IRSTI 65.59.29

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https://doi.org/10.55956/XKGK4405

DEVELOPMENT OF SAFE TECHNOLOGY FOR MEAT PRODUCTS MADE ON THE BASIS OF COMPOSITE ADDITIVES

Abstract. Modern food industry trends are aimed at increasing the nutritional value of products, enhancing their functional properties, and optimizing production efficiency. One promising direction is the inclusion of plant-based ingredients in meat product formulations. This article explores the development of a safe and cost-effective technology for meat products through the use of composite additives based on legumes (pea, soybean, lentil) and vegetables (carrot, beetroot, pumpkin). The aim of the research was to create meat products with enhanced nutritional and biological value by incorporating functional composite mixtures of plant origin. The main objectives included selecting the optimal composition of such blends and evaluating their impact on the physicochemical, structural-mechanical, and organoleptic properties of meat systems. The scientific and practical significance of the study lies in the development of ecologically clean, nutritionally enriched food products that meet modern safety and quality standards. The methodology involved laboratory modeling of recipes with varying plant-based additives and comprehensive evaluation of the resulting samples in terms of sensory, technological, and hygienic parameters. The experimental results demonstrated that incorporating composite blends significantly improved the nutritional value of meat products by enriching them with plant proteins, dietary fiber, vitamins, and minerals. The addition of vegetable ingredients enhanced the appearance, taste, and color of the products without the need for artificial additives. Improvements in texture and shelf life were also observed. This study contributes to the advancement of functional meat product technologies. Its practical relevance lies in the potential industrial application of the developed formulations with minimal cost and maximum benefit to the consumer.

Keywords: meat product, horse meat, composite mix, beans, carrots.

Nurseytova Z.T., Nurynbetova G.Zh., Muldabekova B.Zh., Myrzaly S.N., Yakiyayeva M.A. Development of safe technology for meat products made on the basis of composite additives //Mechanics and Technology / Scientific journal. – 2025. – No.2(88). – P.75-81. https://doi.org/10.55956/XKGK4405

Introduction. Nutrition, built on a scientific basis, is the most important component of the complex of factors that form the social conditions of life and reproduction of the population [1]. In this regard, programmes to improve the health of the population by expanding the range of functional foods with a directionally modified biochemical composition are becoming increasingly common in many countries of the world [2,3]. The key aspect in solving these problems is the scientifically substantiated selection of promising sources of raw materials with high sanitary-hygienic and medical-biological parameters [4].

In recent years, functional food products are increasingly developed and consumed, the component composition of which simultaneously contains various functional ingredients (prebiotics, mineral salts, dietary fibres, antioxidants) [5], the combination of which is based on a synergistic effect on physiological, biochemical and behavioural reactions of the human body [6,7].

Functional properties of meat products are usually improved by correcting their composition of fatty acids, amino acids and mineral substances, as well as enrichment with micronutrients. Establishing the possibility of using natural additives with antioxidant effect in the technology of meat products to preserve their quality, improve biological efficiency and safety, and increase shelf life determines the relevance of the study [8].

Perspective of development of compositions with high functional properties for achievement of technological and preventive purposes in various food systems is actual today, especially at reception of meat systems of combined type. In this regard, it is necessary to create compositions with certain functional properties, regulating the quality and compensating the deficiencies of meat raw materials.

At present, the possibility of using composite mixtures based on legumes and carbohydrate-containing raw materials in the composition of meat systems, in particular root crops such as beetroot and carrots, due to their high nutritional value and functional-technological properties [9]. These crops are also a source of dietary fibre (DF) and contribute significantly to increasing the resistance of the human body to harmful environmental influences and have sorption properties, thus providing a safe technology for the preparation of meat products [10].

The aim of the work is to develop and study the properties of compositions based on plant resources with functional properties with a view to their use in the safe technology of meat products.

Materials and methods. Composite mixtures with different content of legumes and vegetables were developed for the study. The minced horse meat was used as a base. The following indicators were studied: chemical composition (moisture content, protein, fat, carbohydrates); organoleptic characteristics (taste, smell, colour, consistency); Analyses were carried out using standard methods of laboratory control and sensory evaluation.

Research results and discussion. In recent years, the increase in demand for horse meat products is caused by the high biological value of this type of meat and especially by the fact that horse meat is not only a dietary product, but also used for preventive and therapeutic nutrition, as horse meat is more easily digested by the human body, due to the features of protein and unique fatty acid properties.

We have developed a recipe for the preparation of minced horse meat with the addition of protein-carbohydrate complex on the basis of beans and carrots.

For this purpose, at the first stage we developed a recipe of protein-carbohydrate complex (PCC) on the basis of beans and carrots for horse meat steaks (Table 1).

Table 1

Composition of protein-carbohydrate complex (per 1000 g of dry complex)

Component	Quantity, g	Purpose
Bean flour (red)	400	Source of protein (up to 22%), fibre and complex carbohydrates
Carrot powder	250	Improves colour, contributes natural sugars and carotenoids
Oat flour	150	Increases viscosity, retains moisture, makes steaks juicier
Wheat dietary fibre	100	Reduces shrinkage, improves mince texture
Soy protein isolate	50	Complements amino acid composition, improves structure
Pectin	50	Natural thickener, stabilises the structure of steaks

Further, a recipe for the preparation of minced horse meat with the addition of protein-carbohydrate complex based on beans and carrots was developed and studied to determine the optimal concentration of the additive (Table 2). Different amounts of protein-carbohydrate complex in dry form at the initial stage of minced meat preparation were used in the formulation of horse meat steaks.

Table 2

Recipe for preparation of minced horse meat with the addition of protein-carbohydrate complex

Raw material	Control	Sample No. 1	Sample No. 2	Sample No. 3
Raw materials not salted, kg per 100 kg				
Horse meat, trimmed, 1st grade	87.0	85.0	84.0	83.0
Horse fat	15.0	15.0	15.0	15.0
Protein-carbohydrate complex	-	2.0	3.0	4.0
Salt per 100 kg of unsalted raw material	2000	2000	2000	2000

Technology of application in beefsteaks:

1. Mix dry protein-carbohydrate complex with water (200 ml per 100 g of mixture), leave for 10-15 minutes to swell.
2. Add to minced horse meat, mix thoroughly until smooth.
3. Form beefsteaks, leave for 30 minutes to stabilize the structure.
4. Fry in a frying pan or bake at a temperature of 180-200°C.

The study of organoleptic characteristics of horse meat steaks with a protein-carbohydrate complex (PCC) based on beans and carrots showed that adding 3% PCC to achieve an optimal balance of taste, juiciness and texture is the best option. The assessment was carried out on a 5-point scale (Table 3).

The organoleptic data of horse meat steaks with protein-carbohydrate complex (PCC) showed that adding 2% PCC has virtually no effect on the appearance and taste, the steaks remain juicy, soft, with a slight sweetish tint due to carrots. With 3% PCC, the density of the steak slightly increases, but good juiciness is maintained, the color becomes slightly lighter. With 4% PCC, a slight decrease in the intensity of meat flavor is observed, the steak becomes slightly denser and drier.

Table 3

Assessment of the effect of adding a protein-carbohydrate complex (PCC) from beans and carrots in an amount of 2%, 3%, 4% on the organoleptic characteristics of horse meat steaks

Parameter	Characteristic	Control (0%)	2% PCC	3% PCC	4% PCC
Appearance	Uniformity of color, shape, presence of cracks	4.8	4.6	4.7	4.5
Color	Compliance	4.9	4.7	4.8	4.6
Smell	With natural meat shade	4.9	4.7	4.8	4.6
Taste	Meat aroma, presence or absence of foreign odors	4.4	4.6	4.7	4.4
Consistency	Saturation, balance of sweetness and meat flavor	4.4	4.7	4.8	4.6
Overall rating		4.68	4.66	4.76	4.54

Physicochemical parameters of horse meat steaks with the addition of protein-carbohydrate complex (PCC) based on beans and carrots are shown in Table 4.

The following parameters were analyzed: moisture mass fraction (%) determines the juiciness of the product; protein mass fraction (%) is an important indicator of nutritional value; fat mass fraction (%) affects taste and texture; carbohydrate mass fraction (%) evaluates the effect of PCC on the composition; pH of the medium determines the acidity level and the effect of PCC on microbiological stability; losses during heat treatment (%) measures the decrease in weight during frying/baking.

Table 4

Evaluation of changes in the physicochemical parameters of horse meat steaks with the addition of 2%, 3% and 4% protein-carbohydrate complex (PCC) based on beans and carrots

Indicator	Control (0%)	2% PCC	3% PCC	4% PCC
Moisture content, %	67.2	68.5	69.3	70.1
Protein content, %	21.8	21.5	21.3	21.0
Fat content, %	6.5	6.2	6.0	5.8
Carbohydrate content, %	1.2	2.5	3.5	4.8
PH of the medium	5.9	6.0	6.1	6.2
Losses during frying, %	32.5	28.7	26.3	24.8

The analysis of the results of the physicochemical parameters of horse steaks showed that the humidity increases with the addition of PCC, since bean flour and dietary fiber retain water. With 4% PCC, the steaks are the juiciest. In terms of protein, the data show a slight decrease (up to 1%) due to the dilution of meat raw materials with plant components. Fat content decreases, since PCC does not contain fats. Carbohydrates increase with an increase in PCC due to carrot powder and bean starch. pH increases, which can have a positive effect on juiciness and microbiological stability. Thermal losses decrease with an increase in PCC – this is due to moisture retention and a decrease in fat rendering.

Based on the study of the quality indicators of model minced meat systems, taking into account the organoleptic indicators, the optimal level of introduction of the pumpkin protein-carbohydrate component based on beans and carrots in the amount of 3% PCC in the recipe for horse meat steaks was established. With such a quantitative additive, the juiciness of the finished product increases (humidity –

69.3%), a good balance of proteins and carbohydrates is maintained, losses during heat treatment are minimized (26.3%), an improvement in taste characteristics is observed due to carrot sugars and bean proteins.

Conclusion. The use of composite mixtures based on legumes and vegetables in meat systems is a promising direction that allows to create products with high nutritional value, improved technological characteristics and affordable cost. The introduction of composite mixtures increased the nutritional value due to the content of vegetable protein, dietary fibre and trace elements. In terms of appearance, vegetable additives gave the products a richer taste and colour without the use of artificial dyes. The presence of natural antioxidants slowed down fat oxidation processes and will lead to a longer shelf life.

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Received: 29 January 2025
Accepted: 6 June 2025

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КОМПОЗИЦИЯЛЫҚ ҚОСПАЛАР НЕГІЗІНДЕ ЖАСАЛҒАН ЕТ ӨНІМІНІҢ ҚАУІПСІЗ ТЕХНОЛОГИЯСЫН ЖАСАУ

Аңдатпа. Қазіргі заманауи тағам өнеркәсібі өнімдердің тағамдық құндылығын арттыруға, олардың функционалдық қасиеттерін кеңейтуге және өндірістік үдерістердің экономикалық тиімділігін қамтамасыз етуге бағытталған. Осыған байланысты ет өнімдерінің құрамына өсімдік текті шикізатты енгізу перспективалы бағыттардың бірі болып табылады. Бұл мақалада бұршақ тұқымдастар (бұршақ, соя, жасымық) мен көкөністерге (сәбіз, қызылша, асқабақ) негізделген композициялық қоспаларды қолдану арқылы ет өнімдерінің қауіпсіз және тиімді технологиясын әзірлеу мәселесі қарастырылады. Зерттеудің мақсаты – функционалдық және технологиялық артықшылықтары бар өсімдік текті композициялық қоспаларды қолдана отырып, тағамдық және биологиялық құндылығы жоғары қауіпсіз ет өнімдерін дайындау технологиясын жасау. Негізгі міндеттер – бұршақ тұқымдастар мен көкөністер негізіндегі композициялық қоспалардың оңтайлы құрамын анықтау және олардың ет өнімдерінің физика-химиялық, құрылымдық-механикалық және органолептикалық қасиеттеріне әсерін бағалау. Жұмыстың ғылыми және қолданбалы маңыздылығы – экологиялық таза, байытылған және сапалы өнімдер дайындау арқылы тағам қауіпсіздігі талаптарына жауап беретін технологияларды дамыту. Зерттеу әдістемесі әртүрлі өсімдік текті қоспалар қосылған рецептураларды зертханалық деңгейде үлгілеуді және алынған үлгілерге органолептикалық, технологиялық және санитарлық-гигиеналық көрсеткіштер бойынша кешенді бағалау жүргізуді қамтыды. Эксперимент нәтижелері композициялық қоспаларды қосу арқылы ет өнімдерінің тағамдық құндылығының артқанын көрсетті – өсімдік ақуыздары, тағамдық талшықтар, дәрумендер мен минералдар есебінен. Көкөністік қоспалар өнімдердің түсін және дәмін жақсартып, жасанды бояғыштарды қолданусыз-ақ тартымды органолептикалық сипаттамаларға қол жеткізуге мүмкіндік берді. Сонымен қатар, құрылымы жақсарып, сақтау мерзімі ұзартылды. Зерттеу нәтижелері ет өнімдерін функционалдық бағытта жаңғыртуға өз үлесін қосады. Жұмыстың практикалық маңыздылығы – ұсынылған рецептураларды өнеркәсіптік жағдайда тиімді түрде енгізу мүмкіндігінде.

Тірек сөздер: ет өнімі, жылқы еті, композициялық қоспа, үрмебұршақ, сәбіз.

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РАЗРАБОТКА БЕЗОПАСНОЙ ТЕХНОЛОГИИ МЯСНЫХ ПРОДУКТОВ, ИЗГОТОВЛЕННЫХ НА ОСНОВЕ КОМПОЗИЦИОННЫХ ДОБАВОК

Аннотация. В современных условиях пищевая промышленность ориентирована на разработку продуктов с высокой пищевой ценностью, расширенными функциональными свойствами и экономически эффективными технологиями производства. Одним из перспективных направлений в этой области является использование растительного сырья в мясных продуктах. Данная статья

посвящена исследованию возможности внедрения композиционных добавок на основе бобовых культур и овощей в рецептуры мясных изделий с целью повышения их пищевой и биологической ценности, улучшения органолептических характеристик и увеличения срока хранения. Целью проведённого исследования стало создание безопасной и ресурсосберегающей технологии мясных продуктов с использованием композитных смесей из растительного сырья, обладающих функциональными и технологическими преимуществами. Основными задачами являлись выбор рационального состава композиций на основе гороха, сои, чечевицы, моркови, свеклы и тыквы, а также оценка их влияния на физико-химические, структурно-механические и органолептические свойства мясных изделий. Научная и практическая значимость работы обусловлена направленностью на разработку экологически чистых и обогащённых пищевых продуктов, соответствующих современным требованиям безопасности и качества. Методология исследования включала лабораторное моделирование рецептур с различными вариантами растительных добавок, проведение комплексной оценки полученных образцов по органолептическим, технологическим и санитарно-гигиеническим показателям. Результаты экспериментов показали, что добавление композитных смесей значительно повышает пищевую ценность мясных продуктов за счёт растительного белка, пищевых волокон, витаминов и минеральных веществ. Овощные компоненты улучшили внешний вид изделий, придавая им насыщенный цвет и вкус без необходимости использования искусственных красителей. Кроме того, наблюдалось улучшение текстуры и увеличение срока хранения изделий. Проведённое исследование вносит вклад в развитие технологий функциональных мясных продуктов и подтверждает целесообразность использования растительных ингредиентов в составе мясных систем. Практическая значимость работы заключается в возможности адаптации разработанных рецептур в условиях промышленного производства с минимальными затратами и максимальной пользой для потребителя.

Ключевые слова: мясной продукт, конина, композитная смесь, фасоль, морковь.