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TECHNOLOGY OF PROCESSING CATTLE BONES INTO MEAT AND BONE PASTE AND THE STUDY OF QUALITY INDICATORS

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Bone disposal is one of the important tasks for modern meat processing enterprises aimed at responsible consumption and reducing the amount of food waste in the meat industry. The purpose of the study is to study the physico-chemical, microbiological and food safety indicators of the obtained meat and bone paste. The paper presents the technology of processing cattle bones into meat and bone paste. Physico-chemical analyses were carried out, a protein content of more than 10 g, fat of more than 6 g, carbohydrates of less than 1 g was detected per 100 g. Microbiological studies and analysis of the food safety of meat and bone paste carried out on the basis of accredited laboratories according to GOST methods prove that meat and bone paste meets the requirements for meat products. The content of QMA&OAMO is less than $1*10^5$ CFU/g, the content of bacteria of the E. coli group was not detected. The technology of obtaining meat and bone paste from the rib bones of cattle has been studied. Microstructural analysis revealed the presence of bone plates with a size of up to 1 mm. Thus, according to the technology of bone processing, a meat and bone paste was obtained suitable for use in the technology of meat products for the purpose of enrichment with mineral and protein substances. The need for deeper grinding of bone particles was found.

Keywords: bones, technology, processing, cattle, food safety.

ІРІ ҚАРА МАЛДЫҢ СҮЙЕКТЕРІН ЕТ ЖӘНЕ СҮЙЕК ПАСТАСЫНА ӨҢДЕУ ТЕХНОЛОГИЯСЫ ЖӘНЕ САПАЛЫҚ КӨРСЕТКІШТЕРДІ ЗЕРТТЕУ

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Сүйектерді кәдеге жарату-ет өнеркәсібіндегі тамақ қалдықтарын жауапкершілікпен тұтынуға және азайтуға бағытталған заманауи ет өңдеу кәсіпорындары үшін маңызды міндеттердің бірі. Зерттеудің мақсаты-алынған ет-сүйек пастасының физикалық-химиялық, микробиологиялық және тағамдық қауіпсіздік көрсеткіштерін зерттеу. Жұмыста ірі қара малдың сүйектерін ет және сүйек пастасына өңдеу технологиясы ұсынылған. Физика-химиялық талдаулар жүргізілді, 100 г-да 10 г-нан астам ақуыз, 6 г-нан астам май, 1 г-нан аз көмірсулар табылды. МЕМСТ әдістемелеріне сәйкес аккредиттелген зертханалар базасында жүзеге асырылған ет-сүйек пастасының тағамдық қауіпсіздігін микробиологиялық зерттеу және талдау ет-сүйек пастасының ет өнімдеріне қойылатын талаптарға сәйкестігін дәлелдейді. МЭжФАМС мазмұны 1*105 ККБ/г кем, E. coli тобының бактерияларының құрамы табылған жоқ. Ірі қара малдың қабырға сүйектерінен ет және сүйек пастасын алу технологиясы зерттелді. Микроқұрылымдық талдау жүргізу кезінде өлшемі 1 мм-ге дейінгі сүйек пластиналарының болуы анықталды. Осылайша, сүйектерді қайта өңдеу технологиясына сәйкес минералды және ақуыз заттарымен байыту мақсатында ет өнімдерінің технологиясында қолдануға жарамды ет-сүйек пастасы алынды. Сүйек бөлшектерін тереңірек ұнтақтау қажеттілігі анықталды.

Негізгі сөздер: сүйектер, технология, қайта өңдеу, ірі қара мал, тағам қауіпсіздігі.

ТЕХНОЛОГИЯ ПЕРЕРАБОТКИ КОСТЕЙ КРУПНОГО РОГАТОГО СКОТА В МЯСОКОСТНУЮ ПАСТУ И ИССЛЕДОВАНИЕ КАЧЕСТВЕННЫХ ПОКАЗАТЕЛЕЙ

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Утилизация костей – одна из важных задач для современных мясоперерабатывающих предприятий, направленная на ответственное потребление и уменьшение количества пищевых отходов в мясной промышленности. Цель исследования – изучение физико-химических, микробиологических показателей пищевой безопасности полученной мясокостной пасты. В работе представлена технология переработки костей крупного рогатого скота в мясокостную пасту. Осуществлены физико-химические анализы, на 100 г обнаружено содержание белка более 10 г, жира более 6 г, углеводов менее 1 г. Микробиологические исследования и анализ пищевой безопасности мясокостной пасты, осуществленные на базе аккредитованных лабораторий согласно методикам ГОСТ доказывают соответствие мясокостной пасты требованиям, предъявляемым к мясным продуктам. Содержание КМАФАнМ менее 1*105 КОЕ/г, бактерии группы кишечной палочки не обнаружено. Исследована технология получения мясокостной пасты из реберных костей КРС. При проведении микроструктурного анализа обнаружены наличие костных пластин, имеющих размер до 1 мм. Таким образом, согласно технологии переработки костей, получена мясокостная паста, пригодная для применения в технологии мясных продуктов с целью обогащения минеральными и белковыми веществами. Обнаружена необходимость более глубокого измельчения костных частиц.

Ключевые слова: кости, технология, переработка, КРС, пищевая безопасность.

Introduction

Meat is a valuable food product. It is essential for a human body as a material for building body tissues, synthesis and metabolism, and as a source of energy. In the modern nutrition system, including the nutrition of children and adolescents, meat is one of the important components of their daily diet.

The quality of any food product determines a set of properties: the ability to provide the human body with a balanced amount of nutrients; health safety; compliance with different age groups.

The purpose of the research is to study the physico-chemical, microbiological and food safety indicators of the obtained meat and bone paste (MBP).

Materials and Research Methods

The laboratories of the department "Food Technology and Biotechnology" of Shakarim University was involved in the experimental research of the work. During the experiments (2021-2022), proven research methods, modern instruments and equipment were used. The determination of physico-chemical parameters was carried out based on GOST 9793-2016 [1], GOST 23042-2015 [2]. Microbiological evaluation of the product was carried out using methods of bacteriological analysis according to GOST 9958-81 [3], GOST 9792-73 [4].

Literature review

The socio-technological development of the meat industry assumes that meat industry enterprises must meet the needs of consumers by developing high-quality functional products [5, 6].

When meat carcasses are processed into sausage products, meat trimmings, adipose tissue, tendons and bones are waste. Meat trimmings are used for making pate, adipose tissue - for melting fat, tendons - for broth, bones - for fat, gelatin, animal glue, feed flour, tuks, activated charcoal, as well as for making various bone products, soup sets and semi-finished products.

Bones obtained after deboning carcasses are sorted and processed separately. The bones are sent for processing no later than 6 hours after deboning. The delay leads to oxidation. In order to extract fat from the bones as much as possible, it is necessary to destroy the bone tissue inside. The brain matter in the tubular bones gives a light fat with a high content of oleic acid. High-quality edible fat is obtained from tubular bones. In ordinary bones, the brain matter has a red color and the fat turns out to be dark, and it is used for technical purposes [7].

Thus, taking into account the significant practical interest of efficient processing of secondary raw materials in the food industry, the development and improvement of meat products technologies corre-

sponding to the norms of standards, technical regulations and regulatory documents is a promising task of ensuring food safety of meat products production using bone raw materials.

Pepsin is the main gastric enzyme [8]. Optimal catalytic activity during protein hydrolysis is at pH 1.5-2.0 [9-11].

It is known, that enzymes have been used widely in the food industry. Processes with the use of proteases have been developed, in order to separate meat and bones [12].

Modern information and patent literature shows that secondary raw materials as a source of biologically active substances have great prospects. The closest one is the work of Chinese scientists and experts. In China, methods of processing meat and bone raw materials in the poultry processing industry for obtaining food products have been proposed [13, 14].

There are studies where ultrasonic pretreatment is used to facilitate enzymatic extraction of poultry bone protein [15].

Uzakov [16] proposed the use of protein-fat emulsion in the production of meat products. The emulsion contains methionine, lysine, tryptophan, as well as polyunsaturated fatty acids, tocopherols, trace elements. It is proved that the protein-fat emulsion improves the organoleptic characteristics of finished products, and gives them tenderness and juiciness.

Kuderinova [17] developed a technique for dissolving bone particles and obtaining a biological preparation.

Results and their discussion

Determination of physico-chemical parameters is a mandatory assessment when the freshness of meat products is being determined. Undesirable microbiological, autolytic, chemical processes that occur when storage regimes and terms are violated lead to deterioration in the indicators of food products.

There is a line for processing bone and meat and bone raw materials at Shakarim University of Semey, which includes a spinning top crusher and a micro-grinder "Supermaskoloider MKZA 10-15" (Japan).

To obtain a finely dispersed MBP, the rib bones of cattle are subjected to a mechanical method of grinding using power grinders.

By means of multi-stage grinding and freezing from minus 18 to 20°C and grinding on the micro-grinder, MBP from the rib bones of cattle was obtained. In order to determine the content of minerals in MBP from rib bones, a physico-chemical analysis of the resulting MBP was carried out (Table 1).

Table 1 – Results of physico-chemical analysis of MBP

№	Indicator, units of measurement	Results
1	Proteins, g/100 g	10,1
2	Fats, g/100 g	6,7
3	Carbohydrates, g/100 g	0,5
4	MFMC, % max	76,7
5	Energy value, kcal/100 g	103,2

The physico-chemical analysis of MBP was carried out, the protein content was found to be more than 10 g per 100 g, which can be compared with the protein content in beef paste (GOST 55334-2012).

A microstructural analysis was performed to detect the presence of bone particles in MBP (Figure 1, 2).

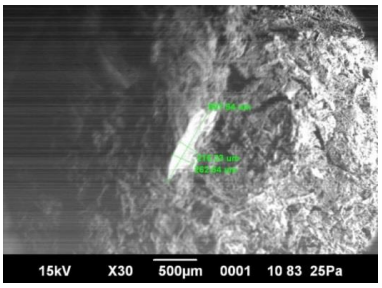

Figure 1 – Microstructure of MBP from cattle bones (30x magnification)

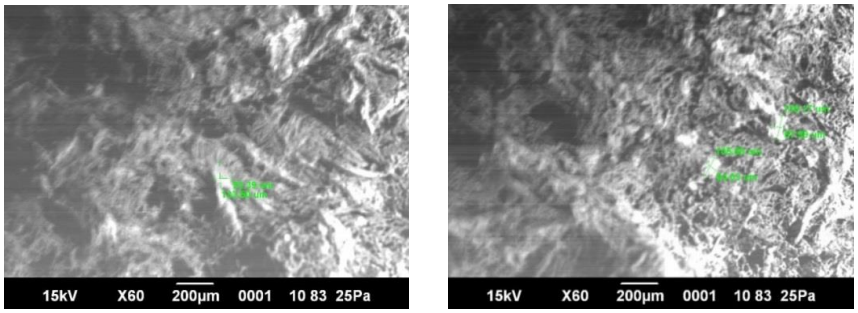

Figure 2 – Microstructure of MBP from cattle bones (60 x magnifications)

Thus, the presence of bone particles, ranging from 0.5 to 1 mm in size, was detected, which indicates the need for further processing of meat and bone paste for its safe use in meat products technology.

The content of total viable count (QMA&OAMO) in MBP is less than $1*10^5$ CFU/g; coliforms, L.monocytogenes, pathogenic microorganisms including salmonella were not detected (Table 2).

Table 2 – Microbiological indicators of MBP

№	Microbiological indicators	Normalized indicator	Research results
1	QMA&OAMO	GOST 10444.15-94	Less than $1*10^5$ CFU/g
2	E. coli group bacteria (coliforms)	No more than $5*10^5$ CFU/g	Not detected in 0.0001 g
3	L.monocytogenes	GOST 31747-2012	Not detected in 25.0 g
4	Pathogenic m/o including salmonella	Not allowed in 0.0001 g	Not detected in 25.0 g

As a result of microbiological analysis, compliance of microbiological indicators with established indicators according to regulatory documentation was established.

Table 3 shows the analysis of MBP for the content of macro and microelements.

Table 3 – The content of macro- and microelements in MBP

№	Name	Content, mg/100 g	Regulatory document
1	Calcium	5318.13±1063.63	P 4.1.1672-2003, p.II, p.3
2	Magnesium	207,62±41,52	P 4.1.1672-2003, p.II, p.3
3	Iron	8,35±1,67	GOST 26928-86
4	Zinc	Not detected	GOST 33824-2016
5	Copper	Not detected	GOST 33824-2016

The content of calcium, magnesium, iron were found in MBP, while zinc and copper were not detected.

MBP for the purpose of application in the technology of meat products must meet the requirements of food safety.The results of the analysis are presented in Table 4.

Table 4 – Indicators of food safety of MBP

№	Name	Norms according to regulatory documents	Content	Regulatory document
1	Toxic elements, mg/kg, no more:			
	Lead	0,5	0,056	GOST 20178-96
	Arsenic	0,1	0,011	GOST 31266-2004
	Cadmium	0,05	Not detected	GOST 30178-96
	Mercury	0,03	Not detected	MUC 4.1.1472-03
2	Antibiotics, mg/kg, no more:			
	Levomycetin	Not allowed	Not detected	ST RK ISO 13493-07
	Tetracycline group	Not allowed	Not detected	ST RK 1505-2006

The studies of food safety indicators of MBP showed the absence of antibiotics, pesticides, cadmium, mercury and the permissible content of lead (0.056 mg/kg), arsenic (0.011 mg/kg), caesium-137 (5.7 mg/kg).

Conclusion

As part of the study, meat and bone paste was studied for physico-chemical and microbiological indicators, as well as food safety indicators. A high protein content (10 g/100 g), the content of elements such as calcium (5318.13±1063.63), magnesium (207,62±41,52) and iron (8,35±1,67) were determined. According to the results of microbiological analysis, the compliance of meat and bone paste with the requirements of microbiological safety was established. A microstructural analysis was carried out, which revealed the presence of bone particles ranging in size from 0.05 to 1 mm. For future studies, it is proposed to use the method of enzymatic treatment with pepsin and ascorbic acid in order to break down bone particles.

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