

Animal Protein Concentrator Technological Research and Test Results

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Abstract

A technology is studied based on determination of general chemical composition and content of collagen protein and to determine amount of ingredient to be used as an additional raw material for boiled sausage. It's confirmed as the optimal sublimation procedure to use collagenase ferment as a catalyst and cook the pork scalp at 95-970C for 2-2.5 hours to extract protein concentrator, which will be then frozen at -860C for 13 hours before being dried in an environment with temperature at -540C and pressure P=28.9Pa for 8 hours. It's the most optimal solution if the fibrous protein concentrator is used at 5% of meat mass to be used in the boiled sausage. Dried fibrous protein concentrator is rich of collagen protein (32.6%) and low-moisturized (23.59%), which has a high importance in terms of physiology and is long lasting product in terms of storage.

Keywords: Pig, scalp, collagen, composition, content, ingredient, meat

Introduction

More than 1 billion people, which is more than a fifth of the world's population, suffer lack of life-supporting protein, which is caused by lack of physiologically-critical collagen and elastin, according to specialists of the Food & Agriculture Organization of UN (FAO) and the World Health Organization (WHO) [6]. Sources say that it had a positive impact to fill lack of protein if 15% of the daily animal-originated perfect protein need of person is supplied with the collagen protein [1;7]. However, meat & milk factories have a wide range of possibilities to keep proper balance of proteins, which are required in human bodies, by concentrating the products with peptide protein.

The Ministry of Health and Social Health Institute of Mongolia run the national survey "Nutrition Report" in 1999, 2004 and 2010-2013, which showed that there's a necessity to enrich food products with bio-active compounds and substances. New technologies to treat food products with the compounds and substances, which are necessary for normal metabolism process of human body, have already been introduced to Mongolia. Law on Food (2012) particularly stated the legal principle to regulate the relations regard with adjustment of ingredients and compound in the future.

Possessing the advanced technology and method to extract bio-active compounds and substances by using organic raw materials resources, originated from Mongolian animals, and treat the meat products has particular importance not only of industrial, but also the social wise.

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Methods and Materials

The technology to extract protein concentrator from pig scalp is studied as a research object with theory-practice method and the result is processed with mathematics-statistic method by using "EViews 7.0" software. The research for quality and safety of raw materials and final products used test and inspection standards as well as highly-sensitive tool analyze methods. The research material is "Collagenase Type II" dry product of "Thermo Fisher Scientific" company, which is the import ferment with health and safety conformity, made of scalp of "Big White" breed pig, of Russia. The technological process has taken place at the Meat process plant of "Khan Brand" LLC of the Technological Institute, sausage equipment of "Trust Meat" and "Trust Ham" factories of Trust Trade LLC and Bioorganic Chemical Laboratory Lyophilizer of the National University of Mongolia (NUM).

Physical-chemical, general chemical compounds, microbiological and safety specifications are determined at scientific laboratory of the Technological Institute, General Food Laboratory of "SAMO" Food scientific and industrial institute, Toxicological laboratory of the National Center for Social Health and the National Reference Laboratory of SSIA for food safety.

Results and Discussion

A. Research on technology to produce fibrous protein concentrator

Sensibility indicator of the pig scalp is determined in accordance with the standard MNS 1023:2007 "Variety meat and its products for food. General Technical Requirements". Sample of scalded, scalped and prepared scalp is considered as acceptable for test purpose hence it meets the sensibility requirements of the standard MNS 1023:2007. As well as use of organic solvent, hot water is used to push oil to process biochemical fermentation of collagen protein of scalp. Serial technological tests are performed to produce fibrous protein concentrator and main parameters are determined.

Pre-decoction with organic solvent and hot water push methods are combined to decrease oil content of the pig scalp in laboratory. Water is pre-heated up to 600C and collagen ferment is added while solution pH reached 7.0-7.5 before adding 30kg of the scalp, which is prepared for the industrial process, and continuously stirring for 30 minutes at 600C. Then the temperature is slowly increased to 95-970C and the cooking process continued for 2-2.5 hours. The mousse is soured with 50% lemon acid solution and thick white residue extracted. Lemon acid solution ingredient is adjusted to have protein solution pH=5.2-5.4. Protein solution, at warm temperature, is filtered with a 0.1mm diameter filter and is frozen with sublimation method at -860C for 13 hours. The ice is evaporated and dried at -540C and P=28.9Pa environment for 8 hours to extract the protein concentrate (Fig.1).

Figure1. Dried fibrous protein from pig scalp



B. Quality research of fibrous protein concentrator

Table 1. Fibrous protein concentrator sensibility parameters

№	Characteristics	Pig scalp	Fibrous protein concentrator
1	Texture/clarity	Evenly scalped, surface is clean and soft	Surface is a bit harder, even and light
2	Appearance	Light yellowish	Light and white
3	Aroma	Specific odor of own	No specific odor

The sensibility assessment of the pig scalp and dried protein concentrator, which were used in the test, are shown. Prior to cook the pig scalp, its fat is separated by decoction, washout, distilling and pushing methods. So, appearance of the prepared protein concentrator is light and white. The crystal ice, which is formed when the protein concentrator is deep-frozen, is evaporated in a vacuum environment and dry substance is stuck with and dried at cell walls. So, the protein concentrator is light-weighted (Table 1).

Table 2. Dried fibrous protein chemistry general parameters

№	Physical-chemical parameters	Samples	
		Raw materials /Pig scalp/	Dried fibrous protein from pig scalp
1	Moisture %	67.59	20.8
2	Fat %	8.26	2.3
3	Protein %	15.0	65.8
4	Ash %	9.15	11.1
5	Collagen %	7.22	32.6

Dry substance concentrate is increased because the moisture is decreased when the protein is extracted from the scalp and dried with sublimation method. The best way to separate fat out from the pig scalp is steam decoction and hot water washout, which is confirmed with the analysis result (fat 2.3%) Table 2.

Table 3. Dried fibrous protein microbiology general parameters

№	General parameters	MNS 6308:2012	Dried fibrous protein
1	Total number of bacteria	$2.5 \cdot 10^3$	$2.4 \cdot 10^2$
2	Salmonella, 25 _r - Δ	not present	not detected
3	E.coli 0157:H7, 25 _r	not present	
4	Listeria monocytogenes, _r	not present	

Total number of bacteria in the test solution is relatively low ($2.4 \cdot 10^2$) compared with the acceptable level. Pathogenic or protein extractor bacteria is not detected, which shows the raw material meets the quality standard requirements and the technological requirements (Table 3). Water bearing capacity of the protein concentrator is calculated by accounting how much water is absorbed at percentage of the own weight and color and formation are assessed.

Table 4. Water absorption of the protein concentrator

№	Water absorption ratio	Sensibility assessment
1	Version I (protein concentrator : water, 1:2)	Light colored, rather liquid
2	Version II (protein concentrator : water, 1:4)	Light white, liquid, free flowing when stirred.

Further increase of water level decomposed the protein structure. So the final value of water absorption of the protein concentrator is version II or the best optimal to process tests. So, the sausage (cooked) is selected for concentration (Table 4).

C. Process research to determine amount of fibrous protein concentrator as an additional raw material to sausage

In order to determine the amount of protein concentrator ingredient as an additional raw material to sausage, 3 versions of ingredients are used to cook sausages.

Table 5. Fibrous protein-enriched the sausage recipes /for 100 gram %/

№	Raw materials	Control sausage samples	Experimental version samples		
			5%	10%	15%
1	Beef	25	25	20	20
2	Goat meat	65	60	60	60
3	Pork hard fat	10	10	10	10
4	Dried fibrous protein: water* /1:4/	-	5	10	15
5	Common salt	2	2	2	2
6	Prescription	0.2	0.2	0.2	0.2
7	Phosphate salt	0.1	0.1	0.1	0.1
8	Garlic	0.3	0.3	0.3	0.3
9	Ice	30	30	30	30
	Gateway	100	103	106	110

Comment water* 37°C.

The sausage with 5% fibrous protein concentrate has less output but it has better results in consumption properties, including appearance and formation of the sausage, compared against other versions (Table 5).

There are 40 people in total participated in tasting of the concentrated test sausage and provided their assessment. Based on total assessment of people, who have participated in our sensibility assessment and taste (39 score the maximum) and statistic processes of physical-chemical parameters, we confirmed that the most optimal option of the fibrous protein concentrate in sausage is 5% of the sausage meat. (Fig.2:3)



Figure 2. Dried fibrous protein



Figure 3. Fibrous protein-enriched the sausage

Table 6. Physical-chemical parameters of the sausage which is concentrated with fibrous protein

Physical-chemical parameters	MNS 0108:2007	Test product	
		Control sausage samples	5% Fibrous protein-enriched the sausage samples
Moisture , % no more	54-62	59.2	60.0
Fat , % no less	13.0	12.7	13.2
Protein % no less	12.0	15.2	18.1
Salt %	1.5-2.8	2.3	2.1
Nitrite, мг/1 кг no more	5.0	3.8	3.6

Physical-chemical parameters of the sausage, which is concentrated for the test, fully meet with the current Mongolian standard: MNS 0108:2007 "Varies of sausages. General technical requirements". Particularly, the content of nitrite, exceeded accumulation of which in human body may result to cancer, is at the acceptable limit. It shows the technological process fully meets with the safety standards (Table 6).

Table 7. Microbiology general parameters of the sausage which is concentrated with fibrous protein

General parameters	MNS 0108:2007	Test product	
		Control sausage samples	5% Fibrous protein-enriched the sausage samples
Total number of bacteria	1*10 ³	1*10 ²	1*10 ¹
E.Coli 0157:H7	No present	No detected	No detected
Salmonella, 25 r-Δ	No present	No detected	No detected
S.aureus, 1r-Δ	No present	No detected	No detected

Total number of bacteria in the sausage, which is concentrated with fibrous protein, is relatively low compared with the acceptable limit. Bacillus and pathological bacteria are not detected, which shows the sanitary and health requirements are strictly followed. Fibrous protein concentrator extracted from scalp and all samples of the sausages concentrated with this product had no mercury or aflatoxin. It again showed that there was no metal pollution in the pig scalp caused by water and the process requirements in relation with storage and process have not been breached.

Conclusion

1. It's confirmed the optimal to cook pig scalp at 95-970C for 2-2.5 hours and freeze the protein at -860C for 13 hours and dry at -540C and P=28.9Pa environment for 8 hours.
2. Collagenase ferment shortens the cooking time and it's confirmed with the technological process test.
3. It's the optimal solution to use the fibrous protein concentrator at 5% of the meat weight in the sausage.
4. Concentrated sausage is 2-3% better compared with control sample in terms of output. It shows the collagen protein is good in extension.
5. Protein concentrator and concentrated sausage are in compliance with the general chemical ingredients, physical-chemical and microbiological criteria requirements and standard requirements. It's confirmed with results of the certified laboratory analysis.
6. New test products are free from heavy metal or bacteria toxic pollution and it's confirmed with the certified laboratory analysis.

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