

UDC 637.5

DEVELOPMENT OF FORMULATION MULTICOMPONENT PROTEIN-FAT EMULSION

Y. Kotlyar, Senior teacher*, E-mail: evgenyj11@mail.ru

T. Goncharenko, graduate student**, E-mail: yataya@ukr.net

O. Topchiy, The Candidate of Tech. Sci., docent**, E-mail: oksanatorpchiy@ukr.net

*Odessa National Academy of Food Technologies, Odessa, Kanatnaya Str., Ukraine, 65039

**National University of Food Technologies, Vladimirskaya Str., 68, Kyiv, Ukraine, 01601

Abstract. The article is based on research of the protein components of different nature analysis. The possibility of their use as components of protein and fat emulsions for the purpose of modeling their optimal formulations for use in the composition of meat pates was proved. Rational individuals' emulsification process parameters, which guarantee high-quality homogeneous emulsions, were found. The samples of protein and fat emulsions using protein drugs and partial replacement of animal fats fortified blend of vegetable oils, determined by their biological value, rheological, functional and technological properties were investigated. Organoleptic analysis model of meat pates masses were analyzed and recommended percentage of protein and fat emulsions on recipes meat pates are shown.

Keywords: fat-protein emulsion (FPE), fortified blending of vegetable oils (FBoVO), meat pates.

РОЗРОБКА РЕЦЕПТУР БАГАТОКОМПОНЕНТНИХ БІЛКОВО-ЖИРОВИХ ЕМУЛЬСІЙ

Є.О. Котляр, старший викладач*, E-mail: evgenyj11@mail.ru

Т.Ю. Гончаренко, аспірант**, E-mail: yataya@ukr.net

О.А. Топчій, кандидат технічних наук, доцент**, E-mail: oksanatorpchiy@ukr.net

*кафедра технології молока, жирів і парфумерно-косметичних засобів

Одеська національна академія харчових технологій, вул. Канатна, 112, м. Одеса, Україна, 65039

**Кафедра технології м'яса і м'ясних продуктів

Національний університет харчових технологій, вул. Володимирська, 68, м. Київ, Україна, 01601

Анотація. У статті досліджено білкові компоненти різної природи та доведено можливість їхнього використання у якості складових білково-жирових емульсій для використання у складі м'ясних паштетів. Визначено раціональні фізичні параметри процесу емульгування, які гарантують отримання високоякісних однорідних емульсій. Досліджено зразки білково-жирових емульсій з використанням білкових препаратів та частковою заміною тваринних жирів вітамінізованими купажами рослинних олій, визначено їхню біологічну цінність, реологічні, функціонально-технологічні властивості. Проаналізовано органолептичні показники модельних паштетних мас та наведено висновки щодо рекомендованого відсоткового вмісту білково-жирових емульсій у рецептурах м'ясних паштетів.

Ключові слова: білково-жирова емульсія (БЖЕ), вітамінізовані купажі рослинних олій (ВКРО), м'ясні паштети.

Copyright © 2015 by author and the journal "Food Science and Technology".

This work is licensed under the Creative Commons Attribution International License (CC BY).

<http://creativecommons.org/licenses/by/4.0>



DOI: 10.15673/fst.v10i4.250

Introduction

The creation of foods with high nutritional and biological value is issue of the day. Meat pates products are not an exception because of involving the use of various properties of animal and vegetable raw materials. Liver and fats are usually used in the production of meat pastes. However, in the production of foods for a healthy diet it is suitable to replace animal fats with the alternative, namely the fortified blends of vegetable oils, which are rich with polyunsaturated fatty acids. Creating a balanced recipe of meat products increased nutritional value, with an improved fatty acid composition and enriched with fat-soluble vitamins can be considered as important trends in modern nutrition. Technological effect of the introduction of protein-lipid emulsions is based on fortified blends of vegetable oils in the formulations of meat pate to improve the physical, chemical and

functional and technological indicators, improving the stability of the meat of the system during the heat treatment and during the storage period.

Formulation of the issue

There is no sufficient number of information resources for the simulation of high-quality protein and fat emulsions based on the fortified blends of vegetable oils, with certain indicators. Technological contrast of animal and plant protein products requires effective ways of using. That will take advantage of each of these types of raw materials [1,2].

One of the technological solutions that will enable more efficient use of raw materials complex is sharing in the form of protein and fat emulsions, which is a technological product with certain quality parameters. Therefore, there is a

need to study the chemical and amino acid composition, and functional and technological properties of the protein products of animal and vegetable origin, their rational justification for the amount of the compound with fortified blend of vegetable oils in the composition of protein and fat emulsions.

There are many formulations of protein-fat emulsions with different ratios of protein, fat and a liquid component. Behavior of protein in real meat systems is always considered in interrelation with other components (water, fat, minerals, etc.), and with the environmental conditions (pH, temperature) that vary during the process of raw material processing. Therefore, in order to compile PFE that should be used in the production of meat pates, it is necessary to study their functional and technological, rheological and organoleptic characteristics.

Literature review

One of the common ways of adjusting the composition of meat products is a combination of raw meat with ingredients of plant origin, which contains unique set of essential nutrients and various components of the therapeutic and prophylactic action: a high content of vegetable protein, unsaturated fatty acids, rich in mineral and vitamin composition. The use of vegetable raw materials, a natural concentrate of essential nutrients, can achieve synergies and a significant increase in health effects from the use of combined meat products, in contrast to similar products enriched with synthetic biologically active substances [3].

Research results which show that the juiciness and tenderness of meat fat content significantly affects [4-6] are reflected in the works of A. Bolshakov, I. Rogov, A. Sokolov, S. Khlebnikov etc. In these studies it was shown that the addition of fat is necessary to ensure standardized quality indicators of meat products. The authors also demonstrated that the addition of fat in meat products is advantageously carried out in the form of emulsions, as in this way the fat is better absorbed by the human body. Emulsified fat and vitamins dissolved therein is better absorbed in the digestive tract by increasing the contact surface with the enzymes involved in the digestion of [1].

Many scientific papers have been focused on the study of basic properties of two-component systems. They proved that the presence of various substances (proteins, salts, organic and inorganic acids, etc.) allows to change the functional properties of these systems even at low concentrations [7].

Thus, the development of recipes multi-protein-fat emulsion is an urgent task in the creation of balanced foods.

Selection of components and protein and fat emulsions recipes modeling

Chemical emulsifier choice and amino acid composition and the functional and technological

properties of protein drugs, «Bilkoton A91», «Forward 450» and «Supro 500E» were studied on basement of market analysis of protein drugs of plant and animal origin in order to adequately.

Determination of emulsifying capacity of protein preparations was performed by developed R. Inklaar and J. Fourtuin, by preparing emulsions from 1 % on aqueous dispersions of protein and vegetable oil to further homogenization, incubation, centrifugation. The criterion of stability of emulsions in the original ratio of fatty and aqueous phases is the average ratio of the phases in the system [8].

Emulsions with the ability to unite fats were determined by the prescription of the company «Central Soy», which is based on determining the amounts of fat, which held 1g sample [8].

Determining the ability of meat pates to unite fats was conducted by means of "Press" method, developed by R. Grau and R. Hamm in V. Volovinsk and B. Kelman's modification [8].

Determining pH emulsions and meat pates was determined by potentiometric method. The method is based on measuring the electromotive force element, consisting of the electrode with a known size and capacity indicator (glass) electrode potential is due to the concentration of hydrogen ions in the test solution [8].

«Bilkoton A91» is a functional compound based on meat and connective tissue protein that has a high coefficient of moisture and fats-unites capacity, designed for use in emulsified meat systems using Cutters, mixers, Grinders. This fine cream-colored powder with characteristic taste and odor produced from genetically unmodified products. In the manufacture of meat products for forcemeat dense structure, as well as to counter the secondary heating was used. To prepare emulsions recommended the following there was ratio used – 1:4:4.

«Forward 450» is the complex nutritional supplement that has high structural properties. This fine powder uniform light cream color with a characteristic odor produced from genetically unmodified products. It is used in food industry as a processing aid in the manufacture of meat products. To prepare emulsions recommended there was ratio used – 1:10:12.

«Supro 500E» is an isolated soy protein, derived from vegetable raw materials (soybeans). Provides texture and emulsion stability meat in various systems. With its high viscosity and solubility, hydrolyzes quickly and forms a thermo stable emulsion in meat products. Emulsified oil and moisture contributes to the formation of dense texture of the finished product. To prepare emulsions recommended there was ratio used – 1:4:4.

Qualitative indicators of investigated protein drugs were provided by the manufacturer and shown in Table 1.

Table 1 – Qualitative indicators of investigated protein drugs

Indicators of quality	«Bilkoton A91»	«Forward 450»	«Supro 500E»
<i>Physicochemical indicators:</i>			
Proteins, % is not less	90,0	63,5	90,0
Carbohydrates, % is not more	-	21,1	-
Ash, % is not more	2,0	4,7	4,0
Fats, % is not more	4,0	5,0	1,0
Dampness, % is not more	4,0	5,7	5,0
pH (1% due to 20°C)	5,6-7,0	6,4-6,8	6,9-7,6
<i>Microbiological indicators:</i>			
MAFAnM, TEM in 1,0 g, is not more	1*10 ³	1*10 ³	1*10 ³
CGB, in 0,01 g, including salmonella in 25 g	Not allowed	Not allowed	Not allowed

Analysis of the chemical composition of dry protein preparations proves that they are full with meat pates raw material for products, but this is not enough for choosing components to create balanced product, so we must compare their amino acid composition which indicators are presented in Table 2.

Table 2 – Amino acid composition of protein drugs research

Name of amino acids	Etalon (protein of chicken egg), mg/100 g	«Bilkoton A91», mg/100 g	«Forward» mg/100 g	«Supro 500E», mg/100g
Alanine	-	4,60±0,02	3,40±0,02	3,90±0,04
Arginine	6,70±0,06	7,80±0,03	5,50±0,03	6,90±0,03
Aspartic acid	8,20±0,09	12,50±0,09	8,50±0,08	11,50±0,10
Cystine	2,30±0,01	4,60±0,02	2,80±0,01	4,00±0,06
Glutamine acid	12,60±1,10	16,40±0,11	11,90±0,09	16,30±0,12
Glycine	3,60±0,02	3,20±0,02	2,00±0,01	2,30±0,01
Gistidin	2,40±0,01	3,50±0,02	1,60±0,01	2,20±0,02
Valine + Methionine	8,50±0,06	8,30±0,02	4,75±0,02	7,80±0,09
Isoleucine	4,00±0,03	3,90±0,02	2,38±0,01	3,30±0,02
Leucine	7,00±0,06	6,90±0,03	5,20±0,03	6,02±0,05
Lysine	5,50±0,05	5,40±0,02	5,08±0,03	5,10±0,03
Proline	7,80±0,07	6,10±0,04	3,10±0,02	5,7±0,030
Serine	4,50±0,03	4,40±0,02	1,60±0,01	3,50±0,01
Trionin	4,00±0,02	4,20±0,01	2,20±0,02	4,10±0,01
Tryptophan	1,00±0,01	1,20 ±0,01	0,70±0,01	1,10±0,01
Phenylalanine	6,00±0,01	6,91 ±0,01	2,91±0,04	5,82±0,06

As shown in Table 2, high-grade animal proteins that form the basis of protein drugs «Bilkoton A91» and «Forward 450» far superior plant («Supro 500E») on the balance for the amino acid composition.

For evaluation of functional and technological properties of protein drugs there was conducted relevant research. Results are presented in Table 3.

Table 3 – Functional and technological properties of protein drugs research

Functional and technological properties	«Bilkoton A91»	«Forward 450»	«Supro 500E»
Water-holding capacity, %	120,3	103,7	119,1
Fat-holding capacity, %	126,6	121,5	126,2
Emulsifying capacity, %	231,8	230,6	210,4

The results of the analysis of protein preparations indicate that all protein drugs have high functional and technological properties, but it provides the highest protein «Bilkoton A91».

The influence of technological factors on properties of emulsions was investigated in order to improve the technology of protein and fat emulsions made from two-component and three-component fortified vegetable oil and protein components and to develop recommendations for their use in technology of meat pates.

Preparation of protein and fat emulsions conducted in the technological scheme was shown on Figure 1. There were used such components as protein drugs, two-component and three-component fortified vegetable oil and water.

Based on preliminary studies, the use fortified blends of vegetable oils were designed and selected proteins as components for making protein and fat emulsions intended to add to the recipe meat pates planned.

Six formulations of protein and fat emulsions comprised of fortified vegetable oil blend, blend № 3 –

fortified blends of vegetable oils, two-component (the ratio of ω -6: ω -3 is 10:1), pumpkin (90 %) + linen (10 %); blend № 9 – fortified blends of vegetable oils three-component (the ratio of ω -6: ω -3 is 5: 1), sun-

flower (77.5%) + linseed (9.5%) and protein components, «Bilkoton A91», «Forward 450», «Supro 500E» were suggested. Samples developed recipes are presented in Table 4.

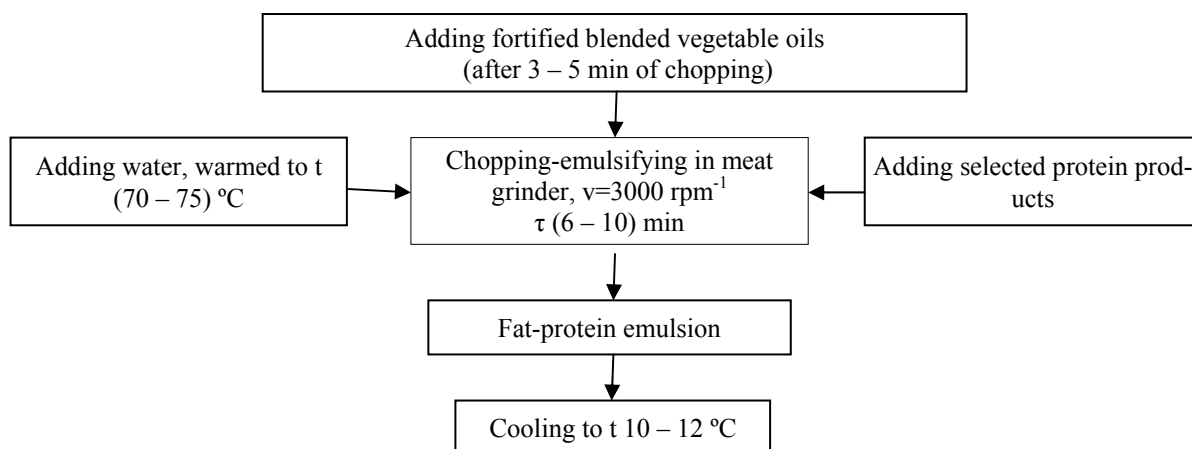


Fig. 1. Technological scheme of protein and fat emulsions preparation

Table 4 – Recipes of protein and fat emulsions

Indicators	Variants of recipes of protein and fat emulsions						
	Control	№1	№2	№3	№4	№5	№6
<i>Raw, kg to 100 kg of emulsion:</i>							
Bilkoton A91	–	10	10	–	–	–	–
Forward 450	–	–	–	5	5	–	–
Supro 500E	–	–	–	–	–	10	10
Animal fats	45	–	–	–	–	–	–
Pork skin	10	–	–	–	–	–	–
<i>Fortified blended vegetable oils:</i>							
Blending №3 (two-component)	–	45	–	45	–	45	–
Blending №9 (three-component)	–	–	45	–	45	–	45
Water	45	45	45	50	50	45	45
All	100	100	100	100	100	100	100
<i>Ratio, %:</i>							
Protein: Fat	1,0:3,0	1,0:4,0	1,0:4,0	1,0:6,1	1,0:6,7	1,0:5,6	1,0:6,6
Protein: Dampness	1,0:3,0	1,0:4,0	1,0:4,1	1,0:5,7	1,0:7,5	1,0:6,0	1,0:7,3

It is known that the main physical factors affecting the quality of the emulsified product are the rate and duration of the emulsification process. It was proved experimentally that emulsification takes place most efficiently when the dispersing device a rotor speed of 3000 rpm⁻¹ and the optimal duration of the process – from 6 to 10 minutes.

The proposed design principle of protein and fat emulsions formulations based on the replacement of the content of animal fat fortified blends of vegetable oils, designed to increase the proportion of polyunsaturated fatty acids sources ratio ω 3: ω 6; holstering decrease in raw materials; increasing the biological value; prevent oxidative damage to the product; increase shelf life by maintaining the addition of natural antioxidants and vitamins; improve nutritional value of the product due to the introduction in the formulation of protein drugs «Bilkoton A91», «Forward 450», «Supro 500E».

The criterion for the choice of rational variant formulations for and fat emulsions meat pates were the ratio of protein and fat in the compositions, as well as the cost of

prototypes. The protein composition of the prescription was presented with meat poultry, and fat emulsion based on fortified blended vegetable oils. Introduction fortified blends of vegetable oils emulsion due to their high biological value, provided the content of vitamins β -carotene and tocopherol and high content of polyunsaturated fatty acids.

At this stage of the work studied emulsion properties on the example of a protein supplement «Bilkoton A91» (using a 1 % solution of protein) in the systems of «fat phase» (triple vitamin blended vegetable oil) the variance with the «Bilkoton A91».

Studies of «Bilkoton A91» fat phase and protein blend in the determination of the ability emulsion showed that the introduction of the fat phase to 50 % provides a stable emulsion.

The effective application of the production of traditional protein and fat emulsions of meat products is needed to know the patterns of change in the basic functional and technological properties such as dynamic viscosity, water-holding capacity, fat-holding ability, emulsion stability. This

is the most significant indicators of the emulsion, as they affect the quality of finished meat products.

It is known that represents protein and fat emulsions dispersions that have a coagulation structure [9,10]. In the formation of coagulation structures play an essential role protein and fat emulsions surfactants dissolved in water and proteins which act as stabilizers and emulsifiers formed and systems can significantly modify their rheological properties. Rheological properties of investigated protein-fat emulsions are given in Table 5.

Studies indicate that not all protein drugs can improve the rheological properties protein and fat emulsion. The best indicators observed in the samples are introduced into the protein preparation «Bilkoton A91».

Series of the studies showed that the introduction of in blended protein and fat emulsion improves their basic indicators of functional properties, including the ability water-holding protein and fat emulsion with «Bilkoton A91» on average 9.0 % higher compared with other proteins, and increase water-holding pH promotes increased capacity (high school) emulsion. High level water-holding capacity –

96.5 %, 95.1 %, fat-holding capacity – 95.1 %, 94.8 % and emulsifying capacity – 96.8 % to 95.4 % samples with «Bilkoton A91» ensures the stability of these emulsions is an average of 4,0-6,0 % higher than in the control and other samples displayed on losses during heat treatment, which on average by 3 – 5 % compared other samples (Fig. 2), were WHC – water holding capacity, FHC – fat holding capacity, ER – emulsion resistance.

Table 5 – Rheology study of protein-fat emulsions (PFE)

Emulsion samples	Dynamic viscosity, Pa·c ⁻¹	The threshold voltage shift, Pa
Control	30,1±0,6	4,8±0,3
PFE №1	44,3±0,3	5,5±0,3
PFE №2	41,5±0,4	5,3±0,1
PFE №3	34,8±0,4	4,7±0,1
PFE №4	36,3±0,5	5,1±0,2
PFE №5	30,1±0,6	4,6±0,3
PFE №6	35,6±0,4	4,8±0,1

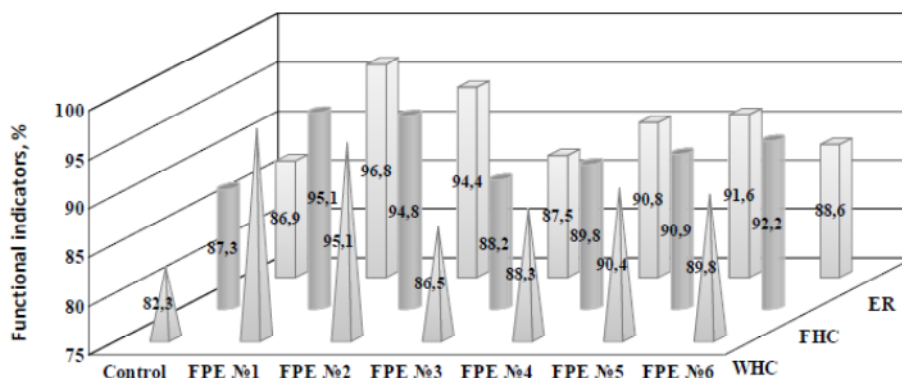


Fig. 2. Functional and technological properties of protein and fat emulsion research

The highest level of rheological and functional properties was marked with the protein in protein and fat emulsion «Bilkoton A91». In this connection, in further studies as a protein component for protein and fat emulsion recipes was elected «Bilkoton A91» in combination with two-component (pumpkin, flax oil) and three-component (pumpkin, linseed oil) blended fortified vegetable oils with a ratio of ω-6:ω-3 is 10:1 and the ratio of ω-6:ω-3 is 5:1.

One of the factors that ensure the quality of manufactured products is its organoleptic characteristics. Therefore, an analysis of the impact of protein and fat emulsions the organoleptic characteristics of model of meat pates masses, which showed that taste aromatic characteristics of each oil used in the manufacture protein and fat emulsion significantly expressed in the finished product.

Organoleptic evaluation meat pates mass of protein and fat emulsion based on fortified vegetable oil shows that adding them to recipes pates in the amount of 15 – 20 % does not degrade the taste, smell and does not affect the consistency of the products. At higher

concentrations BZHE (25 – 30 %) in the meat pates mass color is pale, the products acquire the taste and odor is characteristic of vegetable oils, especially pumpkin.

Therefore, meat pates recipes are recommended for making 15 – 20 % protein and fat emulsion.

Conclusions

The results of the studies of the influence of prescription components in the quality of protein and fat emulsions, as well as practical recommendations for protein drugs, developed formulations of multicomponent protein and fat emulsions, which include fortified blended vegetable oils and protein components, «Bilkoton A91», «Forward 45», «Supro 500E». The introduction of the protein preparations fat-protein data improves the rheological properties and functional properties of emulsions. In this case the highest level of use of these properties provides «Bilkoton A91», which at 4.0 – 6.0 % is higher on average than the control and other samples affects the losses during thermal

processing, in which an average of 3 – 5 % less than the other samples.

An organoleptic estimation model samples were shown, the results of which revealed that the formulations of the meat pates are advisable to make protein-fat emulsion in an amount of 15 – 20 %.

On the basis of experimental data the rational parameters of emulsification were investigated. Namely they are the process speed – 3000 rpm⁻¹ and the total duration of the process – 6 – 10 min.

References

1. Martynuk IO. Alternativni dzhерела рослинного білка в комбінованих м'ясних виробках. *Progresivni tehnika ta tehnologiyi harchovih virobnitstv restorannogo gospodarstva I torgivli. Zbіrnik naukovih prats HDUHT.* 2010; 2(12):269-274.
2. Paslchniy VM, Strashinskiy IM, Furslk OP. Doslidzhennya emulsiy na osnovi blokvmisnih funktsionalnih harchovih kompozitsiy. *Tehnologicheskii audit i rezervy proizvodstva.* 2015; 3(3): 51–55.
3. Avdeeva LY, Shafranska IS. Zbagachennya m'ясnih napivfabrikatіv біологічно активними речовинами рослинної сировини. *Naukovі pratsi [OdeskoYi natsionalnoYi akademiYi harchovih tehnologiy].* 2014; 46(2): 174-176.
4. Fayvishevskiy ML, Grebenshikova TYu. Ispolzovanie belkovo-zhirovih emulsiy v proizvodstve kolbasnyih izdeliy. *Myasnaya industriya.* 2000; 7: 23-25.
5. Fayvishevskiy ML, Grebenshikova TYu, Kryilova VB, Kyuregyan OD. Belkovo-zhirovyye emulsii na osnove belkov rastitelnogo proishozhdeniya i novyih PAV. *Hranenie i pererabotka sel'hozsyrya.* 2000; 6: 29-33.
6. Hlebnikov VI i dr. Kompozitsiya dlya in'etsirovaniya myasa A.S. Pat. 584835 ot 29.02.77.
7. Radzievska IG. Rozrobka tehnologiyi kupazhovanih tvarinno-roslinnih zhiriv pidvischenoyi harchovoyi tsinnostі : dis. kand. tehn. nauk: 05.18.06. K. 2010; 172.
8. Kishenko II, Starchova VM, Goncharov GI. *Tehnologiya m'яsa I m'yasoproduktiv. Praktikum: Navch. posib. K.:NUHT.* 2010; 367.
9. Antipova LV, Glotova IA, Rogov IA. *Metody issledovaniya myasa i myasnyh produktov. M.: Kolos.* 2001; 576.
10. Ivankin AN. *Zhiry v sostave sovremennyh myasnyh produktov. Myasnaya industriya.* 2007; 6: 8–13.

РАЗРАБОТКА РЕЦЕПТУР МНОГОКОМПОНЕНТНЫХ БЕЛКОВО-ЖИРОВЫХ ЭМУЛЬСИЙ

Е.О. Котляр, старший преподаватель*, E-mail: evgenyj11@mail.ru

Т.Ю. Гончаренко, аспирант**, E-mail: yataya@ukr.net

О.А. Топчий, кандидат технических наук, доцент**, E-mail: oksanatorpchiy@ukr.net

*кафедра технологии молока, жиров и парфюмерно-косметических средств

Одесская национальная академия пищевых технологий, ул. Канатная, 112, г. Одесса, Украина, 65039

**кафедра технологии мяса и мясных продуктов

Национальный университет пищевых технологий, ул. Владимирская, 68, г. Киев, Украина, 01601

Аннотация. В статье на основании исследований проанализированы белковые компоненты различной природы и доказана возможность их использования в качестве компонентов белково-жировых эмульсий с целью моделирования оптимальных рецептов для дальнейшего использования в составе мясных паштетов. Определены рациональные физические параметры процесса эмульгирования, которые гарантируют получение высококачественных однородных эмульсий. Исследованы образцы белково-жировых эмульсий с использованием белковых препаратов и частичной заменой животных жиров витаминизированными купажами растительных масел, определена их биологическая ценность, реологические, функционально-технологические свойства. Проанализированы органолептические показатели модельных паштетных масс и приведены выводы относительно рекомендованного процентного содержания белково-жировых эмульсий в рецептурах мясных паштетов.

Ключевые слова: белково-жировая эмульсия, купажированные растительные масла, мясные паштеты.

Список литературы:

1. Мартинюк І. О. Альтернативні джерела рослинного білка в комбінованих м'ясних виробках [Текст] / І. О. Мартинюк // Прогресивні техніка та технології харчових виробництв ресторанного господарства і торгівлі. Збірник наукових праць ХДУХТ. – 2010. – №2(12). – С. 269-274.
2. Пасічний В. М. Дослідження емульсій на основі білоквісних функціональних харчових композицій / В. М. Пасічний, І. М. Страшинський, О. П. Фурсік // Технологічний аудит і резерви виробництва. – 2015. – № 3(3). – С. 51–55.
3. Авдєєва Л. Ю. Збагачення м'ясних напівфабрикатів біологічно активними речовинами рослинної сировини / Л. Ю. Авдєєва, І. С. Шафранська // Наукові праці [Одеської національної академії харчових технологій]. - 2014. - Вип. 46(2). - С. 174-176.
4. Файвишевський М. Л. Использование белково-жировых эмульсий в производстве колбасных изделий / М. Л. Файвишевський, Т. Ю. Гребенщикова // Мясная индустрия, 2000 – №7. – С. 23-25.
5. Файвишевський М. Л. Белково-жировые эмульсии на основе белков растительного происхождения и новых ПАВ / М. Л. Файвишевський, Т. Ю. Гребенщикова, В. Б. Крылова, О. Д. Кюрегян // Хранение и переработка сельхозсырья, 2000 – №6 – С. 29–33.
6. Хлебников В. И. и др. Композиция для инъектирования мяса А.С. Пат.№584835 от 29.02.77.
7. Радзівська І. Г. Розробка технології купажованих тваринно-рослинних жирів підвищеної харчової цінності : дис. канд. техн. наук: 05.18.06 [Текст] / І. Г. Радзівська // – К. – 2010. – 172 с.
8. Кишенюк І. І. Технологія м'яса і м'ясопродуктів [Текст] / І. І. Кишенюк, В. М. Старцова, Г. І. Гончаров // Практикум: Навч. посіб. – К.:НУХТ. – 2010 – 367 с.
9. Антипова Л. В. Методы исследования мяса и мясных продуктов [Текст] / Л. В. Антипова, И. А. Глотова, И. А. Рогов. – М.: Колос, 2001. – 576 с.
10. Иванкин А. Н. Жиры в составе современных мясных продуктов / А. Н. Иванкин // Мясная индустрия. – 2007. – №6. – С. 8–13.

Отримано в редакцію 13.09.2016

Received 13.09.2016

Прийнято до друку 16.11. 2016

Approved 16.11. 2016