean lecithin-containing reduced-fat mayonnaise: formulation characteristics, subjective fullness, and subsequent energy intake

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This study investigated how reducing mayonnaise oil content and applying a hydrogenated soybean lecithin (HSL)-containing formulation modification affected physical and sensory properties, subjective appetite, and subsequent ad libitum energy intake. Four formulations containing 80% or 40% oil, with or without HSL, were evaluated in a randomized crossover study involving 42 women. HSL-containing formulations showed lower D(3,2) values than their respective non-HSL counterparts at both oil levels, while rheological responses differed by formulation context. Sensory evaluation showed that 80M-H was thicker and less watery than 80M, whereas 40M-H was thicker, more mouth-coating, and less watery than 40M. Fullness netAUC showed a significant oil level×HSL interaction (p=0.002), with greater cumulative fullness following 40M-H than 40M (p=0.014). Despite nearly identical preload energy, subsequent intake was 86.6 kcal lower following 40M-H than 40M (p=0.002). Subsequent energy intake showed a significant main effect of HSL addition (p<0.001) without a significant interaction; intake was 34.0 kcal lower following 80M-H than 80M, although this difference was not significant. These findings indicate that formulation-related responses varied across formulation contexts and outcomes, highlighting the importance of considering the complete formulation when designing reduced-fat emulsion foods.

P-76

Chitosan-based stabilization and characterization of liposomal formulations containing a high content of plant extract complex

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This study aimed to prepare a chitosan-coated liposomal formulation with increased plant extract complex (PEC) content and to enhance its physical dispersion stability. The PEC consisted of *I. cylindrica, C. sappan, C. illinoinensis*, and *L. tenuissimum*. To increase the final PEC content to 1.0%, an additional PEC solution was mixed with PEC-loaded chitosan-coated liposomes. This mixing caused severe aggregation and precipitation. Therefore, the additional PEC solution was premixed with 0.1–1.0% chitosan before mixing with the liposomal formulation, reducing particle size from about 18.5 μm to below 1 μm. No visible precipitation was observed in the 0.6%, 0.8%, and 1.0% chitosan formulations. Among these, the 0.6% chitosan formulation showed a significantly smaller particle size (636.25±46.74 nm) than the 0.8% and 1.0% formulations (p<0.05). Because particle size affects digestion, cellular uptake, and bioavailability in liposomal delivery systems, the 0.6% chitosan condition was selected for the final formulation. In ABTS and FRAP assays, the selected 0.6% chitosan formulation showed lower antioxidant activity than an unformulated 1.0% PEC control but retained substantial activity. The lower activity suggests reduced immediate accessibility and controlled release of antioxidants. These results indicate that chitosan premixing enabled the preparation of a physically stable liposomal formulation with a high PEC content while retaining its functional properties.

P-77

Understanding the role of hydrocolloids in the quality characteristics of zein-based gluten-free bread

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The limited loaf expansion and firm texture of gluten-free bread, primarily due to the absence of a gluten network, remain major technological challenges for the food industry. Although various alternatives such as hydrocolloids have been extensively investigated to mimic the functionality of the gluten network, their scientific effects on the quality attributes of gluten-free bread still remain unclear. This study thus investigated the effects of eleven hydrocolloids on crumb structure development and loaf volume expansion in zein-based gluten-free bread. In particular, hydroxypropyl methylcellulose (HPMC), sodium alginate, xanthan gum, and guar gum, which exhibited the most favorable baking performance, were selected for further evaluation. HPMC showed the highest specific volume and high total porosity. HPMC and guar gum also showed lower bread hardness than sodium alginate and xanthan gum. The dough samples with HPMC had a softer texture, which was accompanied by relatively longer T2 relaxation times. These findings show that hydrocolloid-induced changes in dough properties play a critical role in determining the structural development and final quality of zein-based gluten-free bread.

P-78

Wavelength-dependent mechanisms of bacterial inactivation by LED irradiation

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Photoinactivation is a promising non-thermal approach for microbial control; however, the relationship between wavelength, inactivation efficiency, and cellular damage remains poorly understood. This study investigated the wavelength-dependent inactivation of three food-associated bacteria, *Escherichia coli*, *Listeria innocua*, and *Enterococcus faecium*, using LEDs emitting at 265, 308, 365, and 405 nm. Microbial inactivation was evaluated by plate counting, while DNA damage, ROS generation, membrane permeability, intracellular dsDNA release, and cellular ultrastructure were characterized. All bacteria reached complete inactivation at each wavelength, but the required fluence increased markedly with increasing wavelength, from 0.014–0.024 J/cm² at 265 nm to 25.7–904.1 J/cm² at 405 nm. The predominant damage pattern also varied with wavelength. Irradiation at 265 and 308 nm increased Comet assay parameters associated with DNA migration, whereas 365 and 405 nm induced pronounced ROS generation, membrane permeability, intracellular dsDNA release, and structural disruption. These findings suggest that shorter wavelengths primarily contributed to inactivation through DNA damage, while longer wavelengths induced greater oxidative and physical damage. Overall, wavelength determined not only inactivation efficiency but also the predominant type of cellular damage, highlighting the importance of wavelength selection for effective microbial control.

P-79

Fabrication of fiber-like starch nanostructures from short-chain glucans through anisotropic growth

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Starch nanofibers have attracted considerable attention as sustainable structuring materials. However, conventional fabrication of starch nanofibers largely relies on electrospinning, which often requires precise process control, crosslinking, and additional post-treatment, resulting in a complex fabrication process. In this study, a facile strategy was developed to fabricate fiber-like structures composed of starch nanoparticles by exploiting the ethanol-induced self-assembly of short-chain glucans (SCGs). The morphology and aspect ratio of the resulting nanoparticles were modulated by varying the temperature and SCG concentration during the precipitation process. Higher temperature and SCG concentration promoted anisotropic growth, producing thinner and more elongated nanoparticles and giving rise to a pronounced fiber-like structure. The resulting morphological anisotropy may enhance interparticle interactions and promote network formation, thereby influencing their rheological properties. Overall, this study provides a new approach to constructing fiber-like structures from morphology-tunable starch nanoparticles, highlighting their potential as structuring materials for modulating the rheological and textural properties of food systems.

P-80

Quantitative prediction of wheat blend ratios using NIR spectroscopy and machine learning

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Blending technology is widely employed in the flour milling industry to produce wheat flour with consistent quality. However, scientific research on the quality attributes of blended wheat flours, particularly the determination of blending ratios, remains limited. Therefore, this study aimed to predict the blending ratios of wheat flour blends using near-infrared (NIR) spectroscopy combined with machine learning. The experimental dataset consisted of 3,296 wheat flour samples prepared by blending up to three of six different wheat flour varieties at varying blending ratios. The spectra were preprocessed using standard normal variate (SNV) normalization and a first-derivative Savitzky–Golay filter, and then subjected to machine learning analysis. Among the nine different machine learning algorithms tested in this study, CatBoost and multilayer perceptron models showed the best performance in terms of R^2 (0.861 and 0.884, respectively) and RMSE (9.549 and 8.673, respectively). These results demonstrate the feasibility of simultaneously quantifying multiple wheat classes in flour blends using NIR spectroscopy and suggest its potential for rapid verification of blend formulations and quality control in the flour milling industry.

P-81

Analysis of dielectric heating characteristics of home meal replacement (HMR) model foods during microwave heating

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Although microwave heating of HMR foods has convenience, it often causes temperature non-uniformity. HMR food is multi-phase products which has liquid and solid phases with different dielectric properties. Accurate temperature monitoring is essential for temperature uniformity of microwave heating. This study monitored the temperature profiles of model HMR foods under microwave heating (2450 MHz) using a shielded thermocouple. Solid phase of HMR food composed of Tylose gel with different fat (0, 6, 12%) and salt contents (0, 1, 2%). Liquid phase were prepared with starch solution with different fat contents (0, 3, 6, 9%). Solid (squared shape, 2×2×2 cm) and liquid (500 ml) model foods were transferred into HMR pouch. Thermocouple was installed in the geometric center of solid and top-middle-bottom positions of liquid food. Increasing fat content of solid food slow down the microwave heating rate; whereas, higher salt content enhanced the microwave heating rate. For example, microwave heating rate decreased from 9.85°C/min at 0% fat content to 9.02°C/min at 12% fat content. Higher fat content would lower dielectric constant of food with slow microwave heating rate. Liquid parts of HMR food was less affected by fat content as compared to those of solid. When fat content of liquid product increased from 0 to 9%, microwave heating rate change from 15.53 to 16.34°C/min. These results demonstrate that fat and salt contents are key factors governing dielectric heating in HMR foods.

P-82

Effects of the physicochemical properties of K-sauces on microbial inactivation

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This study aimed to investigate the physicochemical properties and thermal behavior of sauces and evaluate the thermal inactivation of *Enterococcus faecium* (*E. faecium*) to establish high-temperature short-time (HTST) sterilization conditions. The physicochemical properties of commercially available sauces, including viscosity, particle size, and specific heat capacity, were measured. Distilled water and six selected sauces were vacuum-packaged in 7×6 cm sterilized polyethylene bags, and the come-up times (CUTs) of the prepared samples were measured using a thermocouple until the target temperatures (60, 70, 80, and 90°C, respectively) were reached. Distilled water was inoculated with *E. faecium* to an initial concentration of approximately 7.6 log CFU/mL and heated at each temperature (60-90°C) and time (0-60 s) to evaluate the effects of sterilization. The CUTs decreased as the heating temperature increased but were extended in highly viscous sauces, while *E. faecium* inactivation increased with increasing temperature and treatment time. Overall, considering the physicochemical properties of K-sauces, differences in come-up time due to viscosity and particle size should be considered in sauce-specific thermal processing and standardization. D-values and z-values of *E. faecium* were determined in distilled water, and further studies should evaluate heat-induced quality changes in sauces and establish optimal processing conditions ensuring microbial safety and product quality.

P-83

Volatile flavor profiling of freeze-dried (FD) instant coffee based on bean variety, origin and roasting degree using HS-SPME-GC-MS

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This study aimed to establish scientific sensory evaluation criteria for freeze-dried (FD) coffee. Thirteen domestic FD coffee products were analyzed for volatile organic compounds (VOCs) with HS-SPME-GC-MS and classified into 6 groups (nutty/cocoa, fruity/floral, sour/fermented, green/vegetable, spice, roasted) based on the SCA Flavor Wheel.

Arabica samples exhibited a stronger fruity/floral character than Robusta samples, whereas Robusta samples displayed a more prominent nutty/cocoa flavor profile. Arabica-Robusta blends showed an intermediate profile. Among Arabica origin samples, the Ethiopian sample featured a harmonious distribution of nutty/cocoa, fruity/floral, and roasted groups, forming a more balanced profile than the Colombian sample and the Colombian-Brazilian blends.

Tracking flavor changes by roasting degree (light, mild, dark) indicated that as roasting progressed, fruity/floral characteristics diminished while the spice group was enhanced. Notably, the relative peak area percentage (Area%) of 4-ethylguaiacol, a key smoky/spicy indicator, increased with roasting degree: 2.98% (Light), 3.87% (Mild), and 7.60% (Dark).

These findings demonstrate that variety, origin, and roasting degree significantly influence FD coffee's volatile flavor. This study contributes to selecting optimized blending ratios and flavor control, serving as fundamental data for FD quality evaluation systems.

P-84

Effects of alginate-based additives on the physicochemical properties of rice cakes during refrigerated and frozen storage

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Starch retrogradation contributes to textural deterioration in rice cakes during storage. This study examined the effects of propylene glycol alginate (PGA) and sodium alginate (SA), alone and in combination, on the physicochemical properties of rice cakes during refrigerated and frozen storage. Breakdown viscosity measured using a Rapid Visco Analyzer was lowest for the combined treatment (0.5% PGA + 0.25% SA). Rheological analysis showed the smallest change in storage modulus (ΔG′) for 0.5% PGA and a comparable value for the combined treatment. Based on these findings, storage experiments were conducted with 0.5% PGA, 0.25% SA, and their combination. Rice cakes containing 0.25% SA showed the smallest increase in hardness during storage. After 7 days of refrigerated storage, the combination showed the smallest increase in retrogradation enthalpy (ΔHr). The PGA and combined treatments showed smaller increases in the FT-IR-derived index of short-range molecular order than control. During frozen storage, XRD-derived relative crystallinity did not increase significantly between day 1 and month 1 in the SA and combined treatments, suggesting limited further development of long-range crystalline order. Overall, the combined PGA-SA treatment most consistently limited physicochemical changes associated with starch retrogradation, although 0.25% SA was most effective in maintaining textural stability, as indicated by the smallest increase in hardness.

P-85

Exploring edible snail protein as a sustainable animal-derived protein resource: optimization of alkaline extraction via Box–Behnken design and characterization of Its gelation properties

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With rapid global population growth and increasing protein demand, edible snails have emerged as a sustainable animal-derived protein source owing to their high land-use efficiency and excellent essential amino acid profile. However, research focusing on snail protein extraction remains limited, and existing methods face constraints such as low recovery yields (3–9%), reliance on enzymatic treatments, and complex processing. To address these challenges, this study proposed a simplified alkaline extraction process and optimized conditions using Box–Behnken design (BBD)-based response surface methodology (RSM) by evaluating key process variables—including extraction pH, time, and temperature—and their interactive effects. Furthermore, the extracted protein under optimized conditions was characterized, and protein gels were prepared. The physicochemical properties of the hydrogels based on the extracted protein were evaluated including texture profile analysis (TPA), water-holding capacity (WHC), viscoelasticity and flow behavior using a rheometer, and microstructural analysis (SEM). Overall, this work presents an optimized alkaline extraction protocol while providing comprehensive insights into snail protein and its gelation properties, offering valuable information on potential applications in future food systems and alternative protein formulations.

P-86

펙틴 가수분해물을 이용한 가루쌀 분말 및 가루쌀 전분의 열전환 (pyroconversion)에 따른 물리화학적 및 소화특성

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본 연구에서는 펙틴 가수분해물을 산 촉매로 이용한 열전환 (pyroconversion) 처리에 따른 가루쌀분말 (floury rice flour, FRF)과 가루쌀전분 (floury rice starch, FRS)의 특성을 비교하였다. FRS는 FRF로부터 알칼리 침지법에 따라 제조하였다. 펙틴 가수분해물 (pectin hydrolysate, PH)은 고메톡실 (HM) 펙틴과 저메톡실 (LM) 펙틴을 효소분해하고, PH의 pH는 구연산을 가하여 같게 하였다. FRF와 FRS는 PH와 혼합하여 건조한 후 150℃에서 3시간 동안 열전환하였다. PH 무첨가 대조군과 비교할 때, 열전환 FRF와 FRS의 용해도는 증가하였고 팽윤력과 호화 점도는 감소하였다. FT-IR 스펙트럼에서 1730-1760 cm^{-1} 영역의 ester 결합을 나타내는 peak의 강도가 증가하였으며, 상대결정도는 23-31%의 범위로 유지되었다. 열전환 처리는 FRF와 FRS의 장단기 노화 현상을 지연시켰으며, 저항전분 함량을 증가시켜 추정혈당지수 (eGI)를 감소시켰다. 특히 효소 저항성은 열전환 FRF에서 열전환 FRS보다 더욱 높았다. 이는 열전환 처리에 따른 쌀단백질-쌀전분, 쌀전분-PH 및 쌀단백질-PH의 상호작용 증가가 열전환 FRF의 응집 구조 및 비특이적 3차원 네트워크 형성을 촉진해 전분가수분해 효소의 접근을 감소시킨 결과인 것 같다. 본 연구의 결과는 펙틴 매개 열전환이 가루쌀분말의 물리화학적 및 소화 특성을 개선하는 효과적인 변형 방법 임을 보여주며, 기존 열전환의 산촉매인 염산 및 초산을 대체할 수 있는 친환경 산촉매로 역할을 할 수 있는 잠재력이 있음을 시사한다. 또한 이러한 열전환 효과는 단백질 및 기타 비전분성 음이온 다당의 존재에 의해 더욱 향상될 수 있음을 가리킨다.

P-87

Agricultural waste valorization and development of multifunctional food packaging materials with antimicrobial, antioxidant, and antifouling performance

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This study aimed to develop sustainable multifunctional food packaging materials capable of reducing microbial contamination and oxidative deterioration during food storage and distribution. Banana peel extract (BPE), rich in phenolic compounds, was incorporated into chitosan (CS) films to provide bioactive properties and promote food by-product valorization. SiO_2-induced surface roughening followed by carnauba wax (CW) coating was applied to achieve superhydrophobic and antifouling properties. The CW-coated film exhibited inhibition zones of 13.0 and 14.3 mm against *Escherichia coli* and *Staphylococcus epidermidis*, respectively. Total phenolic content (TPC) and DPPH/ABTS radical scavenging activities increased with BPE content, indicating enhanced antioxidant activity. BPE incorporation also increased elongation at break (EAB), indicating improved film flexibility. CW coating resulted in a superhydrophobic surface with antifouling properties against bacterial and liquid contaminants. Overall, the developed film shows potential as a sustainable multifunctional food packaging materials with improved flexibility, antibacterial activity, antioxidant activity, superhydrophobicity, and antifouling properties.

P-88

Intermediate oil-phase modulation by β-sitosterol in $W_1/O/W_2$ double emulsions stabilized by heat-ultrasound-treated faba bean protein isolate

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This study investigated β-sitosterol (β-Sit) as an intermediate oil-phase modifier in $W_1/O/W_2$ double emulsions stabilized by heat–ultrasound-treated faba bean protein isolate (HU-FBPI). $W_1/O/W_2$ emulsions ($W_1/O/W_2$=8:2, w/w) were prepared with 3% PGPR and 0—1.5% β-Sit in the oil phase, using 5% HU-FBPI as the W_2 phase. HU-FBPI was prepared by heat treatment (90°C, 2 h) followed by ultrasonication (20 kHz, 120 W, 10 min). Microstructural analysis confirmed the $W_1/O/W_2$ structure and dense adsorption of HU-FBPI particles at the O/W_2 interface. Initial interfacial tension decreased with increasing β-Sit concentration at both the water/oil and 0.01% HU-FBPI/oil interfaces, from 25.74 to 14.83 mN/m and from 19.09 to 12.49 mN/m, respectively. As β-Sit concentration increased to 1.5%, viscosity and viscoelastic moduli increased while creep deformation decreased. Droplet size decreased from 18.14 to 14.83 μm up to 1% β-Sit. However, despite rheological reinforcement, 1.5% β-Sit increased droplet size to 19.60 μm and reduced physical stability and encapsulation efficiency to 89.42%. These findings demonstrate that β-Sit modulates interfacial and rheological behavior, whereas excessive incorporation compromises emulsion stability, highlighting its potential as an intermediate oil-phase modifier for tuning the structure of $W_1/O/W_2$ emulsions stabilized by HU-FBPI.

P-89

Upcycling hemp seed cake into high-moisture meat analogs: influence on thermal gelation, secondary structure, and texturization

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Sustainable protein demand drives interest in plant-based meat analogs utilizing agricultural by-products such as hemp seed cake (HSC). This study evaluated the effects of HSC incorporation from 0% to 20% on the physicochemical, thermal–rheological, and structural characteristics of high-moisture meat analogs (HMMA) produced via high-moisture extrusion. Pasting analysis showed reduced peak viscosity, while temperature sweeps confirmed that HSC blends retained thermal gelation and viscoelastic properties comparable to the control. Textural profiling revealed that increasing HSC up to 20% slightly reduced hardness and chewiness, whereas springiness, cohesiveness, and resilience remained largely unaffected. Notably, analysis of the protein secondary structure revealed that α-helix and β-turn contents were stably maintained across all formulations, while only minor shifts in β-sheet and random coil were observed at 20% HSC, confirming that the underlying protein network was preserved. Crucially, the fibrous orientation was enhanced across all formulations, achieving a maximum texturization degree of 1.15. In conclusion, HSC serves as a viable ingredient capable of replacing conventional proteins up to 20% without compromising textural and structural integrity, validating its potential for sustainable alternative food manufacturing.

P-90

Evaluation of meaty flavor profiles and volatile pattern changes in a plant-based meat flavor system using electronic nose analysis

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This study evaluated meat-like flavor development through thermal reaction in a plant-based meat flavor system and assessed volatile patterns using an electronic nose (E-nose). An extract of roasted and enzymatically hydrolyzed chickpeas, green onions, garlic, and shiitake mushrooms was formulated with cysteine, methionine, and thiamine. Samples were prepared under three secondary reaction conditions: non-heated mixing (Control), 95°C for 40 min, and 121°C for 10 min. Volatile patterns were analyzed using E-nose-based Principal Component Analysis (PCA). E-nose analysis showed separation between the non-heated control and thermally reacted samples. The control exhibited volatile patterns associated with raw and beany off-flavors, whereas thermally reacted samples shifted toward roasted and meat-like aroma patterns. These changes were associated with thermally induced Maillard and Strecker reactions. The 121°C for 10 min condition showed a shift toward roasted and sulfur-associated aroma patterns. Sensory evaluation also showed that thermally reacted samples exhibited enhanced meat-like flavor and reduced beany off-flavors. In conclusion, thermal reaction promoted meat-like flavor development. E-nose analysis differentiated volatile patterns associated with thermal reaction and enabled rapid evaluation of flavor development. These findings support thermal reaction as a strategy to enhance meat-like flavor and reduce raw and beany off-flavors in plant-based food products

P-91

Effect of layer-wise 5-methylfurfural incorporation on the physicochemical properties and flavor retention of multilayer emulsions

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This study investigated the effects of layer-wise 5-methylfurfural (MF) incorporation on multilayer emulsion properties and flavor retention. Lecithin-stabilized oil-in-water emulsions were sequentially coated with chitosan and gum arabic to form up to four layers. Layer-wise formulations (1–4) were compared with core-loaded controls (C1–C4) at 0.05% (w/v) MF. Coating increased particle size from 224.55 to 336.64 nm in chitosan-terminated samples. ζ-potential reversals and transmission electron microscopy supported multilayer formation, while Fourier-transform infrared spectroscopy suggested electrostatic associations between the biopolymers. Bound bromophenol blue was lower in layer-wise than core-loaded formulations at two to four layers, indicating altered surface hydrophobicity. Total MF contents (466–502 μg/mL) and encapsulation efficiencies (72–79%) were comparable among formulations. After 30 min of heating, sample 3 retained more MF than C3 at 50, 70, and 90°C, and the difference increased with temperature, whereas the one-layer pair showed no such trend. At 90°C, sample 3 retained 365 μg/mL MF and C3 303 μg/mL; one-layer values were 373 and 343 μg/mL, and the uncoated emulsion 268 μg/mL. Flavor intensity was likewise higher in sample 3 (2.9) than C3 (1.5) and in sample 1 (2.4) than C1 (2.0), with 1.5 in the uncoated emulsion. These results indicate that MF position within multilayer emulsions influenced MF retention and flavor perception during heating.

P-92

Effects of alkaline agents on the formation and rheological properties of neutralized curdlan gels

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Curdlan is insoluble in water but can form a gel network when its alkaline dispersion is neutralized. This study investigated the effects of different alkaline agents on the formation and rheological properties of neutralized curdlan gels. Curdlan was dispersed in alkaline solutions (pH 11.0–12.0) containing NaOH, Na_2CO_3, Na_3PO_4, K_3PO_4, or $Ca(OH)_2$ and stirred for 30 min at ambient temperature. The resulting dispersions were neutralized to pH 7–8 by adding the predetermined amounts of glucono-δ-lactone (GDL), thereby forming neutralized curdlan gels. Curdlan formed heterogeneous, lumpy gels as a dispersed phase in the $Ca(OH)_2$ solution even before neutralization. In the Na_2CO_3 solution, curdlan formed swollen particles after neutralization but did not form a continuous gel network. In contrast, curdlan dispersed in the NaOH, Na_3PO_4, and K_3PO_4 solutions successfully formed neutralized gel systems. When the NaOH-, Na_3PO_4-, and K_3PO_4-induced gels were subjected to a strain sweep test, all gels exhibited higher G′ values than G″ values across the applied strain range, indicating solid-like behavior. Based on the strain sweep profiles, the G′ values, yield stresses, and flow stresses followed the order K_3PO_4-induced gel>Na_3PO_4-induced gel>NaOH-induced gel. Accordingly, the strongest and most stable gel was obtained by neutralizing the curdlan dispersion prepared in the K_3PO_4 solution.

P-93

Biphaisc co-encapsulation of piperine and curcumin in O/W nanoemulsion and 4-α-glucanotransferase-treated potato starch for enhanced bioaccessibility and dysphagia-oriented delivery

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Incorporating hydrophobic bioactives into oil-containing foods is a preferred strategy for achieving their beneficial effects upon consumption. However, their loading capacity is limited by poor aqueous solubility, chemical instability, and the restricted oil volume fraction in food matrices, resulting in low bioavailability. This study developed a biphasic co-encapsulation system for the simultaneous encapsulation of piperine and curcumin in the both phases of oil-in-water (O/W) emulsions. Both compounds were loaded into the oil droplets and additionally incorporated into the aqueous phase through inclusion complexation with 4-α-glucanotransferase-modified potato starch (GS). The biphasic systems increased the loading capacities of piperine (16.11–19.42%) and curcumin (2.69–6.76%) compared with the control emulsion (EM). After *in vitro* gastrointestinal digestion, EM/GS showed the highest bioaccessibility of both piperine and curcumin among the tested formulations. Notably, GS-based inclusion complexation significantly enhanced their gastrointestinal stability. Moreover, EM/GS exhibited a high viscosity of 195.39 mPa·s and a residual volume of 5.70 mL in the syringe-flow test, indicating a nectar-like consistency with potential to improve swallowing safety. These findings demonstrate that the biphasic-encapsulation system may provide a promising platform for the high-capacity delivery of hydrophobic bioactives in dysphagia-oriented food formulations.

P-94

Engineering meat-like anisotropic structures in pea protein gels via bacterial cellulose-assisted unidirectional freezing

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Developing anisotropic fibrous structures remains a major challenge in plant-based meat production. Although extrusion is widely used to create meat-like structures, its relatively high energy demand has driven interest in more sustainable structuring approaches. In this study, bacterial cellulose (BC) was employed as a nanofibrous structuring agent in pea protein isolate (PPI) gels, and unidirectional freeze–thaw processing was investigated as a potentially lower-energy alternative. PPI formulations with or without BC were heat-gelled, directionally frozen on a copper plate using a dry ice–ethanol bath, and thawed. The resulting samples were characterized for internal structure, texture profile, water-holding capacity, cooking loss, and moisture content. Unidirectional freezing generated aligned pore channels throughout the PPI matrix, demonstrating structural anisotropy. BC incorporation further enhanced the continuity and definition of the fiber-like structures compared with the BC-free control. The three-dimensional nanofibrillar BC network served as a reinforcing framework within the protein matrix, contributing to increased hardness and chewiness and improved moisture retention and water-holding capacity. Overall, BC-assisted unidirectional freeze–thaw processing represents a promising, potentially more sustainable strategy for engineering PPI-based meat alternatives with enhanced fibrous architecture, texture, and physicochemical functionality.

P-95

Synthesis of *Lactobacillus plantarum*-derived carbon dots and their antiviral efficacy against norovirus and SARS-CoV-2 surrogates

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With the rapid surge in infectious diseases, continuous research is being conducted on antiviral agents to eliminate various viruses. This study reports the antiviral mechanisms of *Lactobacillus plantarum*-derived carbon dots (LPCA) against Norovirus surrogates and SARS-CoV-2 surrogates, following surface modification using citric acid. Carbon nanodots, as carbon-based materials, exhibit high antiviral activity upon synthesis. The LPCA synthesized in this study emitted stable fluorescence under UV irradiation, successfully confirming the effective formation of carbon dots. Furthermore, it demonstrated significant antiviral efficacies of 2-log reduction against Norovirus surrogates and 7-log reduction against SARS-CoV-2 surrogates. Additionally, the antioxidant capacity of LPCA was evaluated. An antioxidant activity of 25% was observed at 18 μg/mL, the concentration at which antiviral efficacy was noted. This activity increased in a concentration-dependent manner, reaching a maximum of 100%. FT-IR analysis confirmed that this antioxidant effect was driven by hydrogen donation to 2,2-diphenyl-1-picrylhydrazyl radicals, resulting in the enhancement of N-H bonds. Subsequent safety evaluations via MTT assay and LDH assay revealed no cytotoxicity up to a concentration of 600 μg/mL, indicating that LPCA is highly suitable for practical application as an effective and safe antiviral agent.

P-96

Direct steam injection investigation for thermal treatment of the oyster sauce

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Thermal treatment of a batch of oyster sauce using a steam jacket kettle requires a relatively long processing time. To reduce this treatment time by tens of minutes, conventional steam injection could be considered, but its application is hindered by the high viscosity. This study evaluated the efficacy of a direct steam injection (DSI) treatment system equipped with a positive displacement pump to reduce treatment time and evaluated the quality and microbial properties of the oyster sauce. DSI treatment variables included water content (45-48%, w/w) and flow rate (1.0–2.0 L/min). The oyster sauce was heated at 80°C for 20 min, followed by DSI treatment using steam at 105±5°C. A water content of 46% and flow rate of 1.5 L/min were selected as the appropriate DSI treatment condition. The residence time from mixing steam with the product to discharge was 3 min, shorter than that for conventional steam jacket kettle thermal treatment (97°C for 30 min). The pH, soluble solids content, salinity, and viscosity of DSI-treated oyster sauce did not differ significantly from those of the conventional product ($p>0.05$). After DSI treatment, the number of indigenous mesophilic aerobic bacteria was below the detection limit (<1.00 log CFU/g). These results demonstrate the potential of DSI treatment as a novel method for thermal treatment of oyster sauces with reduced processing time.

P-97

Effects of fermentation time on functional components of sweet potato distillery by-products and their retention after maltodextrin encapsulation

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Sweet potato (*Ipomoea batatas*) distillery by-products retain polyphenols and other functional components with potential as food materials. Sweet potato was fermented with *Saccharomyces cerevisiae* N9 at a sweet potato-to-water ratio of 1:4 (w/w) for 5, 7, and 12 d and vacuum-distilled to obtain the by-products. Dried samples (5 g) were extracted with 20 mL of 70% ethanol for 12 h. Total phenolic content (TPC), DPPH radical scavenging activity, and chlorogenic acid equivalent (CGAE) content were measured before and after maltodextrin (MDX) encapsulation. For encapsulation, 10 mL of extract was mixed with 10 mL of distilled water and 4 g of MDX and dried at 50°C for 24 h. In the extracts, TPC, DPPH activity, and CGAE content increased with fermentation time and reached 2.33 mg GAE/g, 52.73%, and 1.20 mg CGAE/g, respectively, at 12 d. The 12 d powder also showed the highest TPC (1.49 mg GAE/g), DPPH activity (12.72%), and CGAE content (0.94 mg CGAE/g). TPC retention ranged from 61.97 to 64.52%, while CGAE retention was 79.41 and 78.33% in the 7 and 12 d samples, respectively. Powder recovery exceeded 89%, and moisture content was below 5% in all samples. However, aqueous dispersion stability at 60 min decreased from 42.16% at 5 d to 22.17% at 12 d. These results indicate that longer fermentation increased functional component levels, while both component retention and dispersion stability should be considered when using these by-products as powdered food materials.

P-98

Shrimp shell washing using *in-situ* plasma-activated water for microbial decontamination and deodorization

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This study evaluated the effects of *in-situ* ultrasound (US)-assisted plasma-activated water (PAW) treatment on the inactivation of indigenous bacteria and reduction of major off-flavor compounds in shrimp shells, optimizing the treatment conditions using multi-objective optimization. The *in-situ* US-assisted PAW treatment conditions were determined based on a central composite design, with PAW generation power (500–1,400 W) and treatment time (5–15 min). Plasma was generated using a dielectric barrier discharge system. Desirability function and Pareto analysis were used to determine the optimal conditions based on the inactivation rate of the natural mesophilic aerobic bacteria and peak area reduction of major off-flavor compounds. Under the optimal conditions (1400 W, 10 min), indigenous bacteria were inactivated by 2.6±0.1 log CFU/g, while the average peak area of major volatile compounds was reduced by 61.1%. The treatment did not alter the color of the shrimp shells and cytotoxicity of chitin extracted from the skin($p>0.05$). These results suggest that the *in-situ* US-assisted PAW treatment is a potential method to decontaminate shrimp shells with reduced odor-related volatile compounds.

P-99

Sequential extraction of pectin and cellulose from apple pomace by optimized acid and alkaline treatments

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Apple pomace is an abundant agro-industrial by-product containing valuable polysaccharides such as pectin and cellulose. However, efficient recovery of these biopolymers requires controlled extraction conditions. This study investigated a sequential strategy to obtain pectin and cellulose by optimizing acid and alkaline treatments. Apple pomace powder was first washed with deionized water to remove soluble impurities. Pectin was extracted using HCl at 0.5 M or 1.0 M for 1–2 cycles, and recovered from the filtrate through ethanol precipitation and washing. The remaining solid residue was used for cellulose recovery. Cellulose extraction was performed using NaOH at 0.5 M or 1.0 M for 2–3 cycles, followed by NaClO bleaching and washing. The recovered pectin was evaluated for yield, degree of methoxylation, viscosity, and color, while cellulose was characterized by yield, composition, FTIR and TGA analyses. Acid conditions were expected to influence pectin recovery efficiency and structural properties, whereas alkaline conditions affected cellulose purification, crystallinity, and thermal behavior. Overall, this study presents a stepwise extraction process for apple pomace valorization and demonstrates its potential as a sustainable source of functional biopolymers.

P-101

그래핀 중적외선 열원에 대한 닭가슴살 가열 특성

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본 연구에서는 그래핀 기반 면상발열체를 이용하여 고온 단시간 가열 조건에서 닭가슴살의 이화학적 및 물리적 품질 특성을 평가하였다. 닭가슴살 시료는 250℃로 예열된 그래핀 면상발열체를 7 cm의 간격을 두고 상단과 하단에 적용하여 가열하였다. 가열 종결 시점은 닭가슴살의 중심 품온이 65℃에 도달하는 것을 기준으로 설정하였으며, 이에 소요된 시간은 9분 40초였다. 가열 후 닭가슴살의 중량 손실률은 11.08%였으며, 수분 함량은 67.05%를 나타냈다. 색도 측정 결과, 외부의 경우 명도 (L*) 83.64, 적색도 (a*) 0.33, 황색도 (b*) 15.54였으며, 내부의 경우 명도 (L*) 82.77, 적색도 (a*) 1.30, 황색도 (b*) 15.66의 값을 나타내어 외부와 내부 간의 명도 차이가 미미하고 균일하게 가열되었음을 확인하였다. 물성 분석 결과 경도는 11.28 N으로 측정되어 부드러운 조직감을 형성하였다. 이상의 결과를 종합하면, 그래핀 면상발열체를 활용한 상하단 고온 가열 방식은 수분 손실을 최소화하고 균일한 열전달 및 부드러운 식감을 확보할 수 있어, 닭가슴살의 품질 특성을 향상시키는 적합한 조리 기술인 것으로 판단된다.

P-102

Modulation of precursors and dopants for tailoring the functional properties of carbon nanodots

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This study investigated the effects of amino acid and fatty acid doping on the physicochemical properties and antioxidant activity of carbon nanodots (CDs) synthesized via a hydrothermal method. Glucose and citric acid were utilized as carbon precursors, while six amino acids (arginine, leucine, phenylalanine, isoleucine, valine, and tryptophan) and two fatty acids (lauric acid and oleic acid) served as dopants. Hydrothermal synthesis of CDs was conducted at 200°C for 6 h. Among the glucose-based CD samples, phenylalanine-doped CDs exhibited higher fluorescence intensity and appreciable antioxidant activity compared to those prepared with other dopants. Specifically, at a concentration of 1 mg/mL, phenylalanine-doped CDs demonstrated ABTS and DPPH radical scavenging activities of 61.27% and 29.64%, respectively. Notably, while CDs synthesized from citric acid alone displayed minimal antioxidant activity, doping with aromatic amino acids significantly enhanced ABTS radical scavenging, with tryptophan-doped citric acid CDs achieving the highest activity at 82.55%. Overall, these findings demonstrate that the functional characteristics of CDs can be strategically modulated through dopant selection. This approach provides a foundation for designing tailored doping strategies to achieve the specific properties required for advanced, multifunctional food packaging materials.

P-103

Comparison of single- and dual-transducer configurations for real-time monitoring in CIP systems

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Clean-in-place (CIP) systems are widely used in the food industry to automate cleaning without disassembly or manual intervention; however, the inability to visually inspect internal surfaces often results in conservatively designed cleaning protocols and excessive consumption of water and chemicals. This study compared two ultrasonic measurement configurations for real-time CIP monitoring: a single transducer in pulse-echo mode and two transducers in pitch-catch mode. Laboratory-scale CIP experiments were conducted using stainless-steel coupons fouled with skim milk and cleaned using a NaOH solution. During cleaning, ultrasonic signals, electrical conductivity, and turbidity were simultaneously monitored, while cleaning efficiency was quantified based on residual fouling mass. Machine learning models were developed using ultrasonic waveform features, conductivity, and turbidity to predict residual fouling and evaluate the monitoring performance of the two transducer configurations. The results demonstrated differences in monitoring performance between the single- and dual-transducer configurations, allowing the more suitable configuration for real-time CIP monitoring to be identified. These findings demonstrate the potential of ultrasonic monitoring combined with machine learning for quantitative assessment of CIP cleaning processes and more resource-efficient operation in food processing.

P-104

Fucoxanthin alleviates Alzheimer's disease-related protein aggregation and neuroinflammation in APP/PS1 mice

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Alzheimer's disease (AD) is a progressive neurodegenerative disorder characterized by cognitive decline and the accumulation of amyloid-β (Aβ) and tau proteins. This study investigated the effects of fucoxanthin, a carotenoid derived from the microalga *Phaeodactylum tricornutum*, on AD-related protein aggregation and neuroinflammation. The effects of fucoxanthin on Aβ and tau aggregation were evaluated using thioflavin fluorescence, PICUP, dot blotting, and in silico molecular docking. APP/PS1 mice were administered fucoxanthin, and cognitive function, Aβ and tau pathology, glial activation, and NLRP3 inflammasome signaling were assessed using behavioral, histological, and biochemical analyses. Fucoxanthin inhibited Aβ and tau aggregation and promoted the dissociation of pre-formed aggregates. Molecular docking suggested potential interactions between fucoxanthin and hydrophobic regions of Aβ and tau. In APP/PS1 mice, fucoxanthin improved learning and memory and reduced Aβ and tau pathology, glial activation, and NLRP3 inflammasome-associated neuroinflammation. These findings suggest that fucoxanthin may alleviate multiple pathological features associated with AD, supporting its potential as a microalgae-derived bioactive compound for the management of AD-related pathology.

P-105

Digital twin of a microwave based on deep learning for real-time endpoint control during steamed egg cooking

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The objective of this study was to develop a digital twin based on computer vision for real-time monitoring and endpoint control of steamed egg during microwave cooking. Conventional heating for a fixed time cannot accommodate variations in food composition or amount and may cause overheating, rupture, or overflow. A total of 2,315 RGB images from 38 cooking trials were labeled into four cooking states (liquid, coagulating, fully cooked, and overcooked). These images were used to train a custom convolutional neural network (CNN) and eight pretrained CNNs under fivefold cross validation grouped by cooking trial to prevent data leakage. ConvNeXt-Tiny and EfficientNet-B0 achieved the highest macro F1 scores of 0.9770±0.0157 and 0.9717±0.0111, and Grad-CAM++ confirmed that the model decisions were based on relevant surface regions. During cooking, a normal endpoint was triggered when the fully cooked probability remained at or above 0.80 for five consecutive predictions, and an overcooked probability of 0.95 or higher initiated emergency termination. At each endpoint, a solid state relay (SSR) controlled by a Raspberry Pi automatically cut the microwave power. In validation, the cooking endpoint was delayed as salt content or sample volume increased. These results confirmed the development of a digital twin system that terminates heating according to the actual cooking state rather than a preset time.

P-106

맥피 종류 및 효소 처리에 따른 인산염 처리 압출 쌀가루의 이화학적 특성 비교

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본 연구에서는 밀 제분 과정에서 발생하는 부산물인 맥피의 식품 소재로서 활용 가능성을 평가하고자 하였다. 이를 위해 2종의 맥피 (맥피 1 및 맥피 2)에 인산염 및 2종의 효소 (Celluclast BG 및 Viscozyme L) 처리를 적용한 후 가루쌀과 혼합하여 압출성형 하였으며, 처리 조건에 따른 이화학적 및 호화 특성을 비교·분석하였다. 보수력 측정 결과, 맥피 1의 경우 Celluclast BG 처리군에서는 효소 무처리군과 비교하였을 때 소폭 증가한 반면, Viscozyme L 처리군에서는 크게 감소하는 경향을 보였다. 맥피 2의 경우 효소 처리군에서 무처리군보다 보수력이 증가하는 경향을 나타내어, 맥피 종류에 따라 효소 처리가 보수력에 미치는 영향이 상이한 것으로 나타났다. 팽윤력은 효소 처리 조건에 따른 뚜렷한 경향을 나타내지 않았다. 용해도는 효소 처리 여부와 관계없이 맥피 첨가군에서 전반적으로 감소하는 경향을 보였다. RVA 분석 결과, 맥피 첨가군에서 최고점도, 최종점도, 치반값이 감소하는 경향을 나타냈으며 효소처리에 따른 영향은 크지 않았다. DSC 분석 결과, 압출성형 후 전분의 호화 피크가 관찰되지 않았으며, 이는 압출성형 과정에서 전분의 결정 구조가 붕괴되었음을 시사한다. 맥피의 종류 및 효소 처리가 압출성형 쌀가루의 수화 및 호화 특성에 서로 다른 영향을 미치는 것을 확인하였으며, 밀 제분 부산물인 맥피의 식품 소재로서 활용 기초 자료로 사용 가능할 것이다.

P-107

Comparison of lignan content, antioxidant activity, and protective effects against scopolamine-induced damage in SH-SY5Y cells among sesame cultivars

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Sesame contains lignans with potential antioxidant and neuroprotective properties; however, comparative data on the functional properties of different cultivars remain limited. This study compared lignan content, DPPH radical-scavenging activity, total polyphenol content (TPC), and protective effects against scopolamine-induced damage in four sesame cultivars. Lignan contents were 73.6±1.2, 59.6±0.7, 152.2±3.6, and 157.1±0.6 mg/g in Goenbaek, Youngwoong, Seulki, and Roum, respectively. The EC50 values for DPPH radical-scavenging activity were 762.27±79.98, 825.63±41.71, 452.50±37.74, and 458.83±21.68 μg/mL, respectively. TPC values were 13.98±1.4, 16.19±1.1, 20.5±3.0, and 21.80±1.3 mg GAE/g extract, respectively. For cellular evaluation, SH-SY5Y cells were differentiated with 10 μM retinoic acid for 12 days, pretreated with each sesame extract for 1 h, and subsequently exposed to 1 μM scopolamine for 24 h. Western blot analysis showed that sesame extracts modulated the expression of Bcl-2 and other proteins associated with neuronal survival and cognitive function, with more pronounced effects observed in Seulki and Roum. Overall, Seulki and Roum exhibited higher lignan and polyphenol contents, stronger DPPH radical-scavenging activity, and more pronounced effects on neuronal protein expression than the other cultivars, suggesting their potential as functional materials with neuroprotective properties.

P-108

Thiol-ene reaction induction using cold plasma for linseed oil-based bio-polyol synthesis: Application of the bio-polyols to quail egg packaging foam preparation

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In this study, polyurethane foams (PUFs) were prepared using bio-polyols synthesized from vegetable oil via cold plasma (CP)- and UV-induced thiol–ene reactions, and their quality and cushioning properties as a quail egg packaging material were compared. Linseed oil and 2-mercaptoethanol were mixed at a double bond-to-thiol equivalent ratio of 1:3 and treated with CP at 90 W for 90 min with stirring at 300 rpm. For UV treatment, 2-hydroxy-2-methylpropiophenone (2 wt%) was added to the linseed oil-2-mercaptoethanol mixture, followed by UV irradiation for 240 min. The resulting bio-polyols, designated CP90p and UV240p, respectively, were confirmed by nuclear magnetic resonance and Fourier-transform infrared spectroscopy. CP90p and UV240p showed acid values of 1.68 and 0.39 mg KOH/g and hydroxyl values of 115.31 and 112.38 mg KOH/g, respectively, confirming that CP produced a comparable hydroxyl value despite the shorter treatment time. The CP- and UV-based PUFs had apparent densities of 41.7 and 41.7 kg/m³ and compressive strengths of 19.99 and 18.43 kPa, respectively, with uniform cell structures observed by scanning electron microscope. In cushioning tests, the CP-based PUF withstood 9 drops before the first quail egg crack, outperforming the UV-based PUF (6 drops). These results demonstrate that CP can promote the thiol–ene reaction for polyol synthesis and that CP-based PUF could serve as an alternative food cushioning material to conventional thiol–ene-based PUF.

Freeze-drying process fabrication of smart absorbent pads integrating antibacterial activity and real-time colorimetric monitoring for food packaging and freshness indication

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This study aimed to develop a multifunctional freeze-dried smart absorbent pad with integrated water absorption, antibacterial activity, and real-time colorimetric monitoring for food freshness indication. Red cabbage anthocyanins (RCA) were extracted and incorporated into mixtures of poly(vinyl alcohol) (PVA) and chitosan (CS), which were then subjected to three freeze-thaw cycles followed by freeze-drying. Three PVA/CS formulations (70/30, 50/50, and 30/70) were evaluated, and the 70/30 formulation was selected for its favorable balance of structural stability, water absorption, and antibacterial activity. The selected porous pad exhibited a swelling ratio of 1,072%, indicating its high water absorption capacity. In the pour plate assay, the pad showed strong antibacterial activity against *Escherichia coli* and Staphylococcus epidermidis, reducing their populations by 90.6% and 99.4%, respectively, relative to the PVA control pad. RCA displayed pH-dependent color and spectral changes over pH 2-12, and the RCA-loaded pad retained this pH-responsive color behavior. During shrimp storage at 25°C, the pad changed from purple to blue as total volatile basic nitrogen (TVB-N) increased, with a marked color change at 18 h when TVB-N exceeded 20 mg/100 g; ΔE reached approximately 13 at 30 h. In conclusion, the pad showed potential for managing moisture released from fresh foods, inhibiting bacterial growth, and providing visual information on food freshness in real time.

Comparative evaluation of UV-B light sources for bacterial inactivation: process efficiency and inactivation mechanisms

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This study aimed to comparatively evaluate the bacterial inactivation performance of UV-B light sources. The bacterial inactivation effects of a broadband UV-B (UVB-BB) lamp, a narrowband UV-B (UVB-NB) lamp, and a 308 nm LED were evaluated against *Escherichia coli* ATCC 25922, *Bacillus subtilis* ATCC 6051, and S*higella sonnei* ATCC 29930. Inactivation kinetics were characterized by curve fitting, and process efficiencies were quantitatively evaluated. DNA damage, as a major germicidal mechanism, was further assessed in *E. coli* using multiple indicators. The UVB-NB and UVB-BB lamps exhibited distinct spectral distributions. The double Weibull model provided the best fit under most treatment conditions ($R^2 \geq 0.99$, RMSE≤0.25), except for several UVB-NB treatments. The UVB-BB lamp showed the highest process efficiency, requiring the lowest F_{4D} (0.081–0.175 J/cm²) and the lowest E_{EO} (0.83–1.80 kWh/m³). Following UVB-BB, UVB-NB, and 308 nm LED treatments, the relative dsDNA contents of *E. coli* significantly decreased to 49.5±13.6%, 22.7±0.3%, and 36.9±6.6% of the untreated control, respectively ($p<0.05$). The ESS assay further indicated the formation of cyclobutane pyrimidine dimers (CPDs) in genomic DNA following all UV-B irradiation treatments. Notably, the UVB-NB treatment resulted in limited recovery of 15.0±3.6% after photoreactivation. These findings demonstrate that UV-B spectral characteristics critically influence bacterial inactivation efficiency and cellular responses.

P-110

Matrix- and surfactant-dependent properties of spray-dried milk phospholipid-rich extract powders: reconstitution stability and *In vitro* lipid digestion

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Milk phospholipid (MP)-rich extracts are complex lipid ingredients with intrinsic surface activity, making their drying and reconstitution behavior dependent on interfacial composition. This study investigated the effects of wall matrix, whey protein isolate (WPI) structural state, and surfactant type on spray-dried MP-rich extract powders. Gum arabic (GA)–maltodextrin (MD), native WPI–maltodextrin, and denatured WPI (DWPI)–MD were combined with no surfactant, Tween 80, or Span 60. DWPI was prepared under low-temperature conditions (pH 2, 60°C for 1 h; L-DWPI) or high-temperature conditions (pH 2, 80°C for 3 h; H-DWPI), followed by neutralization to pH 7. The formulations were homogenized, spray-dried, and evaluated for powder and reconstitution properties, physical stability, and *in vitro* FFA release. Surfactant addition increased the Turbiscan stability index of WPI-based dispersions, indicating reduced physical stability, with Span 60 showing the greater destabilizing effect. Tween 80 tended to reduce particle size, whereas Span 60 promoted larger particles and higher viscosity, particularly in HDWPI systems. FFA release was maintained or increased in GA-, native WPI-, and LDWPI-based formulations, but decreased in HDWPI systems containing surfactants. These results indicate that reconstitution stability and lipid digestion are governed by matrix-dependent interactions among WPI, phospholipids, and surfactants.

P-111

Effects of microwave reheating time on the quality characteristics of refrigerated cooked rice

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Microwave reheating conditions can affect the quality of refrigerated cooked rice by altering its temperature, moisture distribution, and texture. This study evaluated the quality characteristics of cooked rice stored at 4°C for 1 or 3 days and reheated for different durations in a microwave oven. As reheating time increased, rice temperature increased, whereas hardness generally decreased, likely due to thermal softening and moisture redistribution. However, rice stored for 3 days and reheated for 3 min 30 s showed higher hardness than the 3 min reheated sample, possibly due to moisture loss and surface hardening during prolonged reheating. Total starch and amylose contents in the leachate generally decreased with storage and increasing reheating time, whereas protein content tended to increase with reheating time. These changes may be related to starch retrogradation and matrix restructuring during reheating. Sensory evaluation showed higher stickiness scores for rice stored for 1 day and reheated for 2 min 30 s and for rice stored for 3 days and reheated for 3 min, which was consistent with the instrumental adhesiveness results. These conditions also received the highest scores for temperature suitability and overall acceptability. Overall, the optimal microwave reheating time differed depending on storage duration, with 2 min 30 s for rice stored for 1 day and 3 min for rice stored for 3 days providing the most favorable eating quality.

P-112

Ionized gas-assisted epoxide ring-opening of epoxidized waste cooking oil for bio-based polyurethane foam production

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This study evaluated the effects of ionized gas generated by a cold plasma system on the epoxide ring-opening reaction of epoxidized waste cooking oil and its effects on the chemical properties of the polyols and the foaming behavior and physical properties of polyurethane foams (PUFs). At 600 W, increasing the treatment time from 20 to 60 min decreased the oxirane oxygen content (OOC) from 0.86% to 0.11% and increased the hydroxyl value from 95.37 to 131.84 mg KOH/g. Compared with untreated samples at the same reaction time, ionized gas treatment resulted in lower OOC and higher hydroxyl values, indicating enhanced epoxide ring opening. At 60 min, increasing the power from 600 to 850 W further increased the hydroxyl value to 163.39 mg KOH/g. The acid and iodine values also varied with ionized gas generation conditions, indicating changes in polyol chemical properties. PUFs prepared from polyols produced under different treatment conditions exhibited differences in foaming behavior and physical properties. In particular, the PUF prepared from the polyols synthesized at 850 W for 60 min showed the shortest cream time (5 s) and free rise time (143 s), with compressive strength of 32.98 kPa and core density of 42.44 kg/m3. These results suggest that ionized gas promotes epoxide ring opening and affects polyol and PUF properties depending on treatment conditions, demonstrating its potential as an auxiliary technology for polyol synthesis in waste cooking oil-based PUF production.

P-113

Henry's law analysis of temperature-dependent CO_2 solubility in aqueous lysine solutions at atmospheric pressure

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Carbonated beverages lose CO_2 after opening as pressure falls to atmospheric levels. This study applies an apparent Henry's law framework to determine how temperature and lysine concentration affect CO_2 partitioning between gas and liquid phases. Vapor–liquid equilibrium (VLE) data are obtained for distilled water, 0.1% (w/w) lysine solution, and 1.0% (w/w) lysine solution at 20, 25, and 30°C at atmospheric pressure. Distilled water provides the physical-dissolution reference, and the lysine concentrations are compared to identify concentration-dependent changes in CO_2 uptake. At equilibrium, measured CO_2 partial pressure and liquid-phase CO_2 concentration derived from the VLE mass balance are used to calculate an apparent Henry's law constant ($H_{app}=P_{CO_2}/C_{eq}$). Happ is compared among the systems at each temperature; a lower Happ indicates greater CO_2 uptake at a given CO_2 partial pressure. The difference between lysine solutions and water is used to assess the lysine-associated contribution beyond physical dissolution. Temperature dependence of Happ is evaluated by fitting in Happ against 1/T using the van't Hoff relation, yielding apparent CO_2 absorption enthalpy. CO_2 capture capacity, lysine-normalized CO_2 loading, and pH change are analyzed as complementary indicators of uptake and CO_2-lysine interactions. This approach provides a thermodynamic basis for assessing whether lysine concentration can improve CO_2 retention under post-opening conditions.

P-114

pH-dependent phase behavior of shellac in aqueous systems

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Shellac is a natural resin widely used in food, pharmaceutical, and coating applications because of its pH-responsive solubility. However, the link between its ionization and aqueous phase behavior has not been quantitatively established. This study connected the apparent acid dissociation behavior of shellac with changes in particle size, turbidity, and visual appearance. A 0.1% (w/w) shellac sodium salt solution was prepared in 0.1 M NaOH at 50°C. Its apparent pKa was determined by blank-corrected HCl titration using the differential acid volume required to reach the same pH in shellac and NaOH systems. During acidification from pH 12.78 to 3, particle-size distributions, turbidity, and macroscopic appearance were measured. The apparent pKa of shellac was 6.44. The system was clear and homogeneous from pH 13 to 7, with a small-particle population of approximately 8–13 nm. Turbidity increased at pH 5–6, accompanied by particles near 100 nm. At pH 4 and 3, particle size increased to approximately 190 and 500 nm, respectively, with pronounced turbidity and phase separation. These results show that shellac aggregation begins near its apparent pKa: protonation of carboxyl groups reduces electrostatic stabilization, promotes particle growth, and ultimately drives macroscopic phase separation. This cross-scale relationship provides a mechanistic basis for controlling shellac performance in aqueous food and coating systems.

P-115

Optimization of oleogels with improved creaming properties by response surface methodology and machine learning: Evaluation as a butter replacer in pound cake

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This study aimed to optimize an oleogel as an animal fat replacer with improved creaming functionality and evaluate its application in pound cake. High-oleic sunflower oil was used as the continuous phase, pea protein isolate and high-methoxyl pectin as interfacial film formers, and monoacylglycerol as a fat crystal structurant. A constrained mixture D-optimal design generated 35 formulations, which were prepared by an emulsion-templated method. Rheological fingerprint distance (RFD) was calculated from amplitude sweep data to assess similarity to butter. Butter similarity index (BSI-3) was calculated from yield stress, tan δ, and structural recovery obtained by a three-interval thixotropy test (3ITT). Relationships of RFD and BSI-3 with creaming overrun were analyzed to assess whether rheological similarity translated into creaming functionality. Response surface methodology and machine learning were used to predict formulations minimizing RFD and compare predictive performance. The predicted optimal oleogel was prepared to validate predicted and measured RFD values. Pound cakes with 50, 70, and 100% butter replacement were prepared, and specific volume, texture, and color were evaluated. The optimized oleogel may be applicable as an animal fat replacer in bakery products.

P-116

Signaling pathway involved in DNA damage induced by food additive titanium dioxide

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Titanium dioxide (TiO_2) is a food additive used as a whitening agent in a wide range of processed foods, including confectionery, sauces, and dairy products, owing to its chemical stability. However, the European Union banned the use of titanium dioxide as a food additive after the European Food Safety Authority (EFSA) raised concerns regarding its potential genotoxicity, citing the inability to rule out that TiO_2 particles could accumulate in the body and induce DNA damage. In this study, the DNA damage response (DDR) signaling pathway associated with TiO_2-induced genotoxicity was investigated using human intestinal epithelial cells (Caco-2), representing the primary site of TiO_2 exposure. Following TiO_2 exposure, DDR signaling was evaluated by western blot analysis of p-ATM, p-ATR, p-CHK1, p-CHK2, and p-p53. These results demonstrate that TiO_2 exposure can activate DDR signaling pathways converging on p53 phosphorylation. These findings provide mechanistic insight into TiO_2-induced genotoxicity as a food additive and offer important data for assessing its potential toxicity.

P-117

In vitro polyphenol-mediated effects on titanium dioxide-induced genotoxicity and oxidative stress

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Titanium dioxide (TiO_2) is a widely used food additive in various processed foods due to its high stability and excellent whitening and opacifying properties. In particular, it has been used to enhance the whiteness and brightness of foods such as chocolate and confectionery products. However, concerns regarding its potential toxicity have increased due to its ability to induce oxidative stress and genotoxicity. In the European Union, the use of TiO_2 as a food additive has been prohibited because a risk of genotoxicity could not be excluded. In this study, the mitigating effects of polyphenols on TiO_2-induced oxidative stress and genotoxicity were investigated. ROS generation and the activities of antioxidant enzymes, including superoxide dismutase (SOD) and catalase (CAT), were evaluated following co-treatment with TiO_2 and polyphenols. The mitigating effects of polyphenols on TiO_2-induced DNA damage were further assessed using the comet assay. The results showed that polyphenols affected TiO_2-induced oxidative stress and genotoxicity. These findings can serve as a reference for understanding the potential toxic effects of TiO_2 and the effects of antioxidant compounds on TiO_2-induced oxidative stress and genotoxicity.

P-118

Characteristics of ginseng and red ginseng powder using subcritical water and spray drying integrated process

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Subcritical water (SW) has been reported to alter ginsenoside composition and improve antioxidant and ACE inhibitory activities. However, the characteristics of the SW hydrolysis connected with spray-drying (SD) processing studies have been limited. Therefore, this study aimed to evaluate the effects of SW processing at 200°C and SD processing on ginseng and red ginseng. SW enhanced antioxidant and ACE inhibitory activities and increased Rg5 content in both ginseng and red ginseng. The equilibrium moisture content (EMC) of SD ginseng at SW 200°C (G200-SD) was higher than that of the SD ginseng control (G-SD). In contrast, the EMC of SD red ginseng at SW 200°C (RG200-SD) was lower than that of the SD red ginseng control (RG-SD). G200-SD and RG200-SD showed higher Rg2 contents than G-SD and RG-SD, respectively. All SW-SD powders exhibited higher solubility than their respective untreated-SD controls. The WAI and particle size decreased in the order of ginseng control (GC), G-SD, and G200-SD, while a similar trend was observed for red ginseng, with no significant differences between RG-SD and RG200-SD ($p>0.05$). G200-SD showed a lower ζ-potential of 15.52 mV than 28.64 mV of G-SD, while red ginseng control (RGC), RG-SD, and RG200-SD showed low. Consequently, the SW–SD integrated process showed potential for producing ginseng and red ginseng powders with enhanced antioxidant and ACE inhibitory activities and solubility.

P-119

AI-driven screening and experimental characterization of putative lipase candidates

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Conventional lipase discovery relies on extensive activity screening, making the process labor- and time-intensive. This study developed an integrated workflow combining machine learning, structural analysis, and recombinant validation to improve candidate selection. Lipase-related sequences were collected from UniProt, PDB, NCBI, and the Lipase Engineering Database, and sequence-derived features, including amino acid composition, physicochemical properties, stability indices, elemental composition, and charge characteristics, were used for model development. A multi-stage classification strategy was used to distinguish non-specific lipases from other lipases and identify putative sn-1,3-specific enzymes. Ensemble classifiers showed high predictive performance, while the CN2 rule-based model provided criteria for candidate prioritization. The models were applied to 34,004 putative lipases, and selected candidates were evaluated by AlphaFold3-based analysis of catalytic triad geometry, Ser–ligand distance, and lid-domain features. One prioritized candidate was expressed in a baculovirus–insect cell system and biochemically characterized. The recombinant enzyme showed activity toward p-NPP and triolein and exhibited non-regiospecific hydrolysis of triacylglycerol. These findings show that integrating machine learning, structural screening, and experimental validation is an efficient strategy for prioritizing functional lipases for food lipid applications.

AUTHOR INDEX

A

Ahn Hyo-San P-51
An Jaeha P-35, P-94

B

Bae Chan-Il P-63
Bae Juhyun P-27, P-92
Bae Yu-Jeong P-41
Baek Chang-hee P-11
Baek Seungmin P-37, P-43, P-47, P-55
Baik Moo-Yeol P-3, P-23, P-26, P-41, P-61 P-63
Ban Choongjin P-69
Byun Jihyun P-44

C

Chang U-Ju P-64
Chang Yoonjee P-67, P-95
Cheon Se-Won P-66
Cho Dae-hwan P-11
Cho Dong-Hwa P-10
Cho Eun Hye P-21
Cho Eunchae P-99
Cho Suah P-97
Choe YeongIn P-19, P-106
Choi Go Eun P-103, P-119
Choi Goeun P-104
Choi Gyu-seo P-53
Choi Haeri P-32
Choi Heeju P-81
Choi Heeyeon P-37, P-47, P-110
Choi Hye-Jae P-36, P-72, P-109
Choi Jinmyung P-108
Choi Jisu P-69
Choi Mi-Jung P-20, P-21, P-22, P-25 P-29, P-38, P-68, P-74 P-76, P-88, P-91
Choi Minji P-44
Choi Seohyun P-101
Choi Soo-Jin P-116, P-117
Choi Sung-Won P-3,P-23, P-26, P-41, P-61
Choi Ye Seul P-96, P-107
Choi Yun-Jeong P-22
Chung Donghwa P-13, P-113, P-114
Chung Hyun-Jung P-4, P-10, P-84, P-111
Chung Jiyoon P-95
Chung Myong-Soo P-7, P-31, P-36, P-72, P-78, P-109

D

Doh Hansol P-60, P-97, P-104

E

Evariste Niringiyimana P-32

G

Gu Bon-Jae P-89
Gwak Yoon-Soo P-63
Gwon Han-Gyeol P-6, P-43, P-55

H

Ha Mingyo P-4, P-84, P-111
Ha Ye Eun P-112
Hahn Jungwoo P-14, P-16, P-34
Ham Do-Ah P-116, P-117
Han Hyebin P-16
Han Jaejoon P-101
Han Ji Eun P-115
Han Kyoon Sik P-96
Han Wen P-13, P-113, P-114
Heo Hui Won P-118
Hong Chi Rac P-103, P-119
Hong Geun-Pyo P-82, P-118
Hong Sung-Chul P-103, P-119
Hwang Taesoo P-33
Hwang Yoon Tae P-28, P-62, P-90
Hwang Young-Suk P-57
Hwangbo Hark P-28, P-62, P-90

I

Im SoHee P-19, P-106

J

Jang Hyewon P-87
Jang Seo-Jung P-84
Jang Yoon young P-85
Jeon Chaeeun P-88
Jeon Hyerim P-89
Jeong Se-Ho P-66
Jeong Seo-Yeon P-66
Jeong Sungmin P-12
ji Eun Seo P-102
Ji Hyejin P-60
Jo Yeon-Ji P-6, P-37, P-43, P-47 P-55, P-110
Joe Eun Joon P-98
Joo Yeongeun P-101
Jung heeJung P-35, P-94
Jung Hye Won P-96
Jung In-Geun P-93
Jung Ju-Hyeong P-103, P-119
Jung Sang Won P-28, P-62, P-90
Jung Sena P-91
Jung Yeeun P-92

K

Kang Dong-Gook P-2
Kang Hyun-Soo P-3
Kang Jinmo P-15
Kang Seongmin P-1
Kil YoungSook P-19, P-106
Kim Bo-Hyun P-116
Kim Bomi P-35, P-94
Kim Chang-Young P-25
Kim Cho-A P-26
Kim Dan-Yeong P-84
Kim Do Young P-10
Kim Dohun P-12
Kim Do-Hyeon P-11
Kim Dowan P-32
Kim Euijin P-27
Kim Geon-Ha P-66
Kim Haet Tteum P-28, P-62, P-90
Kim Hansu P-87, P-108
Kim Hyeonbeom P-29
Kim Hye-Yeon P-31
Kim Hyun-Cheol P-30
Kim Hyunseok P-9
Kim Hyun-Seok P-14, P-27, P-34, P-46 P-54, P-92
Kim Jiin P-24
Kim Kitae P-30
Kim Mi-Ju P-63
Kim Min Sung P-14
Kim Mingyu P-13, P-114
Kim Minji P-16
Kim Minjo P-15, P-49
Kim Min-Seok P-3, P-23, P-26, P-41 P-61
Kim Na kyung P-7
Kim Nayoon P-9
Kim Sangoh P-44
Kim Seogwang P-27, P-92
Kim Seon Jeong P-19
Kim Seon Min P-81
Kim SeonJeong P-106
Kim Si Yeon P-20, P-115
Kim Sihyun P-32
Kim Sunyoung P-18
Kim Tae Seok P-28, P-62, P-90
Kim Taein P-27, P-87
Kim Woo-Ju P-24, P-85, P-99, P-102
Kim Ye won P-22, P-23
Kim Yeongyeong P-21
Kim Yong-Ro P-51, P-73, P-93
Kim Yong-Tae P-103, P-119
Kim Youngmog P-52
Kim Young-Rok P-2, P-70, P-79
Kim Youngsu P-81
Ko Ji Su P-90
Ko Min-Jung P-59
Koo Na-hyung P-53
Koo Youngjae P-4
Kwak Byung-Man P-83

Kwak Ji-Hyun P-3
Kwon Il Ryeong P-5
Kwon Ye-Won P-66
Kwon-Sam Park P-119

L

Lee Chae-Eun P-82
Lee Chan Yong P-28
Lee Chanho P-81
Lee Chansung P-80
Lee Da Eun P-65
Lee Dong-Gu P-66
Lee Dong-Heon P-66
Lee Dong-Un P-66
Lee Gahyun P-1
Lee Hanwool P-82
Lee Hye-Seong P-39, P-53, P-64, P-75
Lee JiHo P-19, P-106
Lee Ji-Hyeon P-79
Lee Jimin P-75
Lee Ji-Won P-58
Lee Jiyeon P-76
Lee Jiyeong P-69
Lee Ji-Yoon P-7, P-31, P-78
Lee Jiyoung P-77
Lee Jong Won P-82, P-118
Lee Jung-Soo P-35, P-94
Lee Kiwon P-18
Lee Mi-Ai P-22
Lee Min Hyeock P-50, P-71
Lee Nawon P-64
Lee Na-Young P-119
Lee Sangmin P-67
Lee Seo Yeong P-69
Lee Seong-Ju P-70
Lee Seoyoon P-68
Lee Seulbi P-69
Lee Seung-Min P-23
Lee Shin-Jae P-73, P-93
Lee So Young P-103, P-119
Lee Su Bin P-71
Lee Subin P-72
Lee Suyong P-15, P-45, P-48, P-49
P-65, P-77, P-80
Lee Unhyeok P-69
Lee Wookwon P-44
Lee Yangbong P-52
Lee Yubin P-74
Lim Hyoung-Jun P-83
Lim Sei P-66
Lim Seung-Yong P-103

M

Min Sea Cheol P-5, P-96, P-98, P-112
P-115, P-107
Moon Yebin P-101
Mun Eun Seok P-34
Mun EunSeok P-14, P-46

O

Oh Jun Kyun P-1, P-87, P-108

P

Paik Donghyun P-18
Park Bomi P-18
Park Gunhyung P-113
Park Ilbum P-18
Park Jaeeun P-38
Park Jin-Byung P-64
Park Ji-Soo P-39
Park Ji-Won P-40
Park Jungyeon P-82
Park Sojeong P-35, P-94
Park So-Jung P-36, P-109
Park Sung Hee P-22, P-81
Park Yeeun P-64
Park Yejin P-37, P-43, P-47, P-55
Park Yerin P-101
Pyo Minjin P-111

R

Rhee Dayae P-1
Ryu Hyo-bin P-33

S

Sagong Chanmin P-15, P-45
Seo Jun Sik P-62
Seo Jung-Kil P-103
Seo Kyoung-Min P-83
Seol Chae Eun P-46
Seol Garyeong P-101
Seol Ji-Hyun P-66
Seung Ayeong P-15, P-49
Shim Jun Bo P-81
Shin Ji In P-50
Sohn Ho-Yong P-56, P-57, P-58
Son Byeonguk P-48
Son Gaeun P-37, P-43, P-47, P-55

Y

Yang Gaeun P-52
Yang Hyeon Gyu P-28, P-90
Yang Hyeonmo P-108
Yang Inhye P-54
Yang Si-Yoon P-53
Yeo Chaehee P-43
Yeom Ju-Ho P-56, P-57, P-58
Yeon Chaehee P-37, P-47, P-55
Yim Jonggab P-18
Yoo Hyojin P-35, P-94
Yoo Hyun-Ji P-61
Yoo Jimin P-60
Yoo Sung-Chan P-59
Yoon Hyeong-Rak P-63
Yoon Nam Myeong P-10
You Sang-mook P-33, P-40
Yu Ji Ye P-50, P-71
Yun Uisang P-62

ㄱ

권혜정 P-42
김나윤 P-8
김두은 P-42
김미영 P-100
김선아 P-17
김우정 P-17, P-105
김현석 P-8, P-17, P-86, P-105

ㄴ

노희선 P-42

ㅂ

박명진 P-100
배재혁 P-42

ㅅ

신우식 P-100
심희원 P-100

ㅇ

이기연 P-42
이윤석 P-100
이재희 P-42
이효영 P-42
임재길 P-42

ㅈ

장은정 P-86
조한희 P-100

ㅊ

최규리 P-105
최현욱 P-17, P-105

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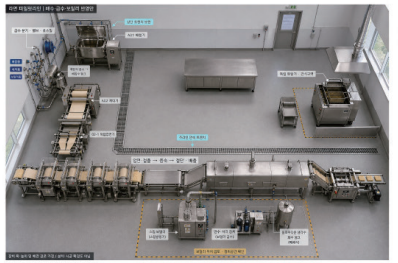
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구미전자정보기술원(GERI)이 식품제조 공정설계·시생산 실증을, 한국식품연구원 경북본부가 품질·안전관리를 담당하며 경운대·구미대 RISE사업과 연계해 전문인력을 양성
구미는 이미 농심 라면공장(하루 600만봉지 생산)이 자리한 K-푸드 도시이며, 오뚜기라면도 2026~2029년 2,000억원을 투자해 수출전용 공장을 신설

자료: 경북도·구미시 보도자료(2025.12~2026.8), 언론보도 종합

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