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Using of pumpkin and carrot powder in production of meat cutlets: effect on chemical and sensory properties

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ABSTRACT--*In this article,the increase of food value of meat minced half-finished products with addition of vegetable powder is considered. The reasonability of using the powder in the production of minced meat semi-finished products is justified. Adding pumpkin and pumpkin-carrot powder to the recipe of the cutlets increases the content of carbohydrates by 14.4% and 27.8% respectively. The protein content is not significantly changed, while there is a decrease in fat content in cutlets with the addition of vegetable powder. In addition, mass losses during heat treatment are reduced and organoleptic characteristics (juiciness, consistency, smell, taste) are improved.*

Keywords-- *meat half-finished products, pumpkin, carrot, powder, cutlets, mass loss.*

I. INTRODUCTION

The modern concept of nutrition science makes a number of demands on the balance and completeness of food composition. In this regard, an actual direction is the creation and use of biologically complete and balanced food systems that meet the requirements of adequate, rational and therapeutic and preventive nutrition with simultaneous increase in output and improvement of product quality through the optimization of technological processes, identification and use of alternative plant resources [1].

In assortment of products of the meat industry there are few scientifically proved formulas of combined half-finished meat products and meat pates corresponding to physiological norms of a healthy food [2, 3]. The monitoring of nutrition and human health is based on the assessment of diets in terms of completeness, balance, etc. Each person's diet is made up of products purchased on the market or in a network of catering establishments. In this aspect, the relationship between the main elements of the innovative development of the food industry and catering industries should be considered as a fundamental factor in influencing public health [4].

The concept of food production strategy is to find new resources of micronutrients, to use non-traditional raw materials, to create new technologies with improved nutritional and biological value of the product, to ensure its

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specified properties, to increase the shelf life. In this connection, it is actual to develop products with set properties on the basis of bioprotectors of local plant raw materials [5, 6].Bioprotectors are the complex of chemicals with various mechanisms of action, having antioxidant activity, blocking the action of free radicals, activating the human immune system and the protective functions of his body [7].

The pumpkin is a rich source of vitamins and trace elements that have a beneficial effect on the activity of all organs and systems. High fiber content normalizes digestion, and vitamin A (beta-carotene) helps to preserve and restore vision. Potassium, iron, magnesium, phosphorus contained in the pumpkin support normal heart function [8]. The development of products with given characteristics (composition, structural forms, sensory indicators) is carried out in accordance with the principles of food combinatorial.

Pumpkin is an essential dietary product, especially useful for problems with the liver, urinary and gall bladder, gout, colitis and other diseases accompanied by swelling. In terms of carotene content, pumpkin ranks first among vegetables. In the body under the influence of enzymes carotene turns into vitamin A. Carotene provides normal functioning of the mucous membranes of the liverand pancreas. It is recommended for hypertension, ulcers, inflammation of the eyes, lungs, gastritis, allergies [9, 10].

A very valuable quality of the pumpkin is the content of soluble solids. Among the water-soluble vitamins the pumpkin contains: vitamin C (ascorbic acid) - an important component of redox processes in the body, increasing its protective reactions [11], vitamin PP (niacin, nicotinic acid), which regulates digestion, liver function, cholesterol metabolism and the formation of red blood cells [12]. In the regulation of carbohydrate and fat metabolism involves the following vitamins: B1 (thiamine), B2 (riboflavin), B3 (pantothenic acid), H (biotin). Vitamin B4 (choline) is involved in fat metabolism, B_8 (inosit) normalizes metabolism in the nervous tissue, stimulates intestinal activity, reduces the content of cholesterol in the blood [13]. The pumpkin contains a number of micro-and macro elements that regulate the heart, water and salt regime of the human body.

Pumpkin contains dietary fibers - non-digestible in the small intestine non-starch polysaccharides such as cellulose, hemicellulose, pectin, gummy, mucus and non-carbohydrate lignin compound [14]. Foodfibres can adsorb and remove various compounds, including exogenous and endogenous toxins and heavy metals. Lack of dietary fiber in the diet can lead to diseases such as colon cancer and other intestinal tract diseases, atherosclerosis, hypertension, diabetes [15].

In world practice, one of the most common ways to improve the composition of products was to combine raw materials with components of plant and animal origin. The use of powders from plant raw materials has wide potential in production of food products with set of consumers' properties. Plant raw materials are of great value primarily due to specific combinations of biologically and physiologically active components. Such substances are difficult to create artificially, they are well assimilated by human body, have therapeutic and/or preventive effect [16].

Chopped meat semi-finished products are portioned products made from chopped meat raw materials with additives. After the production, the minced meat semi-finished products can be raw, chilled or raw frozen. Non-toxic substances of natural origin can be claimed as bioprotectors. Of great interest in this respect are polyphenol compounds, many of which have P-vitamin activity. The diverse pharmacological activity of phenolic compounds is

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the basis for the development of additives for a given purpose. An important fact is that phenolic compounds are characterized by low toxicity or its complete absence [17].

Creation of functional products is of great social importance as it is related to the protection of human health in regions with unfavorable ecological situation. A special place belongs to food products whose targeted effect is determined by added bio-protectors.

II. MATERIALS AND METHODS

In order to determine the influence of vegetable powders on the quality of half-finished meat products, model versions of cutlets were prepared. The recipes were formulated taking into account the functional, nutritional and technological properties of the plant component separately and a mixture of plant powders that optimally affect the technological, organoleptic and functional properties of the finished product.

The impact of replacing part of the bread with pumpkin and carrot powder and complete exclusion of bread from the recipe with the introduction of vegetable powders were studied. Powders from plant raw materials were introduced in hydrated form in ratio of powder:water = 1:4. Such a degree of hydration of the powder is close to the consistency of minced meat, which promotes better mixing of the components.

Minced meat was made in a meat mixer, where grinded meat, water, salt, vegetable additive (pumpkin and carrot powder), onion, garlic, eggs or melange, bread, pepper were sequentially loaded; mixed for 5-7 minutes until the formation of a bound homogeneous mass; shaped cutlets manually.

Determination of chemical composition

The chemical composition of meatcutlets was analyzed by the methods as described by Amirkhanov et.al. (2017) [18].

Determination of water-binding Capacity

The method used to determine the water-binding capacity (WBC) of the samples is based on exudation of moisture to a filter paper by the application of pressure. The moisture absorbed by the filter paper is evaluated based on the spot area on the filter paper. Specifically, for each sample, 0.3 g of minced meat was placed on a 15-20 mm diameter disk plate on a Mettler Toledo electronic balance, (Mettler Toledo, Switzerland). The meat was then transferred onto an ash-free filter (Munktell Filter AB, Sweden) and placed on a glass or plexiglass plate. The sample was covered with the same filter before a 1 kg load was carefully placed on top of the meat. The weight was left for 10 min. Once removed, the top filter was pulled of and bound water was calculated, as described below (see Equation 1 and 2). The filter was scanned using an Xpress M2070 scanner (SAMSUNG, Japan) after the contour of the wet spot was traced on the filter. The area was calculated using the «Compas-3D V-10» software [19, 20].

$X_1=(A-8,4B)\cdot 100/m_0,$ (1)

$X_2=(A-8,4B)\cdot 100/A;$ (2)

Where

X_1 – bound water content, expressed as % of meat;

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X_2 – bound water content, expressed as % to total water;

B – wet spot area, cm^2;

m_0 – sample weight, mg;

A – total content of moisture in the sample, mg.

Statistical Analysis

The differences between samples were evaluated using ANOVA method. The differences were considered to be statistically significant at $p \leq 0.05$.

III. RESULTS AND DISCUSSION

The results of organoleptic evaluation showed that cutlets with vegetable powder have better color and taste comparing with control samples. Fried taste and smell are characteristic of a fried product with a slight flavour of additive; raw taste and smell are characteristic of benign raw materials. Since the pectin substances present in vegetable powders have a higher moisture retention capacity than starch [21], this allows for a juicier consistency of the product. In the cut section, there are light yellow inclusions when adding pumpkin powder and yellow orange while adding carrot powder. The increase in the proportion of vegetable powders has a slight effect on the intensity of the coloration of the minced meat in the incision.

The following indicators have been determined at the next stage: mass fraction of moisture, fat, proteinand carbohydrates. Physical and chemical indicators of minced meat products with plant powders are presented in Table 1. At comparative estimation of experimental samples with full or partial replacement of bread with vegetable powders it has been established that the optimal, favourable effect on organoleptic indices of the ready product is the full replacement of bread with pumpkin or pumpkin-carrot powder in the amount of 5%: variant 1 - full replacement of bread with pumpkin-carrot powder; 2 - full replacement of bread with pumpkin (2:1) powder.

Table 1: Chemical composition of meat cutlets with vegetable powder, g/100g

Index	Mass fraction		
	Control	Variant 1(with pumpkin-carrot powder)	Variant 2 (with pumpkin powder)
Protein, g/100g	14.6±0.56	14.2±0.40	14.4±0.35
Fat, g/100g	20.6±0.70[a]	18.8±0.46[ab]	18.7±0.40[b]
Carbohydrate, g/100g	9.7±0.27[b]	12.4±0.38[a]	11.1±0.34[ab]

[a]$p \leq 0.05$; [b]$p \leq 0.003$

As can be seen from the data presented, the introduction of vegetable powders into the recipe of minced meat products has no significant impact on the chemical indicators of the quality of cutlets. Thus, the mass fraction of moisture in experimental and control samples is the same. There were no significant changes in the mass fraction of fat and table salt in the experimental products, because the specific weight of these components in the recipe has not

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changed, and in powders these substances were absent. The increase in acidity has little effect on the taste of the product, without worsening it.

The degustation analysis of cutlets after frying with different doses of vegetable additive showed that the best organoleptic indices (total score - 27,5) have cutlets with the content of pumpkin and carrot powder in the amount of 5%.

Table 2: Sensory evaluation of cutlets

Index	Cutlets		
	Control	Variant 1(with pumpkin-carrot powder)	Variant 2 (with pumpkin powder)
Appearance	4,5	4,5	4,5
Color	4,4	4,6	4,5
Flavor	4,5	4,7	4,6
Taste	4,5	4,6	4,6
Consistency	4,4	4,6	4,5
Juiciness	4,3	4,5	4,5
Overall score	26.6	27.5	27.2

The water-binding capacity (WBC) of meat and meat semi-finished products determines the quality of the product during technological and culinary processing. The low water-binding capacity influences the loss of moisture and its soluble substances during culinary processing [22]. The results of mass fraction of moisture, WBC and mass losses during thermal processing in control and prototype samples of minced meat semi-finished products, produced with the use of vegetable powders, are presented in Table 3.

Table 3: Moisturecontent, water-binding capacity and mass losses during thermal processing

Index	Cutlets		
	Control	Variant 1	Variant 2
Mass fraction of moisture, %	65.1±0.74	64.4±0.72	64.6±0.72
Water-binding capacity, %	58.3 ± 0.45^{a}	48.5 ± 0.80^{c}	53.2 ± 0.60^{b}
Mass losses during thermal processing, %	31.8 ± 0.12^{a}	30.5 ± 0.16^{b}	27.8 ± 0.26^{c}

$^{a}p\leq0.0001$; $^{b}p\leq0.003$; ^{c} $p\leq0.005$

The data obtained as a result of determining the total moisture content, water-binding capacity and mass loss during thermal processing, taking into account the storage time, indicate that the pH value increases insignificantly when adding the vegetable powders into the experimental samples of minced meat semi-finished products. Water-binding capacity of control and prototype samples is practically at the same level.

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The positive thing is that in prototypes with the introduction of pumpkin powder there is a reduction in weight loss during thermal treatment. The difference between the control sample and the prototype sample is 2.1%, and in our opinion, this is due to the pectin content of the pumpkin powder. The developed cutlets have high quality and desirable indicators of food and energy value, which is confirmed by complex commodity evaluation.

IV. CONCLUSION

Production of combined meat products on the basis of meat and plant raw materials leads to mutual enrichment of their compositions, combination of functional and technological properties, increase of biological value, improvement of organoleptic characteristics of finished products and decrease in its cost price.

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