ISSN: 0975-8585

Research Journal of Pharmaceutical, Biological and Chemical Sciences

Selection And Justification Of The Optimal Raw Materials For The Production Of Protein-Fat Emulsions Based On Vegetable Raw Materials.

Anton Alekseevich Nesterenko[1]*, Andrey Georgievich Koshchaev[1], Nikolay Nikolaevich Zabashta[2], Ruslan Saferbegovich Omarov[3], and Sergei Nikolayevich Shlykov[3].

[1]Kuban State Agrarian University named after I.T. Trubilin, Kalinina str. 13, Krasnodar 350044, Russia.
[2]Krasnodar Research Center for Animal Husbandry and Veterinary Medicine, Pervomayskaya str., 4, Znamensky Village, Krasnodar 350000, Russia.
[3]Stavropol State Agrarian University, Zootekhnicheskiy lane 12, Stavropol 355017, Russia.

ABSTRACT

Over the past five years, the range of sausage products has grown, the prescription composition of which provides for the introduction of vegetable raw materials as an additional source of protein and texture stabilizer. But the use of vegetable proteins often affects the organoleptic characteristics of the finished product. In this regard, it is necessary to search for plant proteins capable of preserving the organoleptic properties of the original formulation. The paper presents studies of possible proteins for the production of protein-fat emulsion.
Keywords: protein-fat emulsion, meat raw materials, vegetable raw materials, gluten, proteins.

Corresponding author

INTRODUCTION

Currently, great attention is paid to the technology of finely ground meat products with pre-prepared protein-fat emulsions, due to the fact that due to their use it is possible to produce emulsions with both high technological properties and low, but with the necessary factors of nutrition, meat poultry mechanical skin and skin of domestic, pigskin, blood and its uniform elements, fatty raw materials that cannot be introduced into minced meat in a large volume in a free form, for example, beef kidney, friction, abdominal fat and more. Pre-prepared emulsions allow you to enter into the prescription composition such components as biologically active and mineral substances, vitamins, dietary fiber and other physiologically active substances of a certain composition and with an established ratio of components, which allows us to create high-quality functional products [1, 2].

The most common are milk-protein concentrates containing not less than 75% protein, not more than 1.5% fat, and not more than 16% carbohydrates. Protein-fat emulsions, including caseinates, are widely used in the production of meat products, since milk proteins have a high nutritional value, a high content of sulfur-containing amino acids, good solubility, and high moisture binding ability [3, 4].

Protein preparations of plant origin, which are intended for use in the meat processing industry, are endowed with the following features: the ability to create stable gels and emulsions, disperse and adsorb fat, resistance to the action of salt, heat resistance.

Vegetable proteins are similar to the structure-forming muscle proteins of meat and improve stability in meat emulsions. The necessary properties for the production of protein preparations of plant origin, which are used in the meat processing industry, are: cereals (wheat), carnival (rapeseed, sunflower, cotton), pods (beans, peas, lentils) cultures, and soy proteins, which are the most known sources of vegetable protein. The protein-fat emulsion, the basis of which consists of soy protein (soy protein isolate, concentrate, texture, soy flour), serves as a substitute for fatty meat raw materials, has received extensive use in the production of meat products at this point in time [3, 5].

Soy protein has good functional and technological abilities and pronounced compatibility with muscle proteins, so it does not require special preparation conditions for the production of protein-fat emulsions. The oversaturation of prescription compositions with soy protein causes a negative impact on consumer demand for such products. In this regard, it is necessary to search for a protein capable of replacing soy.

Comparison of the effect of different types of vegetable protein (wheat, corn and soybean) was carried out on minced meat products. At the same time, all three compared proteins were injected in a ratio of 3.5% by weight of minced meat. In sausage products with protein additives, increased technological properties. Protein supplements have benignly influenced the improvement of the consistency and organoleptic characteristics of the products. In the course of the study, it was found that all three of the studied protein products had similar characteristics as additives to ground meat products. On the basis of wheat protein, a functional additive was obtained, which has a high solubility of protein, dispersibility in aqueous media, and surpasses soy protein isolate in emulsifying capacity [4, 6].

In this regard, the purpose of the study is to search for and substantiate a new protein of plant origin in order to produce a protein-fat emulsion.

MATERIAL AND METHODS

Determination of the mass fraction of moisture was carried out by the Grau-Hamm method according to GOST 9793-74 [7]. The mass fraction of fat was determined by the method of extracting total fat according to GOST 230042-86 [8]. The mass fraction of protein was determined by the method using an amide chelate dye according to GOST 25011-81 [9]. Mass fraction of ash [10]. The definition of emulsifying ability and stability of the emulsion was determined by a gravimetric method [10]. Mathematical processing of the data was calculated by the method of regressive analysis [11].

ISSN: 0975-8585

RESULTS AND DISCUSSION

Analysis of the literature [12-14] suggests that disperse systems consisting of emulsions formed by two or more immiscible liquids. In protein-fat emulsions, the polar liquid is water, and the non-polar fat fraction. Emulsion systems are divided into two types of "water in fat" or "fat in water", the latter system is of great importance for the production of sausages. For the formation of a stable emulsion, an important condition is necessary, reducing the surface tension due to the formation of a layer between the hydrophobic (fat) and hydrophilic (water) phases [15]. Proteins gluten wheat grains have a surface activity. Due to the presence of polar hydrophobic groups, they can be used as an emulsifier to stabilize the fat emulsion [16]. The emulsifying abilities of proteins are analyzed by means of determining the amount of fat mass transferred to the emulsified state and bound by proteins. The more functional activity have proteins.

During the preparation of a protein-fat emulsion (PFE) with a glut of fat, a separation of the emulsion system, called coacervation, occurs. On this basis, the emulsifying capacity is determined by the amount of adipose tissue introduced into the formulation of the protein-fat emulsion until coacervation appears [17, 18].

The use of PFE in prescription compositions of sausages allows the most efficient use of pork fat, raw beef and pork fat, fat trimming and other fatty raw materials. The use of fatty raw materials in the emulsified state reduces the risk of broth-fat edema.

For the production of PFE at meat processing plants, soy proteins are usually selected. They have good moisture binding and emulsifying ability. However, oversaturation of prescription compositions with soy proteins each year reduces the demand for sausage products. Consumers are increasingly abandoning products containing soy proteins. In this regard, it is necessary to search for the most optimal vegetable proteins for the production of PFE. The most promising proteins in terms of their functional and technological properties are wheat grain proteins and lentil proteins.

To determine the most optimal vegetable proteins for the production of PFE, we took soybean and lentil protein isolates from Yug-FoodService LLC, and gluten from wheat, obtained by washing out the highest-grade flour.

The results of a comparative study of the amino acid composition of proteins are presented in table 1.

Table 1: Amino acid composition of soy proteins and wheat grain

Amino acid	Content g / 100 g protein		
	Wheat grain proteins	Soy protein	Lentil proteins
Essential Amino Acids			
Arginine	4,83	8,5	1,78
Valin	5,59	5,3	0,98
Histidine	2,47	3,3	0,49
Isoleucine	4,96	5,5	0,68
Leucine	8,52	9,1	1,49
Lysine	2,8	7,0	1,50
Methionine	1,83	1,4	0,50
Threonine	3,15	4,3	0,79
Phenylalanine	6,09	0,1	1,10
Tryptophan	–	1,3	–
Replaceable amino acids			
Alanine	3,11	4,9	0,77
Aspartic acid	3,84	13,0	2,41
Glycine	4,13	4,7	0,79
Glutamic acid	43,79	21,6	3,40
Proline	15,89	5,7	0,95
Serine	5,28	0,1	1,14
Tyrosine	4,08	4,3	0,71
Cystine	2,53	1,4	0,18

As can be seen from the table of comparative amino acid composition, proteins of wheat grain and lentils are inferior in the number of essential and replaceable amino acids, which may affect the biological value of total proteins in the finished product. Due to the fact that the replacement of meat proteins with proteins of wheat grain will not be made at 100%, and the composition of the prescription composition of the amino acid composition of all components will be combined, these data can be neglected.

The fatty beef trimmings (fatty tissue from different parts of the carcass including raw fat), fatty pork trimmings (fatty tissue from different parts of the carcass including raw fat), melted pigs and beef were taken as the fat component. The chemical composition of fats is given in table 2 [18].

Table 2 - The chemical composition of fats

Type of adipose tissue	Mass fraction, %			
	Moisture	Fat	Protein	Ash
Beef trimming	9,70	88,75	1,39	0,35
Pork fat cutting	6,40	92,20	1,35	0,05
Baked beef fats	0,30	99,63	0,00	0,07
Pork melted fats	0,30	99,68	0,00	0,02

From the literature it is known that the average water binding capacity of the studied proteins is 1: 4–5, and the emulsifying capacity is up to a ratio of 1: 3. In accordance with this, the proposed emulsion is developed in the ratio of protein: water: fat (P: W: F) - 1: (4, 5): (1-3). Depending on the ratio of prescription ingredients in PFE, functional and technological properties change. From the literature [6], it is known that wheat grain protein has the best water binding and emulsifying ability in the temperature range from 25 to 30 ° C, and soy and lentil proteins within 10 °C. Model PFE with proteins of wheat grain was prepared according to the following scheme: gluten of wheat grain with a temperature of 10 to 15 ° C was ground on a cutter with a knife speed of 3000 rpm, while the entire volume of water with a temperature not lower than 20 ° C was added when the temperature in the mixture reached 20 °C injected fatty raw materials and continue to cutter until reaching a temperature of 27 ± 2 °C. After that, the PFE was unloaded in cars and allowed to cool to a temperature of 4 ± 2 °C. For soybean and lentil proteins, PFE was prepared according to the following scheme: protein isolates were poured into a cutter with water at a temperature of 4 ± 2 °C and mixed with a speed of movement of knives of 1000 rpm. Mixing was performed until a homogeneous consistency. After that, they introduce fatty raw materials and continue to cutter at a speed of movement of the knives of 3000 rpm until the temperature reaches 15 ± 2 ° C. After that, the PFE was unloaded in cars and allowed to cool to a temperature of 4 ± 2 °C.

The results of studies of emulsifying ability and stability of emulsions are presented in the figures. For the convenience of drawing pictures, the following abbreviations were adopted: beef trimmings - BT, pork fatty trials - PFT, baked beef fats - BBF, lard pork fats - LPF: wheat gluten - WG; soy protein isolate - SPI; lentil protein isolate - LPI.

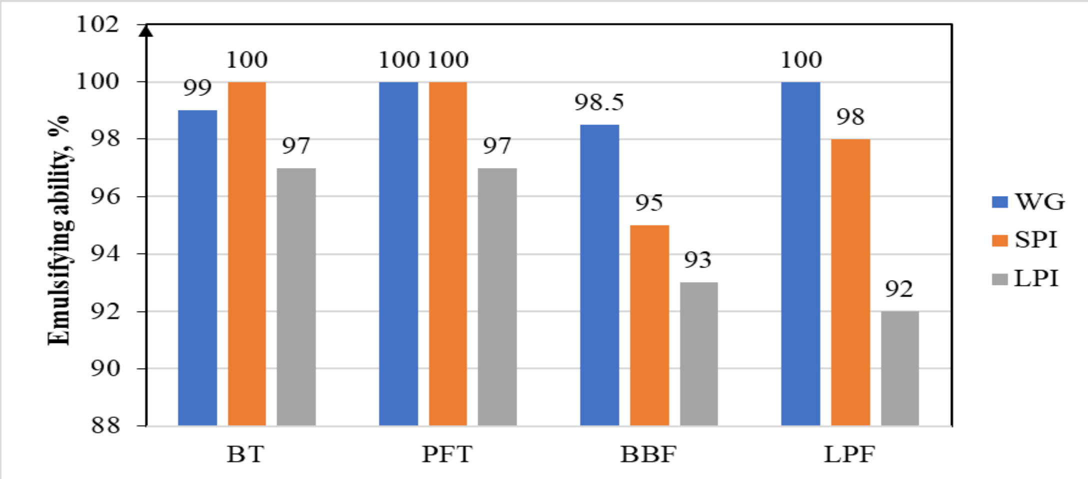

Figure 1: PFE emulsifying capacity at a ratio of P: W: F– 1: 4: 1

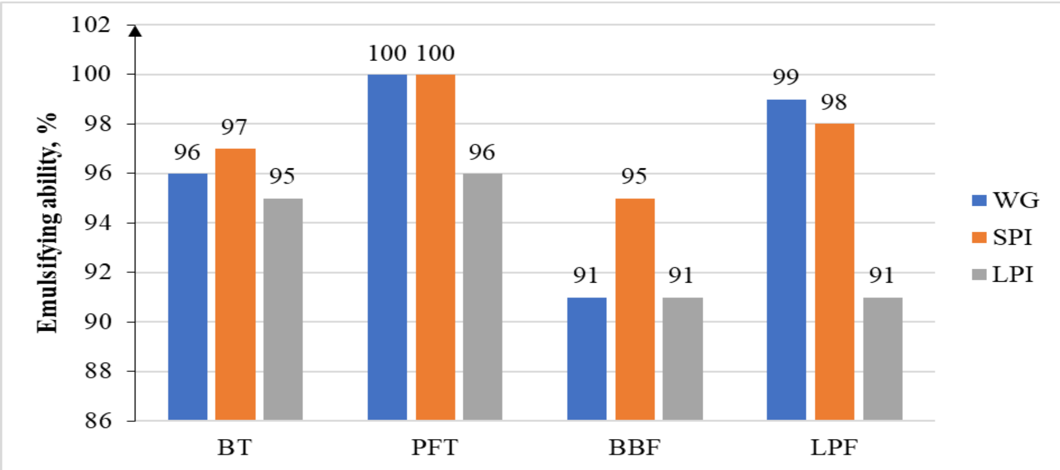

Figure 2: PFE emulsifying capacity at a ratio of P: W: F– 1: 4: 2

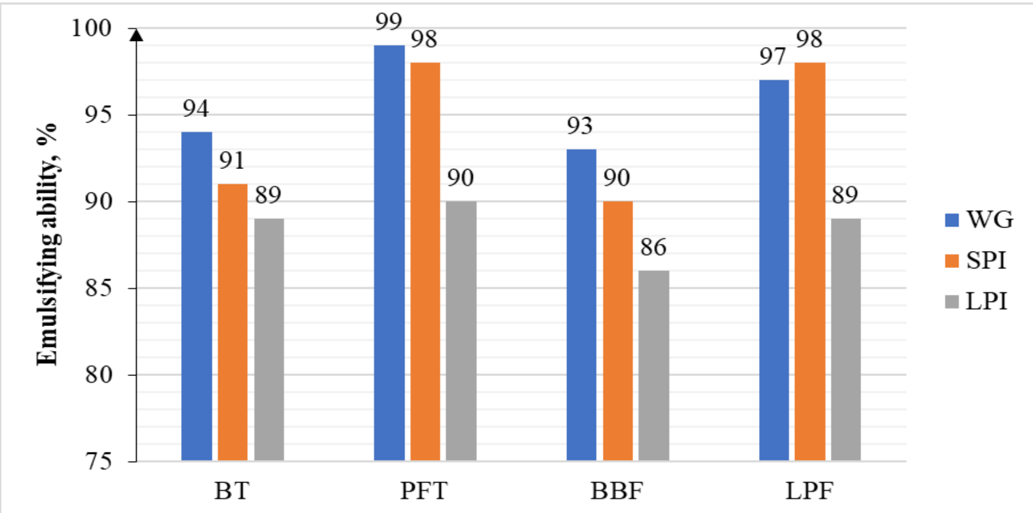

Figure 3: PFE emulsifying capacity at a ratio of P: W: F– 1: 4: 3

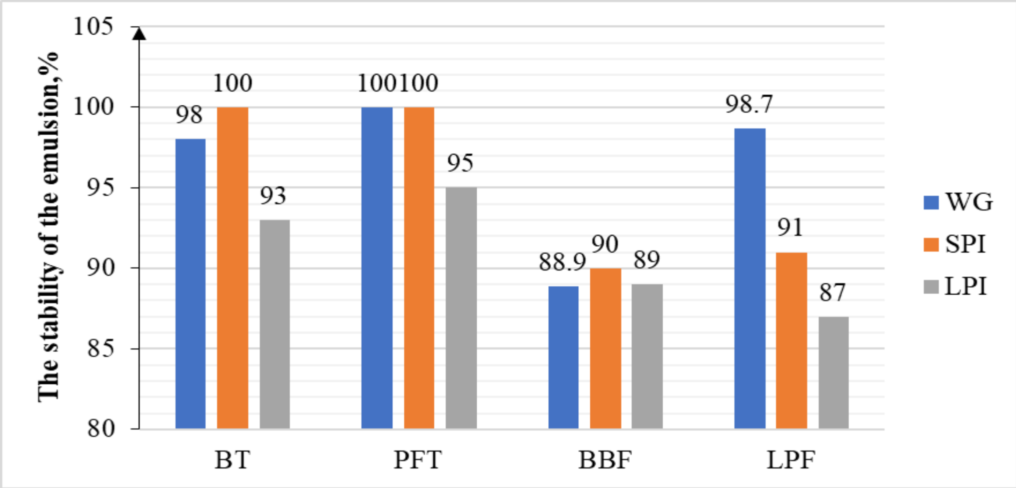

Figure 4: PFE stability at P: W: F – 1: 4: 1 ratio

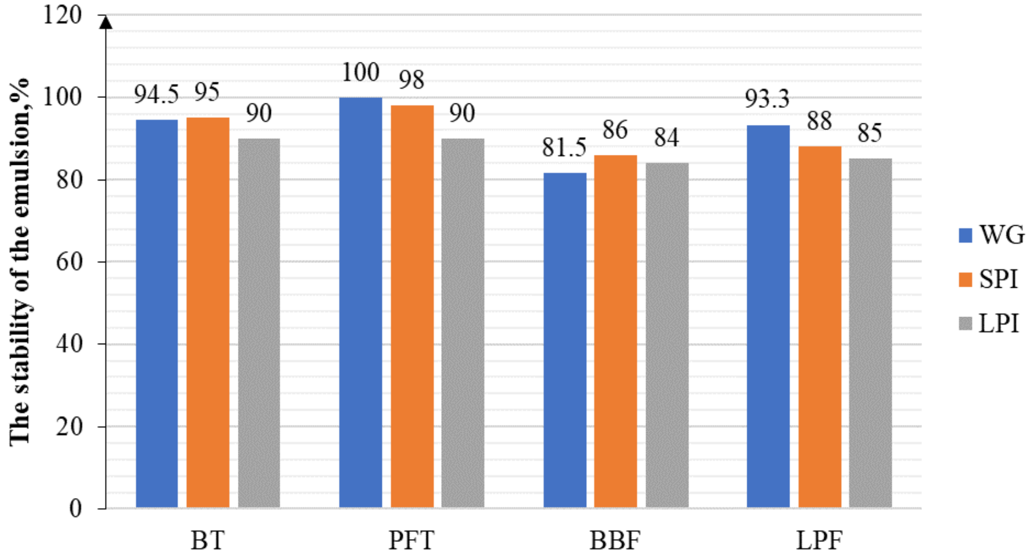

Figure 5: PFE stability at P: W: F – 1: 4: 2 ratio

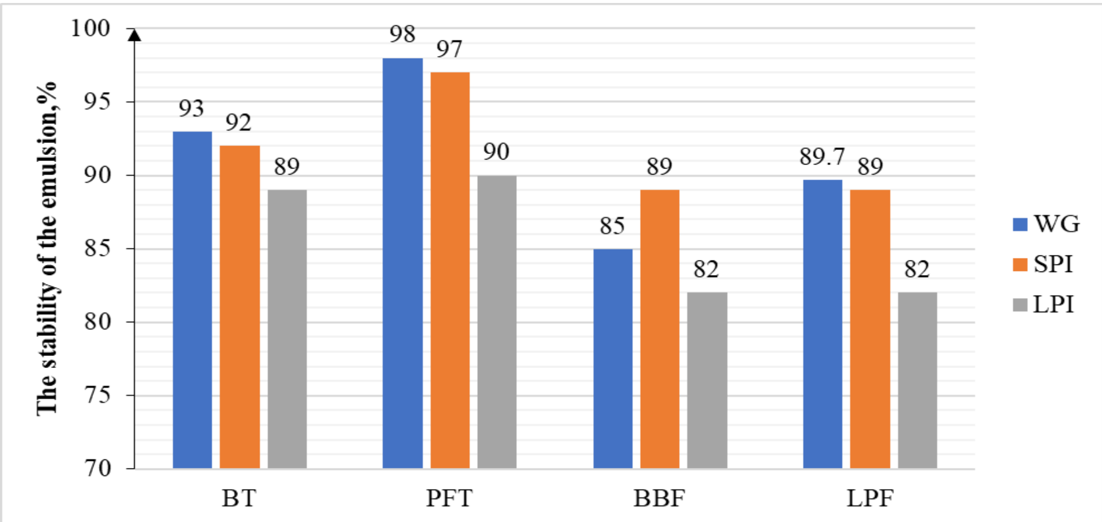

Figure 6: PFE stability at P: W: F – 1: 4: 3 ratio

ISSN: 0975-8585

Analysis of the images indicates a decrease in emulsion stability and emulsifying ability in PFE with lentil protein isolates. The best indicator showed PFE based on gluten proteins. When the ratio of P: W: F in the amount of 1: 4: 2 and 1: 4: 1 showed a 100% result on emulsifying capacity and stability of the emulsion, while the ratio of P: W: F in the amount of 1: 4: 3 there is a slight deviation: emulsifying ability 1% and emulsion stability 2%. Analysis of PFE data based on wheat grain proteins shows that the optimal result of stability and emulsifying ability of PFE showed fat pork trimmings (PFT) in the P: W: F ratio of 1: 4: 2 and the emulsifying capacity is 100%, while the stability emulsions 100%. The worst figure for emulsifying ability and stability of the emulsion showed beef baked fat on all PFE.

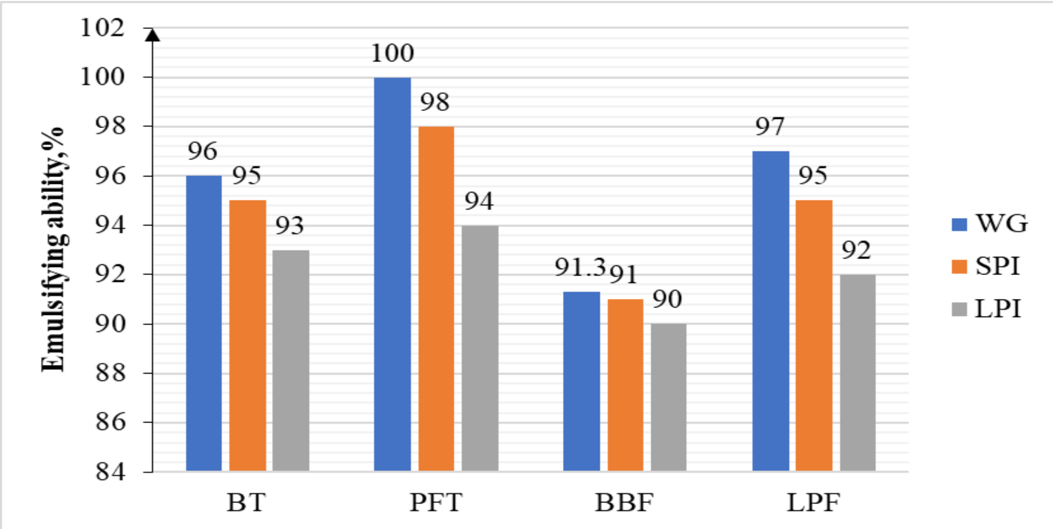

Figure 7: PFE emulsifying capacity at a ratio of P: W: F– 1: 5: 1

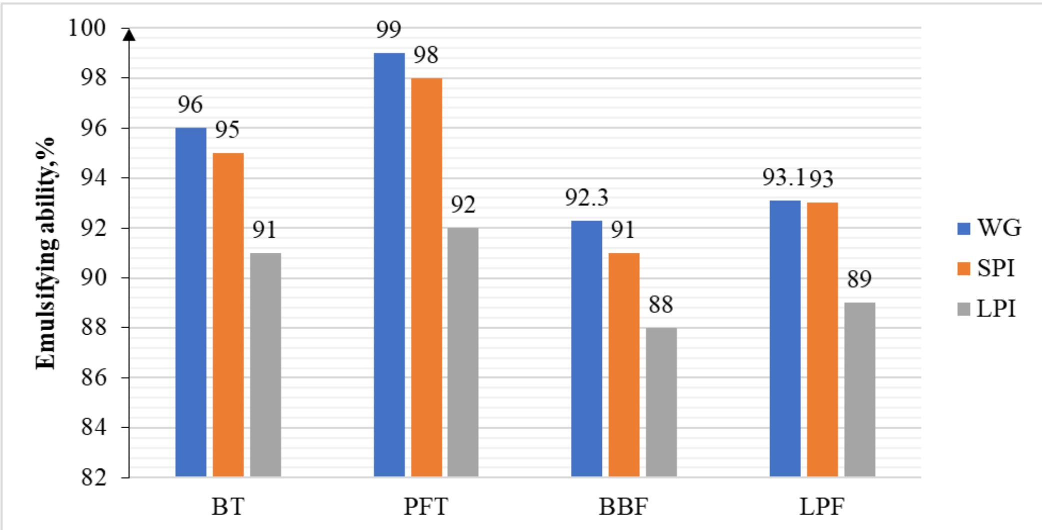

Figure 8: PFE emulsifying ability at a ratio of P: W: F– 1: 5: 2

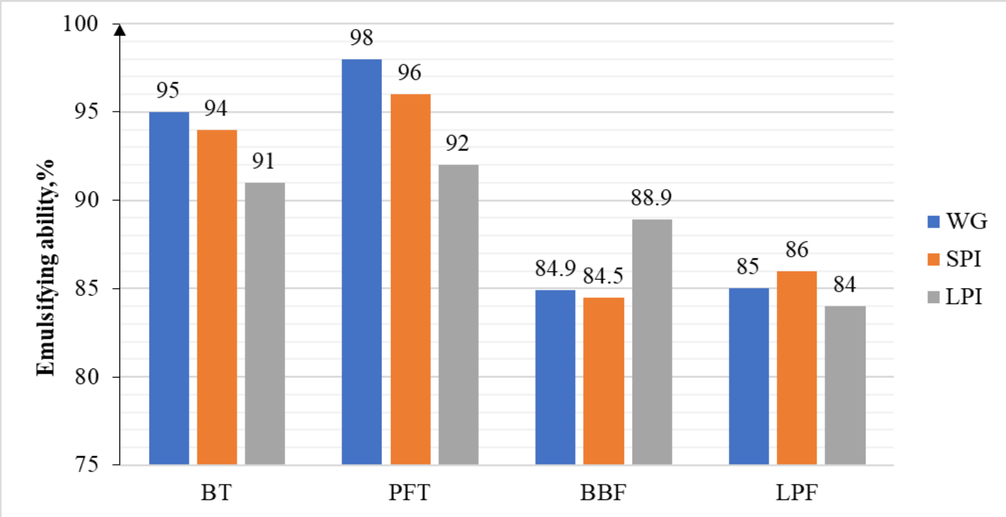

Figure 9: PFE emulsifying capacity at a ratio of P: W: F– 1: 5: 3

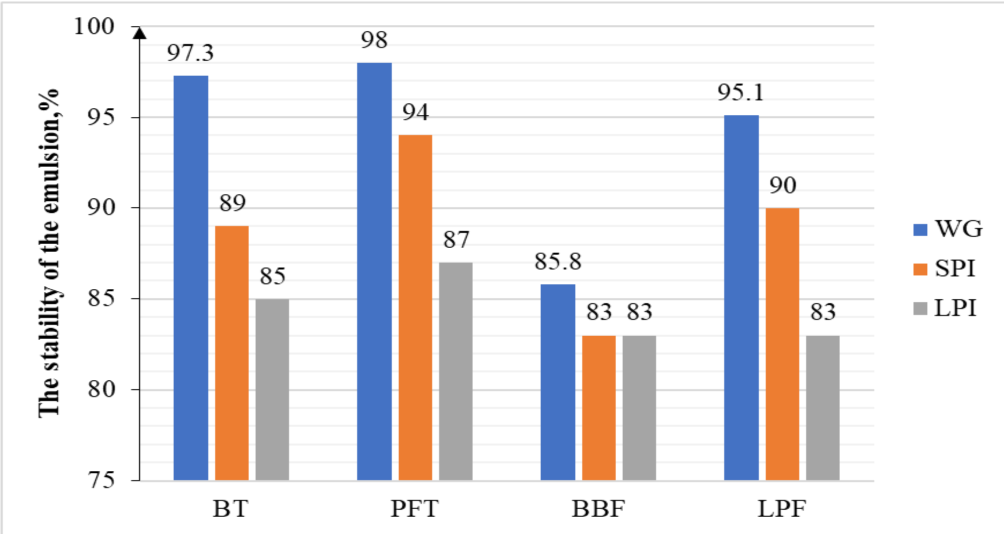

Figure 10: PFE stability with P: W: F – 1: 5: 1 ratio

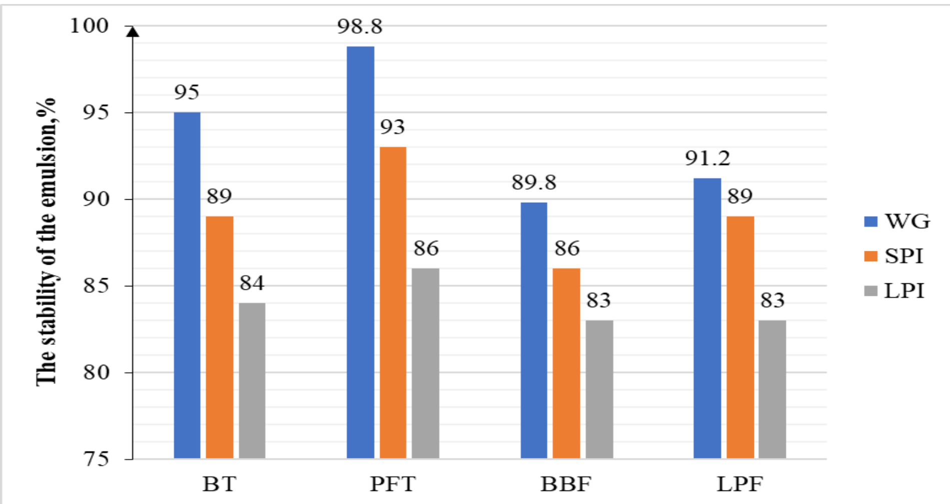

Figure 11: PFE stability at P: W: F – 1: 5: 2 ratio

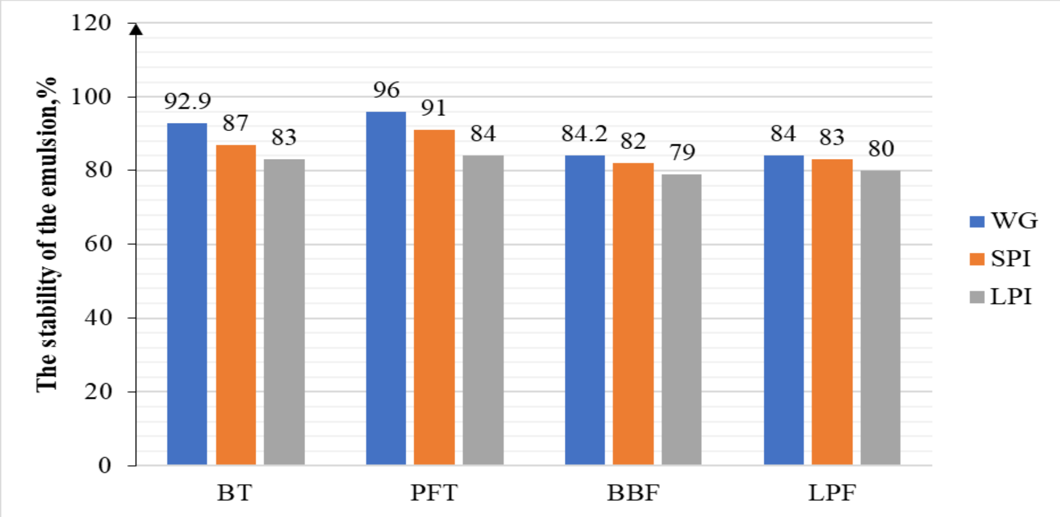

Figure 12: PFE stability at P: W: F – 1: 5: 3 ratio

In accordance with the studies, it was found that the best indicator of emulsifying ability and stability of the emulsion showed PFE based on gluten wheat in the ratio P: W: F in the amount of 1: 5: 2. The stability of the emulsion was 98.8%, and the emulsifying ability of 99% (fat pork was used as fatty raw materials.

In the production of a cooked group of sausages with a high fat content, the most important indicator is the emulsifying ability and stability of the emulsion. In accordance with the studies, it was found that the best indicator of emulsifying ability and stability of the emulsion showed PFE based on gluten, wheat grain with fatty pork trimmings with a ratio of P: W: F– 1: 4: 2 which amounted to 100%. In this regard, we have chosen the ratio of P: W: F in the amount of 1: 4: 2.

In the production of cooked sausage products, one of the quality indicators for PFE is its plastic-viscous characteristics, which were determined in parallel with the emulsifying ability and stability of the emulsion. From the literature [3] it is known that viscosity characteristics of sausage meat of boiled groups vary in the range from 234.2 Pa / s to 272.22 Pa / s. The viscosity indices of the recommended PFE formulation were 245.8 Pa / s, which corresponds to the viscosity range of the minced meat of the cooked sausage group.

Protein-fat emulsions for the production of sausages, usually prepared for earlier. The shelf life of such emulsions does not exceed 24 hours at a temperature of from 0 to 4 ° C. Due to the heterogeneity of the dispersed system, separation can occur in it. In accordance with this, it is necessary to analyze the behavior of PFE during storage for 24 hours at a temperature of from 0 to 4 ° C.

Analysis of the data indicates an increase in the density of PFE after 12 hours of storage at a temperature from 0 to 4 ° C. Consistency compaction occurs as a result of protein swelling. Visible stratification does not occur when stored for 24 hours and at a temperature of 0 to 4 ° C. The data obtained indicate that PFE can be stored for 24 hours at temperatures from 0 to 4 ° C.

Introduction to the prescription composition of an additional amount of fatty raw materials can make significant changes in the fatty acid composition of the model meat. Table 3 shows the analysis of the fatty acid composition of PFE and pork fat.

Table 3: Fatty acid composition of PFE and fat pork

Fatty Acids	Fatty acid content, %	
	PFE	Fat pork
Saturated fatty acids:	38,24±0,30	37,58±0,27
Kapron	0,11±0,01	0,12±0,01
Lauric	0,18±0,01	0,15±0,01
Myristic	2,57±0,03	2,00±0,02
Palmitic	19,97±1,09	20,02±1,01
Margarine	0,57±0,02	0,50±0,01
Stearic	14,84±0,84	14,79±0,71
Monounsaturated fatty acids:	46,24±0,52	46,47±0,45
Tetradecene	1,53±0,03	1,64±0,02
Palmitoleic	3,76±0,07	3,62±0,05
Oleic	40,95±1,89	41,21±1,56
Polyunsaturated fatty acids:	14,38±0,30	13,69±0,30
Linoleic	11,99±0,19	11,39±0,21
Linolenic	2,09±0,02	1,89±0,02
Arachidonic	0,30±0,01	0,41±0,02

From the data presented it can be seen that the replacement of pork in the prescription composition of sausages with PFE does not have a significant effect on the qualitative and quantitative fatty acid composition. Studies have shown the possibility of using wheat grain proteins in the production of protein-fat emulsion.

CONCLUSION

The choice of the optimal fatty raw material is substantiated - internal fat, prises and fat cutlets. It is established that the optimum protein: water: fat ratio is 1: 4: 2, respectively, while the PFE viscosity is 245.8 Pa / s, the emulsifying capacity is 100%, the emulsion stability is 100%, the PFE fatty acid composition is not significantly different from the fatty acid composition of pork fat.

REFERENCES

[1] Khramova, V.N. Creation of functional meat products using prebiotics and plant-based regional raw materials / V.N. Khramova, V.A. Dolgova, E.A. Selezneva, Ya.I. Khramova // News of the Nizhnevolzhsky Agro-University Complex: Science and higher professional education. 2014 - №4 (36) - 81 p.

[2] Omarov R. S. Obtaining a biologically active food additive based on formed elements blood of farm animals / R. S. Omarov, S. N. Shlykov, A. A. Nesterenko // Research Journal of Pharmaceutical, Biological and Chemical Sciences. – 2018. – №9 (6). – P. 1832-1838.

[3] Kenijz N. V. Protein-fat emulsions based on plant materials / N. V. Kenijz, A. A. Nesterenko, D. S. Shkhalakhov // Saarbrücken: Palmarium Academic Publishing - 2017. - p. 105.

[4] N. V. Kenijz. Use of Plant Proteins in Sausage Technology / N. V. Kenijz, A. A. Nesterenko, D. S. Shkhalakhov // Saarbrücken: Palmarium Academic Publishing - 2017. - p. 95.

[5] Development of dietary food with the use of soy protein / Varivoda A.A., Kenijz N. V., Rebezov M.B. Okuskhanova E // Research Journal of Pharmaceutical, Biological and Chemical Sciences. – 2018. – №9 (4). – P. 1005-1013.

[6] Slokenkina, M.I. Expediency of use of textures of vegetable proteins in the production of ham / M.I. Slokenkina, E.A. Kuznetsova, Yu.V. Starodubova, M.N. Chepelenko // News of the Nizhnevolzhsky Agro-University Complex: Science and Higher Professional education. - 2015. - № 1 (37). - p. 161–164.

[7] GOST 9793–74 Meat products. Methods for determination of moisture - M .: Publishing house of standards, 1990. - 4 p.

[8] GOST 23042–86 Meat and meat products. Methods for determining fat - M .: Standartinform, 2010. - 6 p.

[9] GOST 25011–81 Meat and meat products. Methods of protein determination - M .: Standardinform, 2010. - 7 p.

[10] Antipova, L.V. Methods of research of meat and meat products / L.V. Antipova, I. A. Glotova, I. A. Rogov. - M .: Kolos, 2001. - 376 p.

[11] Functions of linear and planned approximation. Al. textbook on MathCAD [Electronic resource]. Access mode: www.detc.usu.ru.

[12] Antipova, L.V. Applied biotechnology. UIRS for the specialty 270900: studies. manual / L. V. Antipova, I. A. Glotova, A. I. Zharinov. - Voronezh: Voronezh. state tehnol. Acad., 2000. - 332s.

[13] Kenijz, N. V. Optimization of sausage recipes in real-time conditions / N. V. Kenijz, A. A. Nesterenko, D. S. Shkhalakhov // Nauch. journals KubSAU [Electronic resource]. - Krasnodar: KubSAU, 2014. - № 08 (102). P. 1113 - 1126. - Mode of access: http://ej.kubagro.ru/2014/08/pdf/71.pdf.

[14] Kudryashov, L.S. Physico-chemical and biochemical basis of meat and meat products production / L.S. Kudryashov. - M .: DeLiprint, 2008. - 160 p.

[15] Frolov, Yu. G. The course of colloid chemistry (Surface phenomena and disperse systems): a textbook for universities. - M .: Chemistry, 1982. - 400 p.

[16] The use of wheat protein products in food production / G. N. Dubtsova, V. V. Kolpakova, A. P. Nechaev. Survey information. Series: Flour-and-cereals industry. - M .: TsNIITEEIkhleboproduktov, 1992. - 40 p.

[17] Biomodification of meat for improving functional-technological properties of minced meat / A. Nesterenko, A. Koshchaev, N. Kenijz, K. Akopyan, M. Rebezov, E. Okuskhanova // Research Journal of Pharmaceutical, Biological and Chemical Sciences. – 2018. – №9 (6). – P. 95-105.

[18] Koshchaev, A. G., Shchukina, I. V., Semenenko, M. P., Sergeevna, K. A., Vasilevich, K. V. (2016): Amino Acid Profile of Meat of Specialized Beef Breeds, in: Research Journal of Pharmaceutical Biological and Chemical Sciences 7, P. 670-676.