Ministry of Education
of the Republic of Belarus

Ministry of Education
of the People's Republic of China

Belarusian State University of Food
and Chemical Technologies
Mogilev, Belarus

Shenyang Agricultural University
Shenyang, China

REPORT ABSTRACTS

I Belarusian-Chinese International Scientific Conference of Young Scientists

«ADVANCED TECHNOLOGIES OF HEALTHY FOOD PRODUCTS»

May 28, 2026

Mogilev – Shenyang 2026

Ministry of Education of the Republic of Belarus
Educational institution
«Belarusian State University of Food and Chemical Technologies»

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Report Abstracts

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沈 阳 农 业 大 学

贺　信

尊敬的白俄罗斯国立食品与化学技术大学亚历山大·瓦西里耶维奇校长，各位同行专家、青年学者：

值此首届白俄罗斯-中国“健康食品先进技术”青年学者国际学术会议开幕之际，我谨代表沈阳农业大学，向大会的顺利召开致以诚挚的祝贺，向贵校同行为会议的成功举办付出的努力表示感谢！

2022 年 9 月 15 日两国元首共同宣布将中白关系提升为全天候全面战略伙伴关系，强调政治互信、务实合作、国际协作、人文交流四大支柱，推动中白关系成为新型国际关系典范。为落实两国元首达成的共识，2025 年 11 月由中国驻白俄罗斯大使馆张汶川大使促成两校签署了校级合作协议，探索多个领域多种形式的教学与科研合作。

沈阳农业大学创建于 1952 年，办学历史可以追溯到 1906 年的省立奉天农业学堂。作为沈农的校长，我也是食品学院的一名教授、博士生导师。学院现有果蔬加工、动物源食品加工与利用、农产品商品化过程控制、健康食品营养与创制、果蔬采后生物学与贮运保鲜及粮油全值化加工与利用、微生物发酵与生物智造等七个学术团队，现已形成了研究方

向齐全、师资力量雄厚、办学层面丰富、具有培养高级工程技术人才的办学实体。

白俄罗斯国立食品和化学技术大学是白俄罗斯共和国唯一一所旨在培养食品和农产品加工行业以及化学工业领域人才的多学科高等教育机构。贵校的办学实力与办学特色突出，专业结构与科研重点发展方向与我方高度一致。

本次学术会议由两校共同主办，聚焦健康食品的前沿技术，为两国的青年学者提供了一个重要的学术交流平台，促进学术互通与科研成果分享。健康食品技术的研发与创新对提升公共健康水平具有直接作用，青年学者是推动该领域科技进步的核心力量。希望参与本次会议的学者能够严谨务实地探讨专业问题，深化两国在食品加工与营养健康领域的科研合作。

祝首届白俄罗斯-中国“健康食品先进技术”青年学者国际学术会议取得预期成果，并期待会议不断扩大范围、提高影响力，聚焦“食品新资源”“食品生物制造”“食药同源物质”“益生菌与精准营养”“健康老龄化”“风味设计”“食品安全智能预警与风险评估”“新污染物”“‘零废弃’食品包装”“食品标签”等研究热点，引领两国乃是全球食品安全与健康领域未来产业高质量发展 。

祝各位同行专家以及青年学者身体健康，万事如意！祝中白友谊长存，祝两国繁荣昌盛！

沈阳农业大学 校长 李斌

2026 年 5 月 28 日

Уважаемый ректор Шэньянского аграрного университета господин Li Bin, уважаемые коллеги и участники конференции!

Рады приветствовать Вас по случаю открытия I Белорусско-Китайской Международной научной конференции молодых учёных **«Прогрессивные технологии продуктов здорового питания»**, которая организована нашими университетами.

Это важное международное событие организовано в рамках стратегического партнерства, определенного главами наших государств.

Сегодня отношения между Республикой Беларусь и Китайской Народной Республикой переживают исторический подъем, достигнув уровня стратегического партнерства. Как неоднократно подчеркивали наши лидеры – Александр Лукашенко и Си Цзиньпин – дружба наших народов является незыблемой, а сотрудничество – образцовым.

Белорусский государственный университет пищевых и химических технологий является единственным в Республике Беларусь учреждением высшего образования в области пищевой и химической промышленности.

Университет ведёт подготовку кадров по 15 специальностям бакалавриата с 27 направлениями профилизации. В настоящее время реализуются совместные образовательные программы, как на русском, так и на английском языках, с выдачей выпускникам двух дипломов. Студентам предлагаются программы изучения русского языка, летние школы, дистанционное обучение.

В магистратуре ведется подготовка по 8 специальностям: производство продуктов питания из растительного сырья; производство продуктов питания из животного сырья; производство продукции и организация общественного питания; товароведение и экспертиза товаров; инженерный бизнес; автоматизация; производство и переработка полимеров и композитов; машины, агрегаты и процессы.

Подготовка в аспирантуре ведется по 7 специальностям. При университете функционирует совет по защите диссертаций на соискание ученой степени доктора и кандидата наук. Совет проводит защиты диссертаций по 2 специальностям.

В университете издается научно-методический журнал «Вестник БГУТ», входящий в перечень ВАК Республики Беларусь.

Учёные Белорусского государственного университета пищевых и химических технологий проводят исследования и занимаются разработками новых пищевых продуктов и оборудования для производства пищевых продуктов, а также разработкой и совершенствованием технологий производства натуральных и химических волокон.

Желаем всем участникам конференции плодотворной работы, интересных докладов, дискуссий, дальнейших успехов и надеемся на продолжение плодотворного сотрудничества с Шэньянским аграрным университетом.

С уважением,
Ректор университета,
кандидат технических наук, доцент Максим Киркор

Проректор по научной работе,
заслуженный изобретатель Республики Беларусь,
доктор технических наук, профессор Александр Акулич

28 мая 2026

CONTENT

UDC 614.7

ANTIBIOTIC RESISTANCE GENES: FROM MECHANISM INSIGHTS TO PRECISE MANAGEMENT

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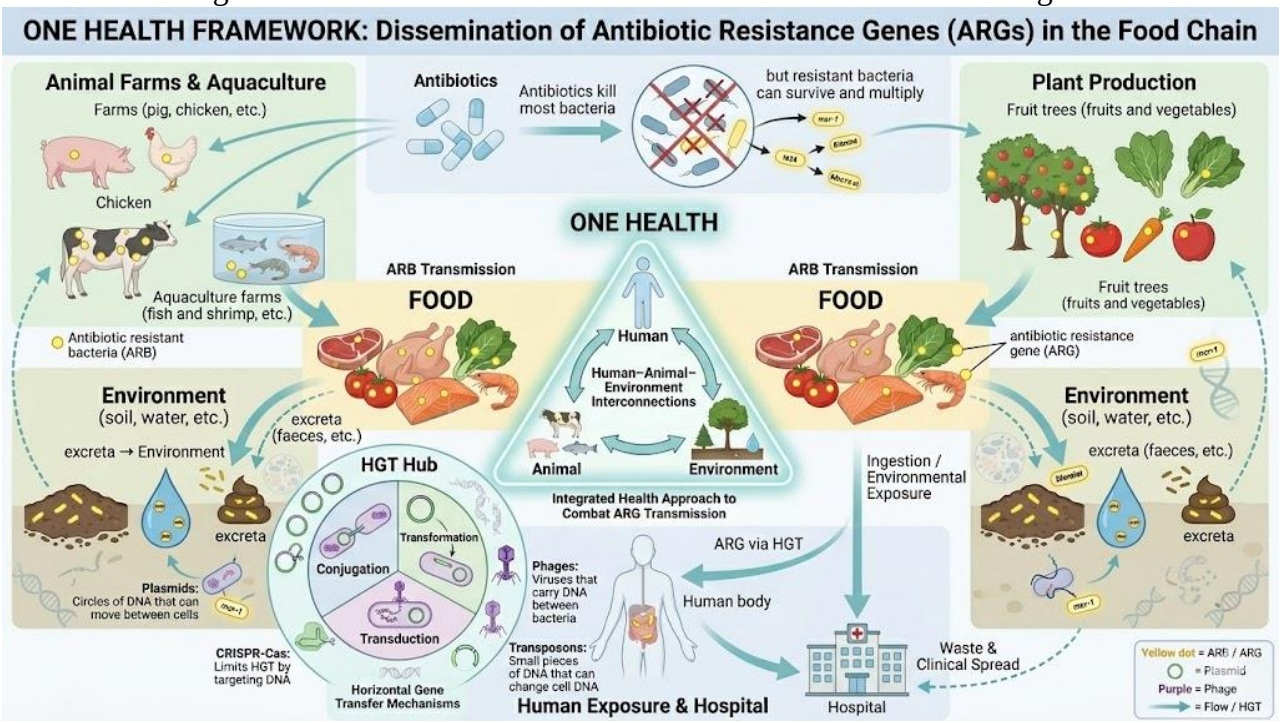
Abstract

This study delves into the assessment of environmental contamination through the identification of key microbial indicators. By utilizing metagenomic analysis, antibiotic resistance genes (ARGs) were unveiled in raw milk, including macB, tetA(58) and so on, which are associated with resistance against macrolides, MLS, and other antibiotics. Notably, the study underscores that proper storage practices markedly diminish the prevalence of these ARGs in milk. The study reveals a noteworthy positive correlation between ARGs and the indigenous bacterial communities. Interestingly, the study uncovers a modulating influence of pasture environments on the gut microbiota of long-term workers. This research explores the intricate interplay between ARGs and bacterial communities within pasture settings, along with their potential ramifications on human gut microbiota. Additionally, it presents initial analytical evidence suggesting the horizontal gene transfer potential of antibiotic resistance gene from pasture environments to raw milk. In summary, the study provides new understanding of antibiotic resistance genes (ARGs) and their bacterial carriers in dairy farms. It is crucial for future monitoring and interventions to control antibiotic resistance in these settings.



UDC 637.3.045

TECHNOLOGICAL FUNDAMENTALS OF PRODUCING LACTOSE-FREE "MOZZARELLA"-TYPE CHEESE FOR BAKING WITH PROPIONIC ACID BACTERIA

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In the HoReCa segment, Mozzarella-type cheeses are widely used for baked dishes, and their quality is determined by the absence of "blisters" and burnt spots on the surface. These defects arise due to the presence of lactose and an unfixed pH value of the cheese used, which together, during high-temperature heating, lead to Maillard reactions and caramelization, as well as thermal degradation of proteins. An additional accelerating factor is the decrease in acidity of the cheese curd during thermoplasticization (pH rise from 5.0–5.3 to 5.5–5.6), caused by the absence of heating media capable of fixing the pH at the cheddarization level. Given the lack of scientific research and technological solutions in the field of producing natural Mozzarella-type cheeses for baking without blisters and burnt spots, one promising approach is the use of enzymatic lactose hydrolysis combined with additional cultures, in particular propionic acid bacteria (PAB), which are capable of deeply utilizing the resulting monosaccharides (glucose and galactose), as well as improving the method of thermoplasticization of the cheese curd to fix the active acidity of the cheese at the level achieved during cheddarization.

Thus, the aim of this work was to develop the technological fundamentals for producing natural Mozzarella-type cheeses for baking with improved technological and consumer properties.

The study investigated the combined effect of lactose hydrolysis and propionic acid bacteria, added to the standardized mixture at the coagulation stage at (37±1) °C together with the main starter microflora, on the stretchability of the cheese curd during thermoplasticization and on the baking characteristics under high-temperature heating. It was found that PAB act as an important additional factor ensuring deep utilization of glucose and galactose formed during lactose hydrolysis, thereby preventing their participation in Maillard reactions during cheese baking. Analysis of the finished lactose-free Mozzarella cheese with propionic acid bacteria confirmed the absence of lactose and a residual monosaccharide content of less than 0.001%. A method for thermoplasticization of the cheese curd was also developed, which fixes the pH at the level achieved during cheddarization (pH = 5.2–5.3) by using dilute aqueous solutions of food acids at a specified temperature as the heating medium [1].

The proposed technology for lactose-free Mozzarella-type cheese with propionic acid bacteria for baking yields a product capable of withstanding high-temperature heating without the formation of blisters or burnt spots, with a pleasant sour-milk taste, a soft consistency, and no signs of cheese hardening or crust formation on the surface of the dish.

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UDC 579.67

INTELLIGENT MINING AND FLAVOR MECHANISM ANALYSIS OF UMAMI PEPTIDES DERIVED FROM LACTIC ACID BACTERIA

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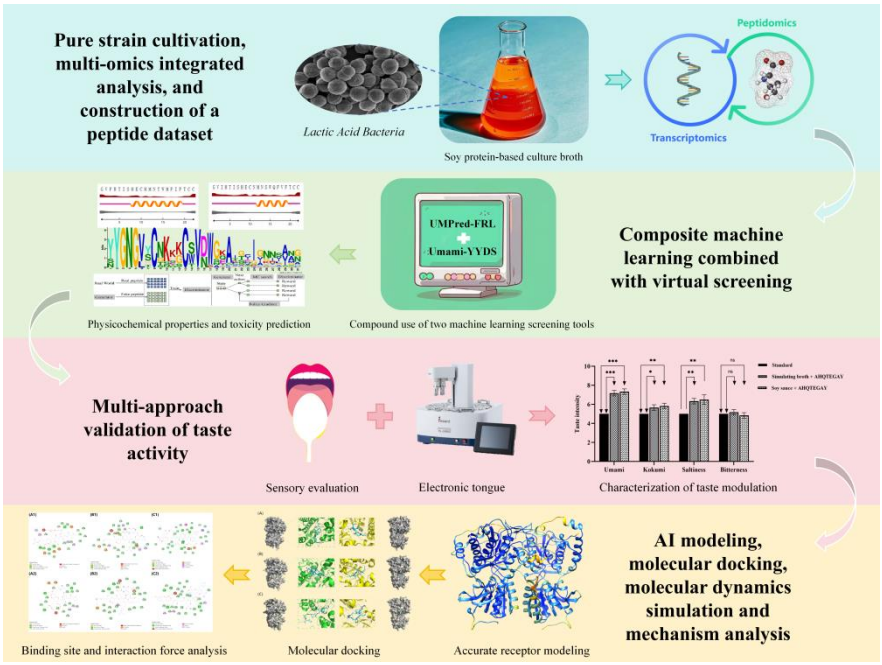
Abstract

Lactic Acid Bacteria-derived umami peptides show strong potential for industrial applications, yet efficient high-throughput screening remains challenging. To address this limitation, our team developed an integrated workflow combining multi-omics analysis with in silico screening. Integration of two machine-learning predictors improved screening accuracy to 91.8%. Processing-related filters, including stability, solubility, allergenicity, and toxicity, were applied to prioritize peptides with favorable physicochemical and safety profiles. Using this workflow, combined with whole-genome, transcriptomic, and peptidomic analyses, multiple novel umami peptides were identified from umami-producing LAB that were obtained through meta-analysis-based isolation and screening, including *Lactiplantibacillus plantarum* z53, *Tetragenococcus halophilus* y11, et al. Their taste thresholds (0.045-0.198 mmol/L) were validated by sensory evaluation and electronic tongue analysis. Molecular docking using an AlphaFold2-modeled T1R1/T1R3 receptor revealed key binding interactions, including hydrogen bonds involving TYR192 and ARG249. Molecular dynamics simulations further demonstrated that AHQTEGAY exhibited the most stable and compact binding conformation with T1R3, explaining its superior umami intensity and synergistic effects. The findings of this study provide an effective strategy for the discovery of microbiota-derived umami peptides and establish a solid scientific foundation for the development of natural, safe, and effective flavor enhancers.



UDC 637.14:663.86.053.2

CREATION OF MULTICOMPONENT DAIRY PRODUCTS WITH HIGH PROTEIN CONTENT FOR HEALTHY NUTRITION

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The promotion of a healthy lifestyle worldwide generates a steady consumer demand for enriched dairy products aimed at balanced diets and therapeutic and preventive nutrition.

Market analysis shows that the segment of functional dry dairy products is insufficiently developed. One promising area in this field is the creation of dry mixes based on a combination of dried buttermilk, natural cocoa butter, and matcha-type powdered teas to produce high-protein dairy drinks with enhanced biological value. Dried buttermilk, whose production volumes are growing in Belarus, serves as a source of high-quality milk protein, phospholipids, and minerals [1]. Cocoa butter has a comprehensive positive effect on the human body: it exhibits cardioprotective and immunomodulatory effects and helps slow down aging processes. Alongside cocoa butter, matcha-type powdered teas also have a complex positive effect on the body: they enrich the final product with biologically active substances while simultaneously forming its attractive color and taste. It is known that regular consumption of matcha green tea slows down aging, reduces the concentration of low-density lipoproteins in blood serum, and has a tonic effect on the central nervous system. In addition to traditional matcha obtained by grinding Camellia sinensis leaves, there are alternative forms derived from various plant sources, each characterised by specific biological effects. For example, Clitoria ternatea, used to produce blue matcha (anchan), contains anthocyanins with pronounced antioxidant and anti-inflammatory properties, while Hylocereus spp. (pitaya), which is a source of pink matcha, is rich in vitamins, dietary fibre, and betacyanins – pigments with antioxidant activity.

In this regard, the development of instant composite dry mixes based on dried buttermilk, cocoa butter, and matcha-type powdered teas that provide high-protein drinks with enhanced biological value is a relevant scientific and practical task, which became the aim of this work.

The objects of the study were instant composite dry mixes based on buttermilk and cocoa butter of various component compositions.

As a result of the research, compositions of instant mixes based on dried buttermilk, cocoa butter, and matcha-type powdered teas for producing high-protein dairy drinks with enhanced biological value have been scientifically substantiated and developed. The developed compositions are characterised by a balanced ratio of protein, lipid, and carbohydrate complexes, as well as high organoleptic indicators, which confirms the feasibility of their integrated use in the technology of high-protein dry mixes for producing drinks with enhanced biological value and allows them to be recommended for use in balanced nutrition.

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UDC 664.66

THE BAKERY MARKET IN THE REPUBLIC OF BELARUS: TRANSFORMATION AND INNOVATION

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The market for bread and bakery products in the Republic of Belarus is currently undergoing an active transformation. Alongside the classic model of mass-market bread production, the industry is increasingly pivoting toward innovative approaches, driven by shifting consumer demand and the imperative to bolster export potential.

The modern Belarusian consumer is becoming more health-conscious, which generates demand for bakery products with enhanced nutritional and functional properties. There is a growing interest in "clean label" products with simplified compositions. Natural sourdoughs and the absence of preservatives, artificial colors, and flavorings are becoming decisive factors for consumers. Furthermore, demand is rising for bakery products enriched with bioactive additives such as dietary fiber, vitamins, trace elements, and probiotics. The segment of specialized nutrition, including gluten-free and low-protein bread, is also seeing active development.

In addition to traditional varieties, the artisanal bread segment is expanding, as are products based on alternative raw materials, such as amaranth, spelt, and various grain mixes.

To improve quality, diversify product ranges, and streamline operations, manufacturers are actively implementing new technologies. These advancements allow for optimized production cycles, reduced losses, ensured freshness, and an expanded geographical reach, particularly for export markets. The introduction of high-performance automated lines, precision-controlled thermal chambers, and vacuum or modified atmosphere packaging (MAP) systems enhances product quality, extends shelf life, and reduces labor intensity.

The proactive use of new starter cultures, enzymatic preparations, and protein components further improves the texture, taste, color, and nutritional value of baked goods. These elements also enable the creation of products with extended shelf life without the need for artificial preservatives.

The rise of e-commerce and fresh bread delivery services is encouraging bakeries and industrial plants to launch their own online stores.

The trends toward product diversification, a focus on healthy lifestyles, and the pursuit of export opportunities are creating the prerequisites for the industry's continued evolution. Innovation is no longer just a tool for increasing efficiency. It has become a vital condition for maintaining competitiveness in a dynamically changing market.

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UDC 637.04

COMPARISON OF SITE-SPECIFIC N-GLYCOSYLATION OF DONKEY AND HUMAN WHEY

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Donkey whey protein has high nutritional value, yet systematic characterisation of site-specific N-glycosylation of donkey whey protein is still in its infancy. This study used label-free site-specific glycoproteomics to identify and quantify 685 intact N-glycopeptides from 135 whey glycoproteins in donkey colostrum (DC) and 384 intact N-glycopeptides from 67 glycoproteins in donkey mature milk (DM). As lactation progressed, 23 site-specific N-glycans mapping to 13 glycosites on 12 glycoproteins were significantly decreased, and 19 site-specific N-glycans mapping to 7 glycosites on 6 glycoproteins were significantly increased. We also found that certain N-glycans attached to the glycosites exhibited significant site specificity. This study provides new insights into the potential relationship between the biological function of donkey whey proteins and their N-glycosylation modifications. Furthermore, the study provides molecular evidence for differences in the site-specific N-glycosylation profile of donkey whey protein during lactation.

List of references

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UDC 664.64

UNSWEETENED FLOUR SNACKS – NEW HEALTHY FOOD PRODUCTS

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The snack market accounts for approximately 1.0% of the food market. It is constantly expanding in volume and product range. This is due to the annual increase in interest in snacking among both young people and adults. Experts note the potential for expansion in the range of products offered by manufacturers. Marketed snacks are high in energy, fat, and carbohydrates, contain food additives (flavor enhancers, flavorings, thickeners, preservatives, stabilizers, and chemical leavening agents), and have imbalances in the content of certain macro- and micronutrients. Overall, snack products lack a variety of nutritionally enhanced options consistent with healthy eating principles. At the same time, more and more people today are seeking healthy foods with complete nutritional content based on natural ingredients, including ready-to-eat products. Therefore, the development of advanced technologies for healthy unsweetened flour snacks based on processed grains, legumes, oilseeds, fruits and vegetables, and other raw materials is a promising area.

A range of unsweetened flour snacks in the «Natural Product» category, including specialized ones, and their production technology were developed at the Department of Grain Products Technology at the Belarusian State University of Food and Chemical Technologies. Rye flour, fermented rye malt, buckwheat, oat, bean, and rice flours, carrot, Jerusalem artichoke, beet, pumpkin, and apple powders, flax and sesame seeds, and spices are proposed as domestically produced raw materials for unsweetened flour snacks. The principles for formulating the new product have been established. The production technology for unsweetened flour snacks includes dosing raw ingredients, kneading dough to a moisture content of 35,0–40,0 % by adding water or liquid rye sourdough at a temperature of 8–12 °C to the raw ingredients, rolling out the dough to a thickness of no more than 0,5 mm, slicing it, baking the dough pieces without oil at a temperature of 155 °C for 10 minutes, and cooling them. A methodology for scoring organoleptic quality assessment of unsweetened flour snacks in the «Natural Product» category has been developed. The safety indicators, chemical composition, and nutritional value of unsweetened flour snacks have been established. Patent BY 24821 for the invention on the composition of unsweetened flour snacks and the method for their production has been granted [1].

Technical documentation for the production of unsweetened flour snacks have been developed. The new healthy food product was presented at the «Best Innovative Project and Best Scientific and Technical Development of the Year» competition, which was held April 14–16, 2026, as part of the HI-TESN 2026 International Exhibition of High Technologies and Innovations in Science and Technology in St. Petersburg, Russian Federation. The unsweetened flour snacks in the «Natural Product» category were awarded a first-place diploma and a gold medal.

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UDC 577.125.8

MECHANISM OF *LACTIPLANTIBACILLUS PLANTARUM* FS5-5 IN ALLEVIATING LIPID METABOLISM DISORDER

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Probiotics have emerged as a promising strategy for alleviating high-fat diet (HFD)-induced metabolic disorders. This study systematically investigated the mechanism by which Lactiplantibacillus plantarum FS5-5 ameliorates lipid metabolism disorders through the gut microbiota–bile acid metabolic axis. FS5-5 intervention significantly reduced serum and hepatic lipid levels, improved intestinal barrier integrity, and promoted the production of Turicibacter in HFD-fed mice. Metabolomic analysis revealed that FS5-5 reshaped the bile acid profile by increasing the ratio of agonistic to antagonistic bile acids for FXR/TGR5, notably elevating levels of hyodeoxycholic acid (HDCA). Mechanistically, HDCA activated the FXR-PPARα/FXO axis, which promoted fatty acid β-oxidation and restored $Lgr5^+$ intestinal stem cell (ISC) regeneration. Chemometric and multi-omics analyses further confirmed that FS5-5-driven modulation of the gut microbiota–bile acid axis is essential for stem cell renewal and metabolic recovery. This study highlights a novel microbiota–metabolite–ISC regeneration axis and provides a theoretical basis for developing probiotic-based interventions against diet-induced lipid metabolism disorders.

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UDC 664.681.15

POSSIBILITY OF USING GLUTEN-FREE FLOURS IN FLOUR CONFECTIONERY PRODUCTION

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Flour confectionery products occupy a significant share of the human diet. These products are high in calories, and excessive consumption can lead to various health problems. A solution to this problem is the use of non-traditional gluten-free flours and stabilizer additives in recipes to improve the structural and mechanical properties of the dough and extend the shelf life of finished products. In the first phase of the study, the chemical composition of gluten-free flours was studied and compared to explore their potential use in the production of flour confectionery products. The chemical composition of various types of gluten-free flours obtained from cereals and legumes is presented in Table 1.

Table 1 – Chemical composition of gluten-free flours compared to wheat flour

Name of indicators	Water,%	Protein,,%	Fat, %	Carbohydrates,%	Dietary fiber,%	Ash, %
Wheat flour	14,0	10,3	1,1	70,6	3,5	0,5
Amaranth flour	14,0	9,5	3,9	67,8	1,1	2,8
Buckwheat flour	9,0	13,6	1,2	71,9	2,8	1,5
Corn flour	14,0	7,2	1,5	72,1	4,4	0,8
Chickpea flour	14,0	20,1	4,3	48,4	10,2	3,0
Rice flour	9,0	7,4	0,6	80,2	2,3	0,5
Soy flour	9,0	43,0	8,0	22,0	14,1	5,3
Lentil flour	7,6	21,3	0,6	48,5	2,3	2,3

An analysis of the data presented in Table 1 showed that, in terms of protein content, soy flour is 4 times higher than premium wheat flour, while lentil and chickpea flour are 1.3 times higher. Rice and corn flour are inferior to premium wheat flour in this regard.

Soy flour has the highest fat content. Rice and lentil flours, however, contain the lowest percentage of fat. Soy, chickpea, and amaranth flours have high ash content. In this respect, they are 10, 6, and 5.6 times higher than premium wheat flour. Soybean and chickpea flours stand out in terms of dietary fiber content.

Therefore, the study conducted on the chemical composition of gluten-free flours allows us to recommend amaranth, rice, and soy flours for further consideration as replacements for premium wheat flour in flour confectionery products.

UDC 602

CONSTRUCTION OF A SYSTEM FOR ENCAPSULATING LACTOBACILLUS PLANTARUM AND THE MECHANISM OF ALLEVIATING COLITIS

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While probiotics offer substantial benefits in modulating gut microbiota and promoting host health, their poor viability in the harsh gastrointestinal (GI) environment severely limits their functional efficacy. This study aims to develop a novel single-cell encapsulation system utilizing aminated mesoporous silica nanoparticles (MSN-NH_2) and chia seed gum (CSG) for the targeted delivery of Lactobacillus plantarum (L. plantarum) and to elucidate its mechanism in alleviating colitis. Structurally uniform MSNs (114.7 ± 2.7 nm) were successfully synthesized and subsequently aminated to yield a positively charged surface (+13.4 mV) without disrupting the mesoporous framework. The MSN-NH_2-CSG encapsulation system was constructed via electrostatic interactions, utilizing CSG as a pore-sealing agent. Under optimal conditions (4 mg/mL MSN-NH_2, MSN-NH_2: CSG ratio of 1:1), the encapsulation efficiency reached 93.5%. In vitro simulated GI digestion revealed that this system provided robust protection, significantly enhancing the viability of L. plantarum in simulated gastric (8.76 log CFU/mL) and intestinal (8.72 log CFU/mL) fluids, while achieving an 85.1% targeted release rate in the intestinal phase. In vivo evaluations using a dextran sulfate sodium (DSS)-induced acute colitis mouse model demonstrated that the encapsulated L. plantarum effectively ameliorated weight loss, disease activity index, and colonic pathological damage. Furthermore, it modulated the inflammatory response by downregulating pro-inflammatory cytokines (IL-6 and TNF-α) and upregulating the anti-inflammatory cytokine (IL-10). Mechanistically, the encapsulated probiotics promoted the expression of vasoactive intestinal peptide (VIP), which subsequently activated the cAMP signaling pathway, as evidenced by the upregulated expression of Epac1 and phosphorylated PKA (p-PKA). Overall, this work provides an innovative nanocarrier strategy for the efficient delivery of probiotics and offers a robust theoretical basis for developing functional foods targeted at inflammatory bowel disease management.

UDC 664.662

EXPANSION OF THE FAST FOOD PRODUCT RANGE BY INCLUDING A RYE BUN WITH MONO(POLY)MALT WORT CONCENTRATE

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The relevance of research is determined by the need to update the fast food product range with products that combine convenience, attractive organoleptic properties, and increased nutritional value. The traditional burger remains popular among young people and the working population; however, its perception is often associated with excess carbohydrates, high calorie content, and insufficient functional properties. In this regard, a promising approach is replacing wheat buns with rye buns made from rye flour with the addition of mono(poly)malt wort concentrates.

The scientific basis for this development is research into the effect of mono(poly)malt wort concentrates on the consumer properties of rye flour bakery products under convective steam processing conditions. The raw materials considered were sifted, medium, and wholemeal rye flour, water, dry baker's yeast, salt, oil, eggs, and mono(poly)malt wort concentrates produced in the Republic of Belarus [1].

Convective steam processing is considered as a resource-saving heat treatment method suitable for food service establishments. Rational process parameters have been established for rye flour bakery products: fermentation at 35°C for 105 minutes, proofing at 75°C for 15 minutes, and baking at 200°C for 10 minutes [2]. Compared to the original process, this reduces the process time by an average of 18%, which is important for small-scale production, HoReCa businesses, training and production laboratories.

The optimal addition range for mono(poly)malt wort concentrates is 30-40% of the flour weight. The products acquire a regular round shape, a pleasant malty flavor and aroma, a uniform brown crust color, developed porosity, and a baked and elastic crumb with no traces of undermixing. Physicochemical parameters remain within standard limits [1].

Based on the obtained results, a product variant has been proposed – a burger on a rye bun, provisionally positioned as a «Ryeburger». It includes a rye bun with mono(poly)malt concentrates, a minced meat patty, cheddar cheese, lettuce, pickles, and sauce. This combination preserves the burger's familiar texture, creates a more original flavor, and enhances the product's image.

Therefore, this research has scientific and practical significance, as it enables the use of raw materials produced in the Republic of Belarus, shortens the manufacturing process, enhances the product's consumer appeal, and creates a modern fast food product with enhanced nutritional value.

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UDC 664.02:637.5

EXPLORING THE EFFECT OF CUMIN SEEDS ON FLAVOR AND LIPID OXIDATION OF ROASTED MUTTON PATTIES

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Cumin seeds can inhibit undesirable flavors of roasted meat, but the specific mechanism remains to be elucidated [1-4]. This study examined the effects of adding 1 g/100 g of cumin seeds to mutton patties roasted at 220 °C for 10–20 min on flavor characteristics and lipid oxidation. Basic indicators (fat, protein, moisture content, and roasting loss), flavor compounds, TBARS values and fatty acid degradation products were measured to this end. The introduction of cumin seeds caused a notable drop in aldehydes, particularly pyridine, isovaleraldehyde, heptanal, and octanal, which are compounds often associated with unwanted fat flavors, while concomitantly increasing the levels of ester and heterocyclic flavor compounds. This enhanced the ester aroma and roasted flavor. The introduction of terpenal and terpenoid compounds imparted citrus and spice aromas to the mutton. In relation to lipid oxidation, cumin seeds inhibited oxidative degradation of the linoleic acid system within the first 10 min and then promoted it, while concurrently promoting oxidative degradation in the oleic acid system. Furthermore, they reduce the generation of oxidative flavor substances (e.g., hexanal and octanal). Overall, adding 1 g/100 g of cumin seeds could be a promising approach to improve lipid oxidation and enhance the flavor profiles of roasted mutton patties.

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UDC 664.681

GLUTEN-FREE VEGETABLE OIL CUPCAKE

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Traditional cupcakes made with wheat flour and solid fats have low biological value and high calorie content.

Rapeseed or sunflower oil, buckwheat flour, whey protein concentrate, agar, apple pectin and carboxymethylcellulose were used to enhance the nutritional properties of the cupcakes and improve their structure and organoleptic characteristics. This allowed us to enrich the cupcakes with complete proteins, calcium, magnesium, phosphorus, iron, B vitamins, fiber and unsaturated fatty acids. Gluten and cholesterol have been removed from the product, the amount of starch has been reduced, the energy value of 100 g of the product has been reduced by 28 kcal. We may also recommend these cupcakes for people with gluten intolerance, hypercholesterolemia, heart and gastrointestinal diseases.

Vegetable oils are characterized by a low content of saturated fatty acids and their trans isomers, a high level of unsaturated fats, no cholesterol, they also have a lower cost compared to solid fats. However, a technological problem of replacing butter with vegetable oil is the possibility of oil separation during the formation, baking and storage of cupcakes. To solve this problem, we used the technology of encapsulating liquid oils in protein-polysaccharide mixture (PPM). As a result of studying the technological properties (water- and fat-holding, emulsifying, foaming capacity) of protein and carbohydrate raw materials, we selected the following components of the BPM: whey protein concentrate (WPC) with a protein mass fraction of 80 %, apple pectin, agar, carboxymethylcellulose. The using of PPM allowed to exclude chicken eggs (a source of allergenic protein) from the cupcake recipe, stabilization of the cupcake's structure and increase in its nutritional value through protein enrichment (100 g of WPC contains 80 g of protein and 100 g of gelatin contains 87,2 g of protein).

We explored the technological regimes of encapsulation and established that the optimal foaming temperature for PPM is 60 °C, and the optimal oil temperature during emulsification is 20 °C.

We cooked experimental cupcake samples to assess the compability of gluten-free flour with encapsulated vegetable oils. The cupcakes were made with using chemical leavening agents, buckwheat flour and either sunflower or rapeseed oil. The use of PPM led to changes in the technological regimes of cupcake cooking: the time of dough preparation was doubled, the temperature was increased slightly, the dough's adhesive tension was decreased by 2 times, that facilitated molding.

The gluten-free cupcake had a high organoleptic quality assessment, which was slightly different from the classic cupcake due to the darker color of the crumb. The necessary structure of the product was formed by using whey proteins and polysaccharides: thin-walled fine porosity, baked crumb. The buckwheat cupcake had minimal density and showed minimal moisture loss during storage.

The results of the study allow us to expand the range of gluten-free flour confectionery products. Additionally, due to the absence of certain raw materials, it can be used by people with gluten intolerance, as well as those with allergies to casein and avian egg protein, hypercholesterolemia, and other diseases.

UDC 634.9

MELATONIN ALLEVIATES OXIDATIVE STRESS AND DELAYS YELLOWING IN POSTHARVEST BROCCOLI THROUGH ENHANCED ANTIOXIDANT CAPACITY: INSIGHTS FROM PHYSIOLOGICAL AND OMICS PERSPECTIVES

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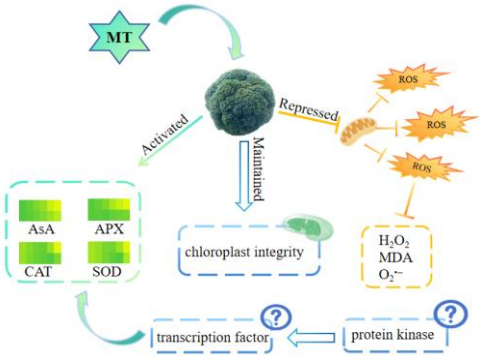
After harvest, broccoli is prone to turning greenish and then yellowish, accompanied by significant loss of nutrients such as flavonoids and glucosinolates[1]. The yellowing of broccoli may be influenced by various pathways, such as nucleic acid metabolism, signal transduction, and defense responses[2]. Melatonin (MT) is a multifunctional green and safe indole compound. MT treatment can inhibit membrane lipid peroxidation in chloroplasts, which helps to delay the yellowing of broccoli and extend its shelf life[3]. We treated broccoli with 100 μmol/L melatonin and found that melatonin can alleviate the oxidative stress of broccoli by reducing reactive oxygen species (ROS) damage, increasing ascorbic acid content, and the activity of antioxidant enzymes. Moreover, the yellowing process is closely related to SOD, CAT, and APX, and related to the change in AsA content. In the future, we will use proteomics and transcriptomics to find the mechanism at the post-translational modification level and explain from the protein perspective how melatonin delays the yellowing of broccoli
through antioxidant effects.



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UDC 664.8

THE USE OF RHUBARB AND PUMPKIN AS NEW FUNCTIONAL FOODS IN THE PRODUCTION OF DESSERTS

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The thesis "food as medicine" is gradually becoming a trend and is becoming dominant in the approach to the development of new recipes and technologies in the field of public catering. The range of "healthy" dishes in public catering facilities in the Republic of Belarus is constantly expanding. There is a growing number of consumers who value not only the taste of food, but also its nutritional value.

One approach to developing new recipes for culinary products for public catering facilities is to use non-traditional plant-based products that are rich in biologically active nutrients. Additionally, the use of non-traditional methods for preparing traditional foods can also be relevant for developing new recipes for "healthy" dishes.

The study also conducted a survey to investigate consumer preferences. The results showed that 98% of the respondents regularly consume desserts. Additionally, 92% of female respondents and 47% of male respondents consider the calorie content and healthiness of desserts when making their choices. It was also found that when choosing a dessert, consumers are primarily guided by its taste, followed by the cost, appearance, and original presentation. 90% of respondents rated the range of desserts available in the public catering establishments in Mogilev as insufficient. When asked if they would be willing to try a new dessert that featured locally sourced fruits and vegetables and had a lower price, 100% of respondents answered in the affirmative. The conducted research allows us to conclude that original desserts using locally produced fruits and vegetables will be popular among guests.

When analyzing agricultural crops that grow in the Republic of Belarus but are limitedly used in the production of culinary products, rhubarb was chosen as a product with a high content of minerals: potassium, calcium, magnesium, phosphorus, and vitamins: C, B2, PP, E, and A.

Pumpkin was also chosen as a local fruit and vegetable raw material, as it is a common vegetable crop in the Republic of Belarus, relatively inexpensive, and available for use for a long period of time, but it is rarely used in the production of desserts. At the same time, pumpkin is rich in biologically active substances: vitamins, micro- and macroelements, and dietary fiber. In the course of research work, recipes and technologies for the production of desserts with high taste qualities, consumer characteristics, and nutritional and biological value have been developed. Technological maps have been developed for the production of desserts, which have been implemented at public catering facilities in Mogilev and Vitebsk.

These desserts can be recommended for all age groups as sources of biologically active substances.

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UDC 664.037

EFFECT OF PULSED ELECTRIC FIELD PRE-TREATMENT COMBINED WITH STATIC MAGNETIC FIELD FREEZING ON STRAWBERRY QUALITY

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Strawberries are commercially significant due to their vibrant color, tender texture, high juiciness, and distinctive flavor profile. However, conventional freezing methods usually lead to the formation of large, irregular ice crystals, causing irreversible damage to the cell structure and reducing food quality. This study investigated the synergistic effects of pulsed electric field pre-treatment combined with static magnetic field freezing (EMF) on strawberry quality.

Compared to conventional freezing (CF), EMF significantly reduced phase transition time by 27.65% and total freezing time by 21.8% while increasing the average freezing rate by 26.9%. EMF increased hardness by 19.3%, reduced drip loss by 32.0%, and best preserved the color by yielding the highest a^* value and the lowest total color difference compared to fresh samples. In addition, EMF increased the total anthocyanin and ascorbic acid content by 14.8% and 10.2%, respectively, improving the antioxidant capacity.

Water distribution analysis revealed that EMF minimized free water conversion and maintained tissue moisture homogeneity. Microstructurally, EMF reduced the ice crystal area by 26.5%, mitigating cell damage and maintaining structural integrity, as confirmed by the reduction in malondialdehyde content and relative conductivity. This integrated approach offers a promising strategy for high-quality fruit freezing.

UDC 664.047

PH DUAL RESPONSIVE ELECTROSPUN FIBER LOADING ANTHOCYANIN AND NISIN FOR FOOD PRESERVATION AND MONITORING: REGULATION IN DYNAMIC SCHIFF BASE NETWORKS BASED ON DIFFERENT OXIDIZED SODIUM ALGINATE

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A green schiff base-mediated crosslinking strategy was developed by modulating the oxidation degree of sodium alginate (OSA) without additional crosslinker to regulate fiber network structure in electrospun films. Nisin and anthocyanins were co-encapsulated into OSA–carboxymethyl chitosan (CMCS) nanofibers to construct a pH dual-responsive film. The optimized OSA2-N/A-CMCS film (30% oxidation) exhibited ideal mechanical properties, rapid pH-triggered color change, and pH-responsive controlled diffusive release of nisin (Ritger-Peppas model, $n < 0.45$). At pH 5.8, the film achieved about 100% inhibition against E. coli and S. aureus by disrupting cell membranes. Moreover, the film visually indicated strawberries spoilage and reduced decay by 40% within five days. This study highlights the application of a green, oxidation-tunable crosslinking strategy to achieve efficient integration of multifunctional responses like simultaneously triggering real-time visual monitoring and sustained antimicrobial controlled release under single pH stimulus, and offer a novel design reference for intelligent food packaging.

UDC 641.56

EFFECT OF WHOLE-GRAIN BARLEY FLOUR AND APPLE PUREE RATIO ON THE CONSISTENCY OF DESSERT COMPOSITIONS

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Developing healthy, low-calorie desserts for school meals is a priority within the framework of healthy nutrition concepts. This study investigates the structural and mechanical properties of compositions where apple puree serves as a natural fat and sugar substitute due to its high pectin content, while whole-grain barley flour enriches the product with ß-glucans.

The aim of the study was to establish the patterns of structural and mechanical behavior in barley flour and apple puree compositions at various ratios to develop a product range with predefined ergonomic characteristics.

Materials and Methods: The research objects were mixtures of whole-grain barley flour and sterilized apple puree in ratios ranging from 10/90% to 90/10%. Quality assessment was performed using a VT6/7 PLUS rotational viscometer, a Brookfield CT3-4500 texture analyzer, and a Hygrolab C1-Set-40 hygrometer.

Results: It was found that the effective viscosity of the system increases exponentially with a higher proportion of flour. At a ratio of 70% flour to 30% puree, the mixture completely loses its fluidity. Increasing the flour content from 30% to 40% leads to a significant rise in normal compressive stress (hardness), which is attributed to the formation of a three-dimensional ß-glucan network. The addition of sugar, salt, and milk powder reduces the hardness of the samples by 1.7–2.4 times.

The highest adhesive stress values were observed in systems dominated by apple puree and upon the addition of sugar, due to the high adhesive capacity of pectin. The optimal pH range for dessert products (5.2–5.4) is achieved at flour-to-puree ratios between 60/40 and 80/20. Water absorption increases linearly until a flour concentration of 50% is reached, after which the system stabilizes.

Conclusion: Based on the investigated structural and mechanical properties, the following formulation ratios (flour:puree %) are proposed for different dessert categories:

70:30 – 80:20: for cookie-type products (minimum puree, high brittleness, and low moisture);

50:50 – 60:40: for muffin and cake-type products (moderate elasticity and softness);

0:100 – 10:90: for jellied dishes and mousses (viscoplastic properties, high moisture, and low density).

The study provides a scientific rationale for using "barley flour – apple puree" compositions to create functional desserts. Varying the proportions allows for purposeful modification of product consistency, enabling the production of items with specific ergonomic properties for school menus.

UDC 663.251

EFFECTS OF BLUEBERRY CULTIVAR AND YEAST COMBINATIONS ON WINE QUALITY AND FLAVOUR

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As one of the deep processing blueberry products, blueberry wine shows great commercial potential[1,2]. This study systematically evaluated physicochemical and flavour Characteristics of 8 blueberry wines fermented from 4 blueberry cultivars with CECA and MT yeast, respectively. The physicochemical results indicated the Northland-MT blueberry wine had the highest total anthocyanin content (1.98 mg/mL) and antioxidant capacity. GC-MS and GC-IMS detected 1,398 and 54 volatile organic compounds in 8 blueberry wines, with esters constituting the highest proportion at 21.17%, which makes a significant contribution to the flavour. Duke-MT and Duke-CECA blueberry wines have distinctive fruity aroma. Meanwhile, relative odor activity values and chemometric analysis revealed that 3-mercaptohexanol and hexanethioic acid, S-methyl ester serving as flavour markers. KEGG enrichment analysis revealed phenylalanine metabolism and phenylpropanoid biosynthesis are key metabolic pathways. This study proposed cultivar-yeast matching strategy, providing a robust theoretical basis for flavour and nutrition design and industrial standardization of blueberry wine.

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UDC 612.39

FEATURES OF THE QUALITATIVE COMPOSITION OF THE DIET IN MULTISYSTEM CHANGES IN THE BODY

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Metabolic syndrome is one of the most pressing issues in modern nutrition science, encompassing pathological conditions such as insulin resistance, dyslipidemia, abdominal obesity, and hypertension. This complex of disorders significantly increases the risk of developing cardiovascular disease and type 2 diabetes. The prevalence of metabolic syndrome reaches 30% worldwide, making it a non-communicable pandemic [1].

The study conducted a comparative analysis of modern scientifically based dietary models, including the Mediterranean diet, the DASH diet, the Nordic diet, low-carbohydrate, low-fat, and plant-based diets. It was found that, despite their differences, all of them are based on similar principles: limiting added sugars and ultra-processed foods, increasing the proportion of whole plant foods, choosing high-quality sources of protein and fat, and maintaining a healthy diet.

The current evidence provides some indication that intermittent fasting diets have similar benefits to continuous energy restriction for weight loss and cardiometabolic risk factors.

Healthy plant foods, including whole grains, vegetables, fruits, legumes and nuts, may protect against tupe 2 diabet in an almost linear fashion, while unhealthy plant-based diets are not beneficial and may even increase disease risk at high level (refined grains, sweets and sugar-sweetened beverages).

The study results highlight the importance of incorporating antioxidant-rich diets into strategies aimed at preventing and treating metabolic syndrome [2].

Based on the data obtained, a diet was proposed that focused not on copying a single diet, but on selecting foods with the highest nutrient density.

The basic healthy eating index and oxidative balance index were used to assess the diet's quality. The developed diet scored 91 points out of a possible 100 and 27 points out of a possible 32, demonstrating its high balance.

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UDC 664.8

POLYPHENOL OXIDASE FROM EDIBLE INSECT *ANTHERAEA PERNYI* PUPA: CHARACTERIZATION AND BROWNING MECHANISM

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The edible insect *Antheraea pernyi* pupa, a promising insect protein resource, undergoes endogenous polyphenol oxidase (PPO)-mediated enzymatic browning during processing, severely compromising product quality.

To elucidate browning mechanisms, this study purified and characterized A. pernyi pupa PPO. LC-MS/MS analysis identified the enzyme as an 80 kDa protein comprising 683 amino acids, exhibiting optimal activity at 45 °C and pH 6.5.

Substrate specificity assays revealed a strong preference for o-diphenolic substrates (L-3,4-dihydroxyphenylalanine and Caffeic acid). Molecular docking further demonstrated high-affinity binding of caffeic acid to the active site via bidentate hydrogen bonds (Ser-628), hydrophobic interactions (Pro-638), and salt bridges (Lys-614), highlighting its role as a critical browning substrate.

By integrating enzymatic characterization and molecular interaction analyses, this work delineates A. pernyi pupa PPO's catalytic features and provides a theoretical basis for understanding browning pathways and designing targeted inhibitors.