А.В. Чижаева – «Астық өнімдері мен мал азығының технологиялары» лабораториясының жетекші ғылыми қызметкері; Қазақ қайта өңдеу және тағам өнеркәсіптері ғылыми зерттеу орталығы, Қазақстан; e-mail: anna_chizhaeva@mail.ru. ORCID:https://orcid.org/0000-0001-6081-0273

М.Ж. Бектурсунова – «Астық өнімдері мен мал азығының технологиялары» лабораториясының жетекші ғылыми қызметкері; Қазақ қайта өңдеу және тағам өнеркәсіптері ғылыми зерттеу орталығы, Қазақстан; e-mail: bek_maya@mail.ru. ORCID: https://orcid.org/ 0000-0002-5105-4864.

Н.З. Оспанов – «Астық өнімдері мен мал азығының технологиялары» лабораториясының ғылыми қызметкері; Қазақ қайта өңдеу және тағам өнеркәсіптері ғылыми зерттеу орталығы, Қазақстан; e-mail: nurospanov.1969@mail.ru. ORCID: https://orcid.org/0000-0002-5031-0029.

Information about the authors

M. Patsaev – researcher of the laboratory "Technologies of grain products and compound feeds"; Kazakh Research Institute of Processing and Food Industry, Republic of Kazakhstan; e-mail: magzam-97@mail.ru. ORCID: https://orcid.org/0000-0003-1071-064X

V. Sidorova – Leading researcher of the laboratory "Technologies of grain products and compound feeds"; Kazakh Research Institute processing and food industry, Republic of Kazakhstan; e-mail: sid-valentina@mail.ru. ORCID: https://orcid.org / 0000-0001-6244-0691.

N. Yanvareva – Leading researcher of the laboratory "Technologies of grain products and compound Feeds"; Kazakh Research Institute of Processing and Food Industry, Republic of Kazakhstan; e-mail: nadya.yanvareva@mail.ru . ORCID: https://orcid.org/0000-0001-8393-7947.

A. Chizhaeva – Leading researcher of the laboratory "Technologies of grain products and compound Feeds"; Kazakh Research Institute processing and food industry, Republic of Kazakhstan; e-mail: anna_chizhaeva@mail.ru. ORCID:https://orcid.org/0000-0001-6081-0273.

M. Bektursunova – Senior researcher at the laboratory "Technologies of Grain products and compound Feeds"; Kazakh Research Institute of Processing and Food Industry, Republic of Kazakhstan; e-mail: bek_maya@mail.ru. ORCID: https://orcid.org / 0000-0002-5105-4864.

N. Ospanov – researcher of the laboratory "Technologies of grain products and compound feeds"; Kazakh Research Institute Institute of Processing and Food Industry, Republic of Kazakhstan; e-mail: nurospanov.1969@mail.ru. ORCID: https://orcid.org/0000-0002-5031-0029.

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A. Kakimov[1], A. Suychinov[2], Zh. Yessimbekov[2], B. Kabdylzhar[2], D. Akimova[1*]

[1]Shakarim University of Semey,
071412, Republic of Kazakhstan, Semey, 20 A Glinka Street
[2]Kazakh Research Institute of Processing and Food Industry (Semey Branch)
071412, Republic of Kazakhstan, Semey, 29 Baitursynov Street
*e-mail: akdilife@mail.ru

STUDY OF CHANGES IN THE WATER-BINDING, WATER-HOLDING AND FAT-HOLDING CAPACITY OF MEAT CUTLETS WITH DIFFERENT CONTENT OF BEEF RUMEN AND BEETROOT

Annotation: *Beef rumen (up to 20%) and beet (up to 30%) were additionally added instead of minced beef in the recipe of meat cutlets. Studies showed that the water-binding capacity in variants 3 and 4 is significantly higher than that of variants 1 and 2 (P<0.05). Indicators of water-holding (WHC) and fat-holding capacity (FHC) in minced meat cutlets without adding rumen and beets were 61.63% and 62.69%, while with adding 20% of the rumen and 20% of beets (Variant 3) these indicators increased to 69.41% (P<0.05) and 66.82%. The pH analysis is characterized by an increase in values when replacing meat with rumen and beets. A significant decrease in the limiting shear stress was observed in variant 4, when 30% of beet and 20% of rumen were added, with the meaning of 442.84 Pa. The most optimal amount of added ingredients is between 10 and 20% of both the rumen and the beets.*

Key words: *moisture; bond; minced systems; rumen; fat holding capacity.*

Introduction

At the processing and manufacture of meat products, a significant role is given to the control of functional-technological, structural-mechanical, and physicochemical indicators of minced meat along with food value and safety of meat and ingredients [1]. The functional and technological indicators express the quality of meat raw materials, define its behavior at processing and storage, providing technological and consumer properties of finished products. In the process of heat treatment, the physical-chemical and colloidal-chemical changes occur, as a result of which the portion of water and fat bound in raw minced meat is separated in the form of mass loss. The amount of water and fat retained in minced meat characterizes its moisture-holding and fat-holding ability [2].

Water-binding capacity (WBC), water-holding capacity (WHC), and fat-holding capacity (FHC) are the most important, functional characteristics that determine the quality of minced meat and determine the organoleptic, structural, and mechanical indicators, as well as the yield of ready products [3]. Water-binding capacity (WBC) characterizes the ability of meat to absorb and retain water in the process of salting and massaging. This phenomenon occurs due to the ability of meat proteins to form hydrate shells, due to retention of water molecules by hydrogen bonds and electrostatic interactions [4].

The water holding capacity (WHC) of meat is the most important indicator for meat products that undergo heat treatment. This indicator shows the ability of minced meat to retain moisture in the heating process, which primarily affects the yield of the finished product. It should be noted that the WHC is associated with the formation of hydrocolloids such as gels [5]. A high role is played by collagen protein, which in the process of heat treatment turns into gelatin, capable of forming a gel. Therefore, the destruction of collagen can harm the level of WHC. The fat retention strength of the meat emulsion is characterized by its fat holding capacity. The degree of change of functional and technological properties depends on the processing intensity of meat (fine grinding, massaging) and ingredients added to the minced meat composition (dietary fibers, emulsifiers, structural agents) [6].

As components that improve the structural and mechanical characteristics of minced meat can be used isolated animals and plant proteins, gum, carrageenan, other polysaccharides and dietary fiber, antioxidants, and food phosphates. These components may also include food raw materials and non-meat products, such as dried milk whey, and egg products [7, 8].

The purpose of this work is to study the changes in the water-binding, water-holding, and fat-holding capacity and pH of meat cutlets with the addition of different amounts of beef rumen and beetroot.

Materials and Methods

Beef, beef rumen and table beet were purchased from the specialized meat and vegetable department of the market in Semey city, Kazakhstan.

The meat of the back and loin carcass of cattle is washed and chopped on a meat grinder. At the same time, the rumen is cleaned, blanched, and cut into small pieces for grinding on a meat grinder. The table beetroot is boiled for 40 minutes and grated. Then the ingredients (Table 1) are mixed on a mixing machine adding eggs, vegetable oil, salt, and spices according to the recipe. Then, the cutlets are formed, panned, and cooked at a temperature of 100-110 ° C for 15-20 minutes.

Table 1 – Cutlets formulation, %

Ingredients	Variants of cutlets			
	1	2	3	4
Minced beef	85.00	65.00	45.00	35.00
Beef rumen	0	10.00	20.00	20.00
Beetroot boiled	0.00	10.00	20.00	30.00
Egg	6.00	6.00	6.00	6.00
Vegetable oil	5.00	5.00	5.00	5.00
Bread crumb	3.00	3.00	3.00	3.00
Salt	0.40	0.40	0.40	0.40
Black pepper	0.10	0.10	0.10	0.10

Laboratory Methods

Determination of water binding capacity

It was carried out using by means of pressing. Stuffing weighing 0.3 g was placed on a polythene circle with a diameter of 15-20 mm, then it was transferred to an ashless filter that was placed on a glass or plexiglass plate. The minced meat was covered with the same plate as the lower one. Then the load of 1 kg was loaded on it and kept for 10 minutes. After that, removed the load and the bottom plate. Then outlined the contour of the spot around the compressed meat. The outer contour was drawn when the filter paper dried out in the air. The area of the spots formed by compressed meat and adsorbed moisture was measured with a planimeter. The size of the wet spot (external) was calculated by the difference between the total spot area and the area of the spot formed by the meat. It was determined experimentally that 1 cm^3 of the wet spot area of filtrate corresponds to 8.4 mg of moisture [9].

The mass fraction of bound moisture, % in the sample was calculated by formulas:

$$X_1=(M-8{,}4S)\cdot 100/m_0,$$
$$X_2=(M-8{,}4S)\cdot 100/M,$$

where X_1 – a mass fraction of bound moisture in minced meat, % to meat weight;
X_2 – mass fraction of bound moisture in minced meat, % to total moisture;
M – total moisture mass in minced meat, mg;
S – wet spot area, cm^2;
m_0 – meat weight, mg.

Determination of water holding capacity

When determining the water holding capacity, the sample of thoroughly ground meat weighing 4-6 g was evenly spread with a glass stick on the inner surface of the wide part of the butyrometer. It was tightly closed with a cap and placed narrowly down on a water bath at boiling point for 15 minutes, after which the mass of the released moisture was determined by the number of divisions on the scale of the butyrometer [10]. The calculation was based on formulas:

The water-holdingWater-holding capacity of minced meat (%):

$$WHC = W - WPC,$$

The water-producingWater-producing capacity of minced meat (%):

$$WPC=a\cdot n\cdot m^{-1}\cdot 100,$$

where W – total mass fraction of moisture in a sample of minced meat, %;
a – measuring sensitivity of the butyrometer; a = 0,01 cm3;
n – the number of divisions on the scale of the butyrometer;
m – hinge weight, g.

Determination of fat-holding capacity

To determine the fat holding capacity, the moisture-producing capacity was calculated beforehand, and the weight of minced meat remaining in the fat was measured with an accuracy of ± 0.0001 g. Minced meat was placed in a weighing cup and dried to a constant weight at 150 ºC for 1.5 hours. After drying, a sample weight (2,000±0,0002) g was taken, placed in a porcelain mortar, where 2.5 g of fine calcined sand and 6 g (4.3 cm3) α-monobromonnaphthalene (liquid) were added. All this was thoroughly rubbed for 4 minutes and filtered through a folded paper filter. Then 3-4 drops of the obtained solution were uniformly spread with a glass rod on the lower prism of the refractometer. The prisms were closed and fastened with a screw. The light beam was focused with the help of a mirror on the prism of the refractometer, installing the visual tube so that the crossing threads (aliad) could be clearly visible. The aliad was shifted until the border between the illuminated and dark parts coincided with the point of intersection of the threads, the refractive index of α-monobromonnaphthalene was counted [10, p.26].

The measurement was repeated at least 3 times, using the average data in the calculation.

The fat-holding capacity of meat (%) was calculated using a formula:

$$FHC=g_1\cdot g_2^{-1}$$

where g_1 – a mass fraction of fat in a sample after heat treatment, %;
g_2 – a mass fraction of fat in a sample before heat treatment, %;

Mass fraction of fat in the sample (%):

$$g = \frac{(10^4 \cdot a \cdot (n_1 - n_2)}{m}$$

where α – coefficient characterizing the mass fraction of fat in the solvent, the numerical value of which changes the refractive index by 104%;
n_1; n_2 – indexes of refraction of pure solvent and the tested solution, respectively;
m1 – a mass of 4.3 cm3 α -monobromonaphthalene, g;
m – a mass of the minced meat sample, g.

The coefficient α was determined experimentally by comparing the results of fat mass fraction determination by Soxhlet and refractometric methods. The calculation was made by the formula:

$$a = \frac{g_f}{10^4 \cdot \Delta n}$$

$$g_f = \frac{m \cdot 100}{m_s}$$

where gf – mass fraction of fat in filtrate, %;
Δn – the difference between the values of pure solvent and test filtrate;
m – a mass of fat in the sample, determined in the Soxhlet apparatus, g;
m_s – solvent mass, g.

Determination of pH

The active acidity (pH) was determined by the potentiometric method on the pH-meter-340 device, by immersion of two electrodes into the solution with recording of pH value on the device scale. The solution (water extraction) was prepared from the grinded product with water (in a ratio of 1:10). pH was measured after infusion for 30 minutes at 20 °C [11].

Determination of yield stress

To determine the yield stress of the product we used an automatic universal device "Strucrometer" designed by the research and production company "Radius" of the Russian Federation, corresponding to TU 2011-011-17326295-01, using a computer program package (Structurometer, 2001). For each tested sample 3-4 measurements were taken. The angle value 2α at the tip of the cone, the constant of the cone K (m/kg), the force produced by the device P (g), and the depth of the cone h (m) are recorded [12].

Measurement and calculation of the yield stress.

For each sample, the yield stress θ0 (Pa) values are calculated with a fixed immersion duration by the following formula:

$$\theta_0 = K\frac{m}{h^2}$$

where: К – constant of the cone,
т – the weight of the cone and all movable parts, kg,
h – immersion depth of the cone, m.

Considering that the device "Strucrometer" instead of the mass of the cone and all movable parts gives the value of loading in grams, and the depth of the cone immersion in millimeters, respectively, for the convenience of calculations the formula is converted into the following dependence:

$$\theta_0 = K\frac{P \cdot 9{,}81 \cdot 10^3}{h^2}$$

where: P – a force generated by the device, r.

Accordingly, the constant of the cone with an angle at the apex equal to α is calculated by formula as below:

$$K = \frac{\cos^2\frac{\alpha}{2}}{\pi \cdot \tan\frac{\alpha}{2}}$$

where α – cone angle (α=45° or α=60°).

The average arithmetic value of the yield stress for each of the variants of the investigated samples is determined by the formula:

$$\theta_0 = \frac{\sum \theta_i}{i}$$

where i – number of measurements.

Description of the Experiment

Meat cutlets preparation

The meat of the back and loin carcass of cattle are washed and chopped on a meat grinder. At the same time, the rumen is cleaned, blanched, and cut into small pieces for grinding on a meat grinder. The table beetroot is boiled for 40 minutes and grated. Then the ingredients (Table 1) are mixed on a mixing machine adding eggs, vegetable oil, salt, and spices according to the recipe. Then, the cutlets are formed (Figure 1), panned, and cooked at a temperature of 100 – 110 °C for 15-20 minutes.

Figure 1 – Meat cutlets before cooking

Statistical Analysis

The results of measurements were analyzed using Excel-2007 and Statistica 12 PL software (StatSoft, Inc., Tulsa, OK, USA). The differences between meat samples with different recipes were evaluated using a one-way ANOVA. P-value <0.05 was considered statistically significant.

Results and Discussion

The high nutritional value of collagen-containing by-products, in particular rumen, indicates the possibility of its wider use in the production of meat products. The rumen contains 17.1 g of total protein (which is comparable to 2nd grade beef), 10.5 g of which is collagen. In terms of amino acid composition rumen contains the full set of essential amino acids, but in less quantity than beef of the first grade [13].

In the process of mixing of minced meat the addition of ground beef rumen and table beet leads to changes in the chemical composition and functional and technological characteristics of the minced meat. The specific characteristic of beef rumen is the high content of collagen. The high functional and technological characteristics of collagen provide broad prospects for the development of new technologies to replace the main raw materials and obtain high quality products at the same time [14].

A balanced combination of meat and plant ingredients will allow to obtain meat products with high macro- and micronutrient content for use as the basis for the production of foods for traditional and functional nutrition. Table beet contains dietary fiber, which is able to retain moisture due to the presence of biopolymers. The major part of beet fiber solids are fiber, lignin, pectin and cellulose [15].

In the production of meat products dietary fibers can be used as stabilizing systems to achieve the given rheological and sensory characteristics, increasing the shelf life of the product, improving the biological and nutritional value and therapeutic and prophylactic properties [16, 17].

The chemical composition of variants of cutlets with the addition of rumen and beet varies significantly in carbohydrate and protein contents (Table 2). Thus, because of the high content of carbohydrates in the beet, their quantity in variants 2, 3, and 4 significantly exceeds (P<0.001) the control sample of cutlets. The increase in the proportion of fat is explained by the addition of beef rumen, which contained up to 9% of fat. The content of moisture and ash in different variants of cutlets varies not significantly. One of the most important indicators of raw minced meat is its water-binding capacity (WBC). The WBC of minced meat cutlets in variants 3 and 4 is significantly increased (P<0.05) compared to variants 1 and 2. This trend is caused by an increase in the composition of hydrophilic substances (carbohydrates, dietary fiber, pectin, collagen), which can hold moisture. Moreover, beef provides a high water-binding capacity, contains a large number of pigments, which determines the color of the product [18].

Table 2 – Chemical composition of meat cutlets, %

Variants	Moisture	Protein	Fat	Ash	Carbohydrate
Variant 1	71,63±1,68	17,89±0,58	7,93±0.18	1,20±0.02	1,36±0.02
Variant 2	71,20±1,46	16,35±0,27	8,37±0.27	1,05±0.03	3,03±0.05**
Variant 3	72,09±2,77	14,16±0,42*	8,81±0.13*	1,11±0.02	3,82±0.11**
Variant 4	73,20±2,01	12,50±0,31**	8,57±0.19*	1,12±0.02	4,62±0.11**

*P<0.01; **P<0.001

Water and fat are antagonists, affecting the stability of the minced meat system before and during heat treatment [19]. The increase in water-binding capacity is caused by the content of pectin substances in the beet. Food fibers contained in plant raw materials, have a variety of functions in the human body: mechanical, bind water (swell), sorbing mineral and low-molecular substances, bile acids, absorb toxic substances and remove them from the body, activate the secretory activity of the intestine, prolong the digestive process, leveling the intake of sugar in the blood [20].

In the minced meat composition, the binding water and fat fraction determine the water-holding and fat-holding capacity. Indicators of WHC and FHC also significantly increase in variants 3 and 4 (Table 3, Figure 2).

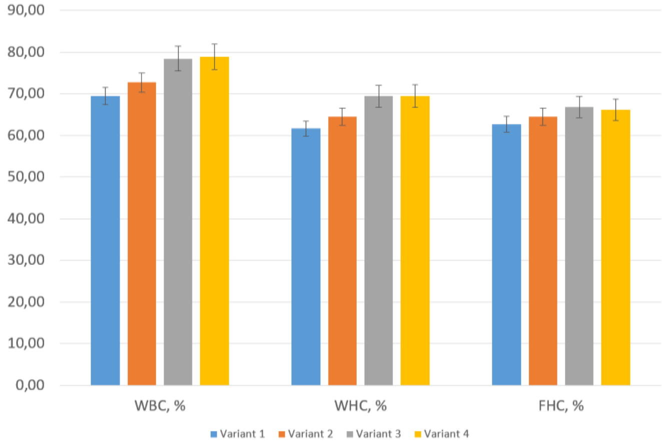

Figure 2 – Water-binding, water-holding and fat-holding capacity of different variants of meat cutlets

Table 3 – Functional and technological properties of meat cutlets

Indicator	Variant 1	Variant 2	Variant 3	Variant 4
WBC, %	69,50±2,18	72,71±1,96	78,43±1,93*	78,88±2,07*
WHC, %	61,63±2.03	64,52±1.52	69,41±2.23*	69,44±1.62**
FHC, %	62,69±1.42	64,41±1.28	66,82±1.62	66,12±1.89

*P<0.05; P<0.01

Thus, if in minced meat cutlets without adding a rumen and beet WHC and FHC were 61.63% and 62.69%, then with the addition of 20% of the rumen and 20% of beet (Variant 3), these indicators rose to 69.41% ($P<0.05$) and 66.82%. However, when adding 30% of the beet and 20% of the rumen in the recipe of minced meat (Variant 4), the WHC and FHC not significantly changed compared to the indicators of Variant 3. The addition of beef rumen and beet significantly increased the pH of meat cutlets in variants 3 and 4 ($P<0.05$) (Figure 3).

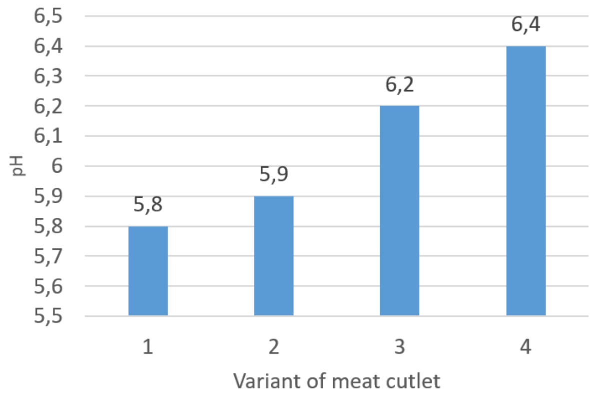

Figure 3 – pH of different variants of meat cutlets

In work [21] it is pointed out that replacing up to 35% of minced pork and beef with a collagen-type additive increases the WHC up to 96.0-99.9%. With the increasing mass content of collagen semi-finished product in model minced meat, the growth of FHC is observed, and substitution of meat for collagen-type additive more specifically affects the increase of FHC of minced meat based on pork.

The work [22] studied the functional and technological properties of cutlets with the addition of topinambur paste to the formulation. The conducted studies showed that the use of topinambur paste in the amount from 10% to 20% improves water-binding capacity. The paste, being mixed in minced meat at the stage of its preparation in the liquid phase, seems to increase the ionic strength of the solution, increases the solubility of protein substances. The concentration of hydrogen ions in muscle tissue determines the water-binding capacity of the meat, affecting the yield of the finished product, weight loss during processing and storage, as well as the stability of the product against the rotten microbes [23].

Minced meat belongs to the plastic-viscous bodies, so its structure and rheological properties are best characterized by the value of the yield stress and plasticity [24]. The structural and mechanical properties of minced meat are strongly influenced by the ratio between water, lipids, and proteins [25].

The yield stress of minced meat cutlets was reduced when the meat was replaced with rumen and beet. In this case, a significant decrease in the yield stress was observed in variant 4 with the addition of 30% beets and 20% of the rumen, the value of which was 442.84 Pa (Figure 4).

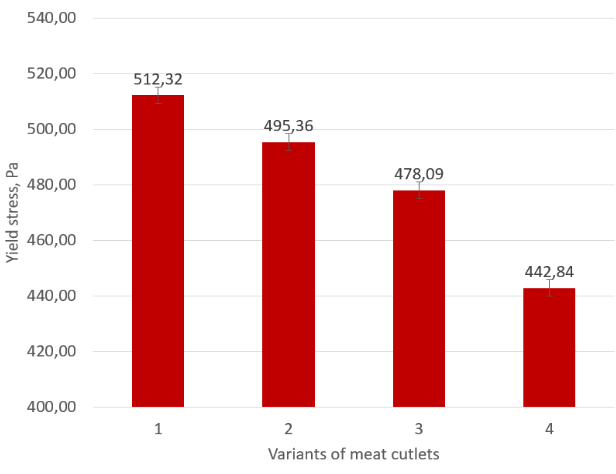

Figure 4 – Yield stress change of minced meat of different variants of meat cutlets

This can be explained by an increase in moisture content in minced meat, which by filling the layers of the structure of minced meat leads to a decrease in shear properties.

Conclusions

The addition of 20% grinded rumen and 30% of beet significantly increases the water-binding, water holding, and fat-holding capacity of meat cutlets. The studies revealed that the addition of up to 10% of the rumen and beet have no significant impact on the functional and technological properties and pH of meat cutlets. A significant reduction of yield stress was recorded in minced meat systems with the content of up to 20% of the beef rumen and 30% of the beet.

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References

1. Gombozhapova N.I., Bazhenova B.A., Leskova S.Y., Badmaeva T.M., Danilov A.M. Influence of the new multicomponent brine on the quality characteristics of the boiled horse meat product / Foods and Raw Materials. – 2017. – № 5(1). – p. 11-19.
2. Yessimbekov Z., Kakimov A., Caporaso N., Suychinov A., Kabdylzhar B., Shariati M.A., Baikadamova A., Domínguez R., Lorenzo J.M. Use of meat-bone paste to develop calcium-enriched liver pâté / Foods. – 2021. – № 10(9). – P. 2042.
3. Rogov I.A., Zharinov A.I., Tekutieva L.A., Shepel T.A. Biotechnology of meat and meat products / Moscow: DeLi Print. – 2009.
4. Serdaroğlu M., Nacak B., Karabıyıkoğlu M., Keser G. Effects of partial beef fat replacement with gelled emulsion on functional and quality properties of model system meat emulsions / Korean journal for food science of animal resources. – 2016. – № 36(6). – p. 744-751.
5. Nesterenko A.A. Technology of fermented sausages using electromagnetic influence on meat and starting cultures / Scientific journal "New Technologies". – 2013. – № 1. – p. 36-39.
6. Goncharov G.I., Strashinsky I.M. Influence of phosphates on functional and technological properties of minced meat / Meat Industry. – 2005. – № 10. – p. 42-43.
7. Normah I., Nur Syuhadah M.Z. Comparative study on the physicochemical characteristics of chicken sausage incorporated with sutchi catfish (Pangasius hypophthalmus) gelatin, carrageenan and pectin / Food Research. – 2019. – № 3(5). – p. 477-483.
8. Ruther B.L., Dickson J.S., Prusa K.J., Tarté R., Sebranek J.G. Effects of processing method and nonmeat binding ingredients on batter stability, yield and texture of frankfurters / Journal of Food Processing and Preservation. – 2020. – № 8(44). – p.14626.
9. Antipova L.V., Glotova I.A., Rogov I.A. Meat and meat products research methods / Moscow: Kolos. – 2001.
10. Salavatulina P.M., Aliev S.A., Lyubchenko V.I. New methods for determination of basic functional properties of minced meat / The USSR meat industry. – 1983. – № 9. – p.26-27.
11. ST RK ISO 2917-2009. 2010. Meat and meat products. Determination of pH. Control method. Astana, Kazakhstan: Gosstandart.
12. Kakimov A., Yessimbekov Z., Bepeyeva A., Kabulov B., Kakimova Z. Consistency cone penetrometry for food products / Pakistan Journal of Nutrition. – 2015. – № 11(14). – p. 837-840.
13. Zinina O., Merenkova S., Tazeddinova D., Rebezov M., Stuart M., Okuskhanova E., Yessimbekov Z., Baryshnikova N. Enrichment of meat products with dietary fibers: A review / Agronomy Research. – 2019. – № 4(17). – p. 1808-1822.
14. Lynch S.A., Mullen A.M., O'Neill E., Drummond L., Álvarez C. Opportunities and perspectives for utilisation of co-products in the meat industry / Meat Science. – 2018. – № 144. – p. 62-73.
15. Rebezov M., Tokhtarov Z., Tretyak L., Kenijz N., Gayvas A., Konovalov S., Rybchenko T., Ermolaev V., Belyakov A. Role of beetroot as a dietary supplement in food products: Review / Plant Cell Biotechnology and Molecular Biology. – 2020. – № 57-58(21). – p. 8-16.
16. Biswas A.K., Kumar V., Bhosle S., Sahoo J., Chatli M.K. Dietary fibers as functional ingredients in meat products and their role in human health / International Journal of Livestock Production, 2011. – № 4(2). – p. 45-54.

17. Bitueva E.B., Biltrikova T.V. Influence of the radish homogenate on the functional and technological properties of model minced meat / Theory and practice of meat processing. – 2016. – № 4(1). – p. 57-64.
18. Mikhaleva E.V., Mikhaleva Yu.A. Modeling of chopped meat using vegetable mixes / Ural Agricultural Bulletin. – 2017. – № 165(11). – p. 32-36.
19. Bao Y., Ertbjerg P. Effects of protein oxidation on the texture and water-holding of meat: a review / Critical reviews in food science and nutrition. – 2019. – № 22(59). – p. 3564-3578.
20. Zhang D., Li H., Emara A.M., Wang Z., Chen X., He Z. Study on the mechanism of KCl replacement of NaCl on the water retention of salted pork / Food Chemistry. – 2020. – № 332. – p. 127414.
21. Patent 2189156 Russia. Method of preparation of minced meat for production of health care and preventive products / L.V. Antipova, I.A. Glotova, A.N. Kuznetsov. – Publ. 20.09.2002.
22. Patent 2502345, Russia. Chopped meat products / T.N. Safronova, L.G. Ermosh, I.P. Berezovikova. – Publ. 27.12.2013.
23. Zuo H., Han L., Yu Q., Niu K., Zhao S., Shi H. Proteome changes on water-holding capacity of yak longissimus lumborum during postmortem aging / Meat science. – 2016. – № 11(121). – p. 409-419.
24. Kabulov B., Mustafayeva A., Kuderinova N., Kassymov S., Khayrullin M., Pavlov A., Ermolaev V., Kuzmina A., Vorobeva A. Effect of mechanical processing of minced meat on the change of yield stress / International Journal of Mechanical and Production Engineering Research and Development. – 2019. – № 5(9). – p. 333-342.
25. Merenkova S., Zinina O., Loretz O., Neverova O., Sharaviev P. Effect of transglutaminase and bacterial concentrates on the development of functional and technological properties of minced meat / Polish Journal of Food and Nutrition Sciences. – 2019. – № 4(69). – p. 387-395.

А.К. Какимов[1], А.К. Суйчинов[2], Ж.С. Есимбеков[2], Б.К. Кабдылжар[2], Д.А. Акимова[1*]
[1]Семей қаласының Шәкәрім атындағы университеті,
071412, Қазақстан Республикасы, Семей қ., Глинки к-сі, 20 А
[2]«Қазақ қайта өңдеу және тағам өнеркәсіптері ғылыми-зерттеу институты» ЖШС,
Семей филиалы
071412, Қазақстан Республикасы, Семей қ., Байтұрсынов көшесі, 29
*e-mail: akdilife@mail.ru

СИЫР ҚАРЫН ЕТІ МЕН ҚЫЗЫЛШАНЫҢ ӘРТҮРЛІ ҚОСПАЛАРЫ ҚОСЫЛҒАН ЕТ КОТЛЕТТЕРІНІҢ ЫЛҒАЛ БАЙЛАНЫСТЫРУ, ЫЛҒАЛ ЖӘНЕ МАЙДЫ ҰСТАУ ҚАБІЛЕТІН ЗЕРТТЕУ

Ет котлеттерінің рецептурасына сиыр еті фаршының орнына қосымша сиыр қарын еті (20% дейін) және қызылша (30% дейін) қосылды. Зерттеулер көрсеткендей, 3 және 4 нұсқалардағы суды байланыстыру қабілетінің 1 және 2 нұсқаларға қарағанда жоғарылығы сенімді (p<0,05). Қарын еті мен қызылшаны қоспай тартылған ет котлеттерінің ылғал ұстау (ЫТҚ) және май ұстау қабілетінің (МТҚ) көрсеткіштері 61,63% және 62,69% құрады, ал 20% қарын еті мен 20% қызылшаны қосқанда (3-нұсқа) бұл көрсеткіштер 69,41% (p<0,05) және 66,82% дейін өсті. pH талдауы қарын еті мен қызылшаға ауыстыру кезінде мәндердің жоғарылауымен сипатталады. Шекті ығысу кернеуінің айтарлықтай төмендеуі 4-нұсқада байқалды, оған 30% қызылша мен 20% ұсақталған ет қосылды, бұл 442,84 Па. Қосылған ингредиенттердің ең оңтайлы мөлшері 10-нан 20% дейінгі қарын еті мен қызылшаны құрайды.

Түйін сөздер: *ылғал; байланыс; фарш жүйелері; қарын еті; майды ұстау.*

А.К. Какимов[1], А.К. Суйчинов[2], Ж.С. Есимбеков[2], Б.К. Кабдылжар[2], Д.А. Акимова[1*]
[1]Университет имени Шакарима города Семей,
071412, Республика Казахстан, г. Семей, ул. Глинки, 20 А
[2]Семейский филиал ТОО «Казахский научно-исследовательский институт перерабатывающей и пищевой промышленности»
071412, Республика Казахстан, Семей, ул. Байтурсынова, 29
*e-mail: akdilife@mail.ru

ИССЛЕДОВАНИЕ ВОДОСВЯЗЫВАЮЩЕЙ, ВОДОУДЕРЖАЮЩЕЙ И ЖИРОУДЕРЖАЮЩЕЙ СПОСОБНОСТИ МЯСНЫХ КОТЛЕТ С РАЗЛИЧНЫМ СОДЕРЖАНИЕМ ГОВЯЖЬЕГО РУБЦА И СВЕКЛЫ

В рецептуру мясных котлет вместо говяжьего фарша дополнительно добавляли говяжий рубец (до 20%) и свеклу (до 30%). Исследования показали, что водосвязывающая способность в вариантах 3 и 4 достоверно выше, чем в вариантах 1 и 2 (P<0,05). Показатели влагоудерживающей (ВЖС) и жироудерживающей способности (ЖЖС) котлет из мясного фарша без добавления рубца и свеклы составили 61,63 % и 62,69 %, а с добавлением 20 % рубца и 20 % свеклы (вариант 3) эти показатели увеличились до 69,41% (P<0,05) и 66,82%. Анализ pH характеризуется увеличением значений при замене мяса рубцом и свеклой. Значительное снижение предельного напряжения сдвига наблюдалось в варианте 4 при добавлении 30 % свеклы и 20 % рубца, что составляет 442,84 Па. Наиболее оптимальное количество добавляемых ингредиентов составляет от 10 до 20 % рубец и свекла.

Ключевые слова: *влага; связь; фаршевые системы; рубец; способность удерживать жир.*

Information about the authors

A. Kakimov – Doctor of Technical Sciences, Professor of the Department of «Technological Equipment and Mechanical Engineering»; Shakarim University of Semey, The Republic of Kazakhstan; e-mail: bibi.53@mail.ru. ORCID: https://orcid.org/0000–0002–9607–1684.

A. Suychinov – PhD, Director of the Kazakh Research Institute of Processing and Food Industry (Semey Branch); e-mail: asuychinov@gmail.com. ORCID: https://orcid.org/0000–0003–4862–3293.

Zh. Yessimbekov – PhD, Project Manager of the Kazakh Research Institute of Processing and Food Industry (Semey Branch); e-mail: ezhanibek@mail.ru. ORCID: https://orcid.org/0000–0002–8556–9954.

B. Kabdylzhar – Researcher of the Kazakh Research Institute of Processing and Food Industry (Semey Branch); e-mail: baktybala.20@mail.ru. ORCID: https://orcid.org/0000–0001–7935–0182.

D. Akimova – doctoral student; Shakarim University of Semey, The Republic of Kazakhstan; e-mail: akdilife@mail.ru.

Авторлар туралы мәліметтер

А.К. Какимов – техника ғылымдарының докторы, «Технологиялық жабдықтар және машинажасау» кафедрасының профессоры; Семей қаласының Шәкәрім атындағы университеті, Қазақстан; e-mail: bibi.53@mail.ru. ORCID: https://orcid.org/0000–0002–9607–1684.

А.К. Суйчинов – PhD докторы, ЖШС Семей филиалы «Қазақ қайта өңдеу және тағам өнеркәсіптері ғылыми-зерттеу институты» директоры; e-mail: asuychinov@gmail.com. ORCID: https://orcid.org/0000–0003–4862–3293.

Ж.С. Есимбеков – PhD докторы, ЖШС Семей филиалы «Қазақ қайта өңдеу және тағам өнеркәсіптері ғылыми-зерттеу институты» жоба жетекшісі; e-mail: ezhanibek@mail.ru. ORCID: https://orcid.org/0000–0002–8556–9954.

Б.К. Кабдылжар – ЖШС Семей филиалы «Қазақ қайта өңдеу және тағам өнеркәсіптері ғылыми-зерттеу институты» ғылыми қызметкері; e-mail: baktybala.20@mail.ru. ORCID: https://orcid.org/0000–0001–7935–0182.

Д.А. Акимова – докторант; Семей қаласының Шәкәрім атындағы университеті, Қазақстан; e-mail: akdilife@mail.ru.

Сведения об авторах

А.К. Какимов – доктор технических наук, профессор кафедры «Технологическое оборудование и машиностроение»; Университет имени Шакарима города Семей, Республика Казахстан; e-mail: bibi.53@mail.ru. ORCID: https://orcid.org/0000–0002–9607–1684.

А.К. Суйчинов – доктор PhD, директор СФ ТОО «Казахский научно-исследовательский институт перерабатывающей и пищевой промышленности»; e-mail: asuychinov@gmail.com. ORCID: https://orcid.org/0000–0003–4862–3293.

Ж.С. Есимбеков – доктор PhD, руководитель проекта СФ ТОО «Казахский научно-исследовательский институт перерабатывающей и пищевой промышленности»; e-mail: ezhanibek@mail.ru. ORCID: https://orcid.org/0000–0002–8556–9954.

Б.К. Кабдылжар – научный сотрудник СФ ТОО «Казахский научно-исследовательский институт перерабатывающей и пищевой промышленности»; e-mail: baktybala.20@mail.ru. ORCID: https://orcid.org/0000–0001–7935–0182.

Д.А. Акимова – докторант; Университет имени Шакарима города Семей, Республика Казахстан; e-mail: akdilife@mail.ru.

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Ж. Серғалиқызы*, Н.С. Мамытова

әл-Фараби атындағы Қазақ Ұлттық университеті,
050040, Қазақстан Республикасы, Алматы қ., әл-Фараби даңғылы, 71
*e-mail: zhansayasss1@gmail.com

БИДАЙ ДӘНДЕРІНДЕГІ АМИЛАЗА ЖӘНЕ СУБТИЛИЗИН ИНГИБИТОРЛАРЫНЫҢ БЕЛСЕНДІЛІКТЕРІН АНЫҚТАУ

Аңдатпа: *Бұл мақалада тыныштық күйдегі бидай дәндерінің өскіндеріндегі амилаза ингибиторының белсенділігі және әртүрлі бидай сорттарындағы субтилизин ингибиторының сандық құрамының айырмашылығы қарастырылады. Зерттеу жұмысы осы тақырып аясындағы отандық және шетелдік мақалаларды негізге ала отырып жасалды. Дәнді дақылдардың дәндері протеазалар мен амилазалардың әртүрлі белоктық ингибиторларын синтездеп, жинақтауға қабілеті бар. Ингибиторлар фитопатогендердің өсімдікке зиян тигізуін алдын алудың тиімді механизмі болып табылады, себебі ингибитордың фитопатоген гидролазаларының белсенділігін тежей алу қасиеті бар. Патоген микроорганизмнің ферментін инактивирлеу арқылы өсімдіктің тұрақтылығын және төзімділік қасиеттерін жоғарылатуға мүмкіндік береді. Ингибиторлар негізінен өсімдіктің зақымдану кезінде және патогендер мен жәндіктерге қарсы тұра алатын функциясы бар екені анықталған. Қазіргі уақытта серинді протеиназалардың ингибиторлары тереңірек зерттелген болып саналады. Амилаза ингибиторлары жөнінде салыстырмалы түрде ақпарат азырақ. Және зерттеушілердің өте үлкен қызығушылығын туғызған ол-бифункиционалды ингибитор. Яғни бір-біріне байланысы жоқ өскіндердегі α-амилазаны және серинді протеаза субтилизинді ингибиторлауға қасиеті бар. Ингибитордың зерттеудің қызығушылығы артудың басты мәселесі оларды ауру қоздырғыштары мен зиянкес жәндіктерге қарсы күрес кезінде пайдалану және патогендерге төзімділік қасиеті артқан трансгенді өсімдіктерді алу.*

Түйін сөздер: *ингибитор, бифункционалды ингибитор, амилаза,субтилизин, патоген, бидай.*

Кіріспе

Дәнді дақылдарда белоктық табиғаты бар әртүрлі ингибиторлар болады. Олардың көбісі бактериялардың, жәндіктердің және сүтқоректілердің экзогенді α-амилазаларына қарсы белсенділік танытады. Ингибиторлар тобын өсімдіктің қорғаныш функциясын атқаратын компоненттер қатарына жатқызады [1].