Modeling the structure and properties of minced meat and liver products

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Abstract. Advances in food technology have created the potential for product modeling. The aim of the study was to determine the possibility of producing and selling minced meat and by-products made using advanced technologies and to ensure the safety of manufactured products. Methods used in commodity science were used to determine the quality indicators of culinary products, establish the shelf life and food safety indicators. Marketing research into the use of raw vegetables in minced meat recipes showed their limited range. The work assessed the effect of using zucchini, carrots, onions, cauliflower, and spirulina as structure-treating agents, added in two concentrations (2.5% and 5%), on the physicochemical and morphological properties of gel-like systems. The addition of raw vegetables improved ($P < 0.05$) the water- and fat-binding properties, except for the case of excluding 0.1% spirulina. The hardness, rigidity and chewiness of the cooked products with the addition of raw vegetables were higher ($P < 0.05$), while the elasticity and cohesion were lower ($P < 0.05$) than in the control samples. The color changes in the meat systems were affected by the type of vegetables and their consistency. The morphology of the sample varied depending on the type of added vegetables, and this is a result of differences in the physicochemical characteristics of the puree or finely chopped vegetables used. In general, the products developed from raw vegetable mince and pureed vegetable additives have a fundamental difference and non-traditional behavior.

1 Introduction

The production and sale of meat culinary products occupies a leading position among other groups of food products. Most consumers prefer meat products. However, their wishes can be satisfied by using vegetable components as additional raw materials, as well as offal (liver, heart, tongue, lungs, udder, kidneys). If vegetable additives in the composition

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of minced meat have been used for a long time, then it is difficult to find offal on the restaurant menu. Jellied or boiled tongue is rarely found on the cafe menu. Because of the specific smell, beef or pork liver is rarely cooked in canteens. Therefore, the task is to rationally use meat raw materials, considering the waste-free technology of its processing (Kurchaeva E. E., Maksimov I. V., Manzhesov, 2006). If we consider the culinary preferences of the population in different countries, we can notice unusual dishes that are prepared from offal. Thus, in Poland, preference is given to "flaki" - a thick tripe soup. In Hungarian and Czech cuisine, there is "goulash" - stewed meat with vegetables. The Jewish dish "Gehakteleber" is well-known - a pate made from poultry liver. In Israel, a special combination with onions and raisins was made from beef liver, which emphasizes their culinary preferences. In Arabic cuisine, you can see a combination of beef or lamb liver with cheese, potatoes, onions and parsley. One of the popular dishes in Egypt is "Liver Alexandrian style", in which the liver is combined with onions, garlic, fresh pepper, lemon juice and pomegranate sauce to give it a piquant flavor. Liver quenelles and dumplings can even be found on a festive German table. The English prefer a combination of liver with bacon, mushrooms, parsley and other herbs and spices. In French cuisine, they prepare "Foie gras" from goose liver (Abu Salem, F.M., Abu Arab, E.A., 2010), as well as baked liver dishes with omelette and cream. Chinese dishes have a more pungent taste. Onions, carrots, fresh peppers and various spices are added to the liver, as well as soy or tomato sauce. In Russian cuisine, "liver Stroganoff style" is prepared with sour cream. There are also unusual combinations of various offal in one dish. Thus, in Jewish cuisine you can see a combination of chicken liver with heart and poultry fillet; beef liver, brains, tongue and chicken giblets. And in Arabic cuisine, lungs, heart and vegetables (onions, tomatoes, sweet peppers) along with spices are added to lamb liver. In Irish technology, in addition to taste characteristics, attention is also paid to the digestion of offal: beef liver and heart in the human body (Erkan, P., El, S.N., 2011). The creation of new combinations of animal and plant products is not limited only to their usefulness and necessity for human physiology, but also to the experience of eating food, the expectation of an effect, excellent quality, and innovation [1].

In this regard, the famous scientist in the field of quality theory, American doctor E. Deming, said: "Quality begins with the "pleasure" of the consumer," and further. - The consumer must receive what he wants, and in the form in which he imagines it and wants to receive it.

The conducted analysis of the literature on this issue allowed us to establish a thematic connection between consistent theoretical studies and practical results tested on industrial production lines. At the junction of various studies in related fields and the economic feasibility of using authentic combinations of components based on the properties and distinctive features of ingredients in food systems, which ultimately leads to obtaining a masterpiece, a synergistic effect of taste, consistency or structure [2].

Research conducted by Yu. Gronov (1997) [3] shows the formation of opinions about the quality of food, its merits and food culture. The publications of Theil and Hennion [4-6], and then J. Gronow, describe and analyze in more detail the development of social processes and judgments about basic categories and the role of the association of tasters in developing the theory of public opinion about food and its benefits [8-10]. Schulze G. (1992) examines the emotional side of a person and his disposition to the process of nutrition and digestion, the education of citizens, the role of food and its physiological significance. Schulze G. concludes that taste sensations are individual for each person and bring personal pleasure [7,8]. Tasting assessments are subjective.

Of course, the psychological attitude of those eating is very important for the absorption of food [9-12]. Physiologists have repeatedly stated this. Therefore, it is necessary to cultivate taste in consumers and to enjoy eating food. The main role in this is given to HoReCa specialists. Formation of the taste range of innovative food products and development of

the methodology for creating public opinion about the nutritional benefits and the need to produce new generation structured meat products is very important during the period of sanctions and import substitution. This issue is especially acute with regard to meat products. More than half of citizens both in our country and abroad give taste preferences to meat dishes. The development of this direction will maximally meet the preferences of consumers and is relevant.

2 Objects and methods of research

The aim of the work is to develop advanced technologies for minced meat products and minced meat from by-products. To achieve the desired result, the structures of meat systems were modeled, consisting of meat, poultry, by-products (chicken or beef liver), vegetable components (onions, carrots, zucchini, cauliflower, spirulina), additional structure formers (wheat flour, wheat bread, eggs), fat-containing additives (raw fat, butter and olive oil, cream, sour cream), liquids (milk, water). The obtained minced meats were used to prepare samples of semi-finished products and culinary products (liver pate with carrots and onions, creamy beef liver pate, tender liver pancakes, beef liver pancakes, liver rolls with filling, liver cutlets, liver soufflé, dietary poultry cutlets, meatballs).

Methods for studying raw materials and semi-finished products: physicochemical, microbiological, statistical. The structure of the minced meats was determined using the "Structurometer ST-1" device, the viscosity of the minced meat was studied on a Brookfield viscometer, the moisture-binding capacity was determined by the pressing method, the moisture-holding capacity by the Grau and Hamm method. Organoleptic assessment of meat products was carried out according to GOST 9959-2015 using the gravity coefficient. The samples that received high quality and safety indicators were tested.

3 Results

The conducted research is aimed at developing competitive and popular meat-and-vegetable products. In this food segment of food products, the population demand for meat-and-vegetable culinary products made from minced meat, offal and poultry with the addition of zucchini, carrots, onions, cauliflower and spirulina was studied. The developed products are low-calorie and are aimed at replenishing the reserve of dietary products, including baby food. It is known that a seven-month-old child needs more iron than an adult. Babies have high nutritional needs, but at the same time, small children's stomachs, a vulnerable gastrointestinal tract, so every portion of food matters. The production of structured meat dietary products, including offal, is an excellent additional protein food that will provide nutrients for the harmonious growth and development of a child at any age. The compatibility of the components of the recipe is based on the interchangeability of ingredients with pronounced rheological and adhesive properties, which made it possible to obtain a synergistic effect in most minced meat systems. The resulting meat-vegetable compositions are presented in Table1.

Modeling of multicomponent systems allowed us to obtain nine recipes based on meat raw materials: liver (chicken or beef), chicken fillet or meat from 49 to 62%, with a share of vegetable raw materials (carrots, onions) from 7 to 18%. Minced meat with the inclusion of carrots and onions, which make up a large and significant part of the carbohydrate component, has a structuring character. In addition, fresh coarsely chopped onions in combination with connective tissue proteins of meat products participate in the formation of protein-carbohydrate complexes with the redistribution of liquid within the food system. Connective tissue proteins are hydrated and, in the process of denaturation, absorb liquid coming

from the cell walls of the onion parenchymatous tissue destroyed during grinding. Carrots are less subject to such processes, but participate in the creation of the minced meat framework and its stabilization in the finished product after heat treatment.

Table 1. Recipes for meat-vegetable and by-product minced meats for culinary products (net, g)

Name of raw materials	Liver pate with carrots and onions	Creamy beef liver pate	Delicate liver pancakes	Beef liver pancakes	Liver rolls with filling	Liver cutlets	Liver soufflé	Cutlets from poultry	Meatballs
chicken liver	592		500		570				
beef liver		495		626		600	545		
chicken fillet								610	
beef									500
carrots	152	145	100		90	70	182	50	
onions	123	100	80	156		80			23
cauliflower			100				26		15
butter	72	100					18		
olive oil	49								
salt	12	10	12	12	10	10	12	12	12
C1 egg			80	60	80	40	72		
wheat flour			97	78	60				
20% sour cream			31						
20% cream		100							
3.2% fat milk				58	100	70	144	100	
40% fat cheese					90				
bread						80		130	140
zucchini		50		10		50		40	
spirulina							1,0	1,0	
raw fat								20	100
water									210

The second and quite important stage was the development of the recipe and technology for the preparation of minced meat and products based on them, taking into account the nutritional value and structural and mechanical characteristics of the main and additional raw materials, which had different moisture, density and plasticity. When adding juicy vegetables (zucchini and cauliflower) to the minced meat, it is necessary to select the appropriate products whose properties will allow regulating moisture transfer, gelatinization and denaturation of protein and carbohydrate nutrients - the structural building blocks of the food system. To solve this problem, in the technological interpretation, complexes of functional-technological and structural-mechanical indicators are used, which well reflect the quality of the finished minced meat. The moisture-binding capacity of combined meat-vegetable and offal minced meats for culinary products is shown in Fig. 1.

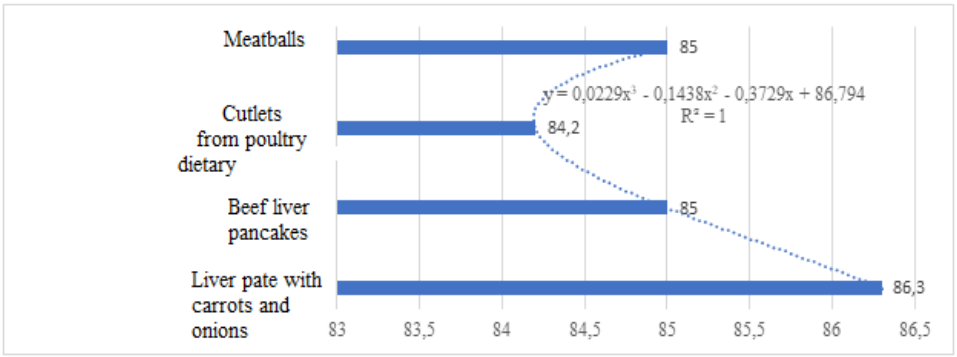

Fig. 1. Moisture-binding capacity of combined meat-vegetable and by-product mince for culinary products

The high content of protein and dietary fiber in meat-vegetable pate with carrots and onions allows to obtain a product with excellent moisture-binding capacity. Since the protein contained in minced chicken cannot hold too much moisture, introduced according to the recipe and together with zucchini and carrots, the VSS system compared to the pate began to decrease (84.2%). The best result of 86.3% was shown by the sample with the addition of relatively equal amounts of carrots and onions, respectively 15 and 12%.

The moisture-holding capacity of meat-vegetable and by-product culinary products is presented in Fig. 2.

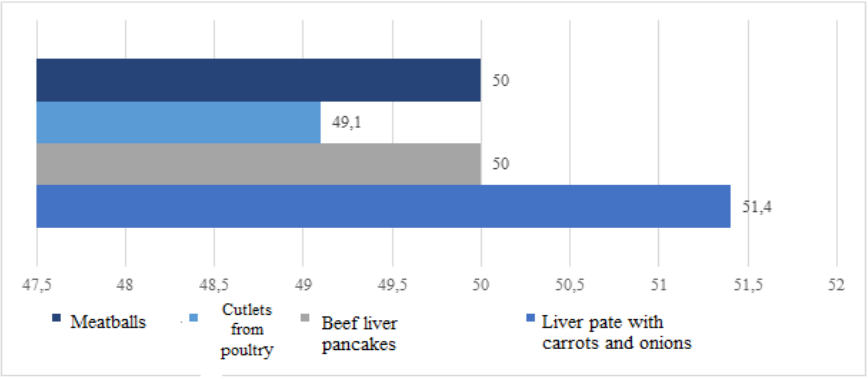

Fig. 2. Water-holding capacity of meat-vegetable and by-product culinary products

All the samples under consideration provide good water-holding capacity of the finished product. The lowest result is shown by the sample of poultry cutlets with the addition of 4% zucchini and 5% carrots. The water-holding capacity of the product is 49.1%. Since minced chicken is quite liquid and the addition of a plant additive with a high water content (93% - zucchini) to it, the food system with these ingredients has a minimum water-holding capacity compared to pate (51.4%), meatballs and pancakes (50%).

Modeling the structure and properties of minced products from meat-vegetable and by-product food systems is not limited to studies of the juiciness and moisture content of minced meats and products made from them. It is also important to regulate the technological modes, the basis of which are time and temperature factors. Delicate liver pancakes are made from chicken liver. It does not have a pronounced taste, but it is very tender and nutritious. In this developed recipe, you can also use other types of liver - turkey, pork or rabbit. There is no need to additionally clean the chicken liver. It is enough to rinse it well and

chop it in a blender. When using pork or beef liver in the recipe, you must first remove the film, cut off the veins and chop it coarsely. To create a delicate structure, it is advisable to soak the beef liver in milk. In this case, you will get an even softer taste and inactivate the bright smell of the liver. It should be noted that for pancakes, chicken liver and vegetables can be chopped in a meat grinder. The pancakes will be no less tasty, but a little more structured.

Liver rolls with cheese filling - a delicate structure and distinct aroma are obtained by adding carrot puree to the liver mince.

A special feature of cooking liver cutlets with zucchini is the stabilization of the structure of the chopped liver by adding chilled zucchini mince. For this, the prepared zucchini was frozen to -4 ° C and chopped in this form and immediately added to the liver mass.

When preparing liver soufflé, as well as pancakes, you can use beef, chicken, turkey, pork or rabbit liver. In addition, instead of carrots, you can take pumpkin. This will help stabilize the structure of the soufflé due to pumpkin pectin, and also enrich the dish with β-carotene. When cooking soufflé with steam or in a convection oven, the soufflé acquires a juicy structure and aromatic taste.

The tastings revealed positive technological methods and rational temperature conditions, allowing to obtain high-quality culinary products. The finished products were distinguished by their homogeneity and balanced taste and aroma.

4 Conclusion

1. Modeling of recipes for pates, pancakes, soufflés, cutlets from meat, poultry, offal and vegetable raw materials has been completed.

2. The quality indicators of the studied samples were established, such as moisture-binding capacity, moisture-holding capacity, and stability of the mincemeat structure. The VSS of the products was 86.3%, and the VUS was 51.4%. The amount of added juicy plant components was selected. The optimal concentration of carrots and onions in the food system is 15 and 12%, respectively.

3. Organoleptic indicators of the developed meat, vegetable and by-product culinary products were determined.

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