ISSN: 0975-8585

Research Journal of Pharmaceutical, Biological and Chemical Sciences

The Effect Of Aging On The Nutritional Value And Sensory Properties Of Marble Beef.

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ABSTRACT

In the human diet, meat as a food product is central due to its unique composition and nutritional properties. The process of refrigeration aging of marbled beef as raw material for the subsequent production of high-quality food products has been studied. The quantitative composition and ratio of volatile components in the gas phase of beef samples for 5, 15 and 26 days of autolysis was established and it was shown that the process of low temperature aging of meat raw materials is accompanied by a change in the chemical composition of beef. More than 250 aroma compounds have been identified and it has been shown that the main components forming the flavor-aromatic range of food products based on beef are fatty acid derivatives and acetals of animal origin. According to the data of electronic nanosensorics, descriptors of taste and smell of marbled beef are established during the aging of raw materials, in particular, taste and smell identical to beef, offal odor and taste, cardboard taste and smell, metallic taste, bitter, salty, sour taste, juiciness. The revealed descriptors of the sensory properties of beef allow further development of programs for the technological preparation of meat raw materials for obtaining high-quality food products with specified flavor and aromatic characteristics.

Keywords: beef, marbling, aging, nutritional value, sensory properties

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ISSN: 0975-8585

INTRODUCTION

In Russia, according to Rosstat (Russian Federal State Statistics Service) consumption of meat and meat products per capita in 2016 amounted to 73.1 kg, including 44% of birds, 33% of pork, 18% - beef, lamb 3%. Beef is an important type of meat in the human diet. In terms of chemical composition, structure and properties, it fully meets the human body needs protein diet. However, the level of consumption of beef is still insufficiently high, and is about 14 kg / person per year at a rate of 21 kg / person [1], [2].

Food or nutritional beef value is determined not only by the content of biologically important constituent components, but also by the availability of these components to the action of the enzymes of the gastrointestinal tract's ability to absorb and satisfy certain physiological needs of the body, which in turn depend on the terms and conditions of its aging – soaking process materials in post-mortem period [3].

According to classical ideas, aging processes conventionally divided into three major phases: rigor mortis, softening or aging proper and deep autolysis [4].

Aged meat characterized by gradual softening and, more importantly, the expression of flavoring and aromatic substances. Meat becomes delicate texture and juiciness. During cooking, a clear broth with a specific pleasant taste and aroma, well-chewed meat and easy to digest. Meat becomes gentle by decay actomyosin complex on actin and myosin, wherein the activated proteolytic enzymes internal cathepsins which provide partial proteolysis of proteins, especially myosin, thereby increasing the amount of carboxyl groups in the protein molecule, binding potassium. Proteins take on a lot of positive charges, which increases their hydration and softness. In addition, under the influence of cathepsins, a partial proteolysis of collagen and elastin intramuscular connective tissue to form soluble degradation products. As a result of these changes is improved meat cooking property. Increase meat tenderness and hydrophilicity promotes proteins also increase the free calcium content in muscle [5], [6], [7]. Increasing meat water binding capacity during aging reduces weight loss during cooking. Histological changes in muscle tissue at this stage of aging are presented with swelling and loosening of muscle fibers. Aromatic and sensory properties of meat formed by the accumulation of non-protein products autolytic decay of volatile substances carboxyl compounds, nucleoproteins cleavage, proteolysis of proteins and polypeptides decay. In the meat increases the content of free amino acids, inosinic acid, hypoxanthine, fatty acids and other substances present in small concentrations. [8]. Meat color during aginghas not significantly changed.

Aging is essential in the preparation of meat for culinary use, not only in terms of the formation of its sensory qualities, but also to ensure the safety position for consumers that can be achieved by compliance with strictly defined conditions [4-9].

In accordance with conventional representations beef halves deemed ripe for functional-technological properties for processing after 5-7 days of storage at a temperature of from 0 to +2 °C. At this point, the development of autolysis results in significant positive changes in the quality of meat - there is a noticeable reduction in stiffness, improved aroma and taste [10].Aging can last long enough, depending on the desired degree of severity of sensory characteristics. For example, several studies have shown that beef aging is advantageously carried out for 10-14 days, to achieve higher flavoring characteristics, while not mentioned thus further improving them [11].

Beef aging processes, taking into account modern ecology, widely studied around the world. Consumers, who prefer beef to other meats, want to get not just beef and the refined product with a more pronounced taste and flavor [12].

A distinctive feature of the present stage of aging of meat of research is to study not only the structural and mechanical properties (shear force), and a deep study of the composition of volatile substances and flavor culinary cooked meat by gas chromatography [12-14]. Most studies focused on the study of changes of muscle tissue proteins, some work directed to the study of adipose tissue lipids which are required for a complete balanced human nutrition.

Currently there are various methods of aging - wet (packed), dry (unpacked), on the shelves and suspension, in cold rooms and in refrigeration cabinets, in half carcasses, quarters, primal cuts. Dry aging is

usually carried out at a temperature of 0-4 °C and relative humidity above 75%, wet aging - at a temperature of 0-4 °C and the relative humidity is not critical, since the contact air expelled by the product packaging. In the works, submitted in 63th International Congress under nutrition, discussed the options for the duration of aging. A long period of aging is a complex biochemical process, problems which in recent years has caused a new phase of research in connection with the development of trade beef subjected to prolonged (up to 90 days) exposure from the time of slaughter to the point of sale in retail outlets or consumption in a restaurant as a premium product.

Considered variants of high quality beef aging– meat is obtained from animals specialized cattle breeds that were fattening on the grain, and also with respect to certain parts of carcasses - spinal and hip were noted following aging time: min - 21 hours [15], [16]; max - 90 days [17].

Aged beef should be performed with the deletion of the risks associated with the hazards of microbiological nature: for the first method - by limiting the formation of humidity and dried up the surface layer of meat of substantial thickness; for the second process - due to the vacuum, preventing the development of aerobic microflora [18].

Dry beef aging is usually conducted under production conditions in cold stores. By the end of aging meat may be sent to the distribution network, where it continues to be stored in similar conditions in special refrigerated cabinets. However, such cabinets can be meat and throughout the aging period. It should be noted that, despite the fact that the cabinets are popular, including in Russia, in a paper published in the 63th International Congress, this equipment has not been used.

The disadvantages of dry aging include: high level of mass loss of meat - about 1% per day, generally up to 30% of the original weight; stock thick crust surface drying, gives the product an unattractive appearance for the consumer (before implementing this layer is cut by increasing the mass loss by an average of 5%); microbiological risks are high, as the temperature and humidity conditions are suitable for the development of many bacteria, fungi and molds.

Microbiological risks are reduced while using beef fat with uniform watering and high-intermuscular and intramuscular fat. In addition, beef marbling provides consistent and marked formation of flavor during aging [17-20].

The advantages of dry aging also include a high concentration of flavoring and aroma-producing substances which accumulate as a result of the activity of tissue enzymes and under the influence of atmospheric oxygen (oxidation processes). Thus, dry aging process is more expensive, but allows obtaining a product of a higher sensory quality [16].

Control of dry aging parameters is extremely important for the production of excellent quality meat. Most full effect of these parameters was presented in Korean papers scientists performed on beef obtained from local breed animals Hanwoo [16].

The advantages of wet aging include: high hygiene and low microbiological risks; high speed aging in vacuum compared with dry aging; more delicate texture due to the high moisture content; the almost complete absence of losses; the absence of oxidized notes in flavor and aroma.

Among the shortcomings method include: less pronounced specific taste and aroma; increased consumption of packaging materials (if meat is repacked before implementation). In addition, the consumer often less satisfied wet aging beef quality compared to dry. It is known that the value of pH has a great influence on the sensory properties, since this indicator is associated with color, taste, tenderness and product stability when stored [19-22].

Considering that in recent years the market for high-quality beef of Russian production has increased significantly, primarily due to the large, vertically integrated holdings, and change the culture of meat consumption, conducting research on the nutritional value and sensory properties of beef of different periods and methods of aging becomes very important.

Comparison of modes and methods of aging, using modern methods of analysis is an important area of researches for the maximum satisfaction of consumers' demand for high quality food.

The purpose of this study was to examine the quantitative and qualitative changes of muscle proteins, fatty acids biochemical transformation, sensory properties during beefaging.

MATERIALS AND METHODS

The study was carried out on beef cuts, obtained by cutting the carcasses of Black Angus young cattle at the age of 18 months, receiving high carbohydrate cereal diet for 200 days before slaughter. Slaughtering and primary processing of animals and butchering were carried out under the conditions of LLC "Bryansk Meat Company", Bryansk region, Russia.

24 hours after the slaughter of the spinal lumbar cut isolated dorsal portion of bone. Each sample was divided into three parts, for transportation and vacuum packing. The weight of each specimen was at least 3-4 kg.

Aging process was carried out in specialized cabinet DryAger DX 1000. Humidity level was regulated Humi Control microclimate regulated DX Air Reg system. To protect the contents of the cabinet from harmful ultraviolet radiation from the stainless steel door had a box of specially tinted glass.

Samples for the experiment were performed at 5, 16 and 25 days of aging. Cuts Cutting carcasses was performed according to the standard procedure according to GOST 31797-2012 "Meat. Beef Cutting on cuts. Specifications. " The boundaries separating cut spinal: Front - between the sixth and seventh thoracic vertebrae and the corresponding parts of the ribs; Back - breast between the last (13th) and the first lumbar vertebra at the posterior edge of the 13th rib; lower - parallel to the spine at a distance of no more than 75 mm from the vertebral bodies. Before laying beef in the cupboard for a long aging packaging removed. Cuts of beef were placed on the shelves of the cabinet. For studies of spinal cord cut isolated long muscles of the back (L. dorsi).

To identify the fatty acid derivatives were used solutions of standard mixtures of methyl esters of C4 to C24 fatty acid in methanol № 47885U Supelco, the mass concentration of 10 mg / ml: butyric, caproic, caprylic, capric, decenoic, undecylenic, lauric, tridecanoic, myristic, myristoleic, pentadecanoic cis-10-pentadetsenovoy, palmitic, palmitoleic, margaric, geptadetsenovoy, stearic, oleic, elaidic, linoleic, gamma-linolenic, alpha-linolenic, nondekanovoy, arachic, gadoleic, cis-11,14-eicosene diene, cis-8,11,14-eykozatrienovoy, cis-11,14,17-eykozatrienovoy, arachidonic, eicosapentaenoic, heneicosanoic, behenic, erucic, cis-13,16-dokozadienovoy, clupanodonic, docosahexaenoic, trikozanovoy, lignoceric, nervonovoy, as well as individual standard:

We are using the following reagents: potassium hydroxide, methanol for HPLC hexane HPLC, sodium chloride (Serva, FRG), acetyl chloride (Fluca, Switzerland).

Composition aroma components was determined on a gas chromatograph HP 7890A Agilent Technologies (USA) with a capillary column HP-5MS diameter 0.25 mm, length 30 m, with the thickness of the stationary phase layer with 0.25 micron c mass selective detector (MSD) 5975C VLMSD Agilent Technologies (USA), as well as for the analysis of basic fatty acids with a capillary column HP-Innowax 30mx0,32mmx0,5mkm with flame ionization (FID) detectors [23].

A weighed sample of 1 g of the sample was treated for 8 hours with a mixture of 12 ml of chloroform and 10 ml of methanol in the presence of 1% KCl solution to dissolve the chemical components, the extract was filtered through paper. 1 ml of extract containing about 0.1 g dry residue was mixed with 5 ml of a 15% solution of acetyl chloride in methanol was heated for 2 hours at 100C in a hermetically sealed glass ampule in an atmosphere of Ar and neutralized by addition of us. solution of KOH in CH3OH solution to pH 5.0-6.0. To the mixture was added 3 ml of sat. aqueous solution of NaCl and 6 ml of hexane, allowed to stand for 30 minutes and collected for analysis 0.5 ml of the clear hexane layer containing the methylated and unmethylated form of analytes. Conditions of chromatography on a capillary column HP-5MS: carrier gas - He, flow rate 1 ml / minute; injector temperature mode splitless 250 ° C, initial column oven temperature of 100 ° C for 2 min,

programmed heating from 100 ° C to 290 ° C at 20 ° C / min, isotherm at 290 ° C and 25 min The time component analysis 25 min, injected sample volume is automatically 1 mm. Identification Parameters: ion source temperature 230 ° C, the quadrupole temperature of 150 ° C, electron energy 70 eV, detection in the full scan mode in the mass range of the mass range 33-1050 amu

To calculate the content of the substances used to automatically search database and identification data chromatography-mass spectrometry NIST08 MS Library c probability of correlation peaks greater than 80%. The results of determination were processed using the methods of mathematical statistics.

To carry out sensory research samples were taken from each test cut. Appearance and color of the samples was determined by visual inspection. The type and color on the cut muscle consistency and evaluated in the deep layers of muscle in fresh meat section. Smell sensory adjusted surface and deep layers of the test sample.

To determine the transparency and broth flavor Each sample was separately passed through a grinder diameter grating holes 2 mm, 20 g of the minced meat was weighed on a laboratory balance and placed in a conical flask of 100 cm3 60 cm3 filled with distilled water, thoroughly stirred, capped with a watch glass and placed in a boiling water bath. Smell broth was determined during heating to 80-85 ° C at the time the vapor emerging from the half-open flask. To determine transparency of 20 cm3 broth was poured in a measuring cylinder capacity of 25 cm3 having a diameter of 20 mm and adjusted its degree of transparency.

Sensory evaluation was conducted of meat before and after heat treatment. Simultaneously with the evaluation of cooked meat broth was determined quality.

The heat treatment was carried out as follows: meat weighing approximately 1 kg of boiled water in a ratio of meat and 3: 1 for 1.0 h until the temperature in the center piece of 75 ° C. For 30 minutes before end of cooking added common salt in an amount of 1% by weight of meat. Meat broth is assessed profile-descriptor method and a 9-point scale for the following parameters: appearance, smell (aroma), taste, texture, juiciness (meat) and the appearance, color, smell (aroma), taste and richness (for broth).

Instrumental investigations freshness and definition of beef flavor during aging was carried out using a multisensor system "electronic nose» («VOCmeter», Germany) according to the method developed and approved in FGBNU "VNIIMP them. VM Gorbatova "[25].

The essence of the method is the multi-sensor analysis "electronic nose" multitouch capability sensor device to capture evolved on heating the sample volatiles meat surface. When passing the test mixture the volatile components of the sensor surface occurring in the sensitive zone physicochemical changes via the inverter are converted into an electronic signal that is transmitted to the computer.

"Electronic nose" to determine the freshness of meat used testimony MOS1-MOS4 sensor device. The received signals of sensors are transmitted to a personal computer and recorded in the form of graphs in «Argus» a computer program. "Electronic nose" treated by the method of principal components using «Argus» computer program for qualitative and quantitative measurement of the volatile components of the analytical gas received signals from each of sensors MOS1-MOS4 device. The principal component is based on the construction of factors - the main components, each of which is a linear combination of the original features. The first major component FC1 determines a direction in space initial attributes by which a set of objects (points) has the greatest variation (variance). The second major component PC2 is constructed in such a way, that its direction is orthogonal to the direction PC1 and is explained as much of the residual dispersion. Since the release of the principal component occurs in the descending order in terms of the proportion of the explained variance, the symptoms included in the first principal component with large coefficients have the greatest impact on the differentiation of the objects under study.

When processing method of principal components obtained readings of sensors calibration curves were constructed, allowing to identify the category of fresh meat raw materials [24-26].

ISSN: 0975-8585

Indication of the category of raw freshness are cluster boundaries established by using standard samples. A feature of this method is the low limit of detection of the volatile components characterizing the particular meat odor during aging.

Ingredients Meat volatile components determined by gas chromatograph HP 7890, detection is performed using MSD 5975 C with software MSD Productivity Chem Station mass selective detector.

Sensory research was conducted on fresh beef Russian standard, preparation of samples for sensory studies and determination of the quality level of samples after cooking was evaluated by 9-ball scale according to Russian standard.

RESULTS AND DISCUSSION

Spent multi analysis beef samples at different stages of autolysis method using electronic nanosensory showed that qualitative content of the volatile components, causing the aroma of raw meat is different, as shown by the square profile and "visual imprints". The resulting multi-touch method data correlated with the results of gas chromatography-mass spectrometry.

Change profile raw meat odor due to the accumulation aromatic substances during aging due to degradation of protein compounds under the action of its own enzymes muscle, oxidation of fats and proteins, leading to accumulation of volatile aromatic active compounds. Odor intensity of samples for 16 days and 25 days of aging, respectively increased by 1.4 and 1.8-fold compared to the original, as indicated by area "visual fingerprint" (Table 1).

Table 1 - Areas "visual imprints" the smell of raw meat during aging

Aging, days	Square "visual imprints", cond. u · 107
5	28.53
16	39.69
25	52,20

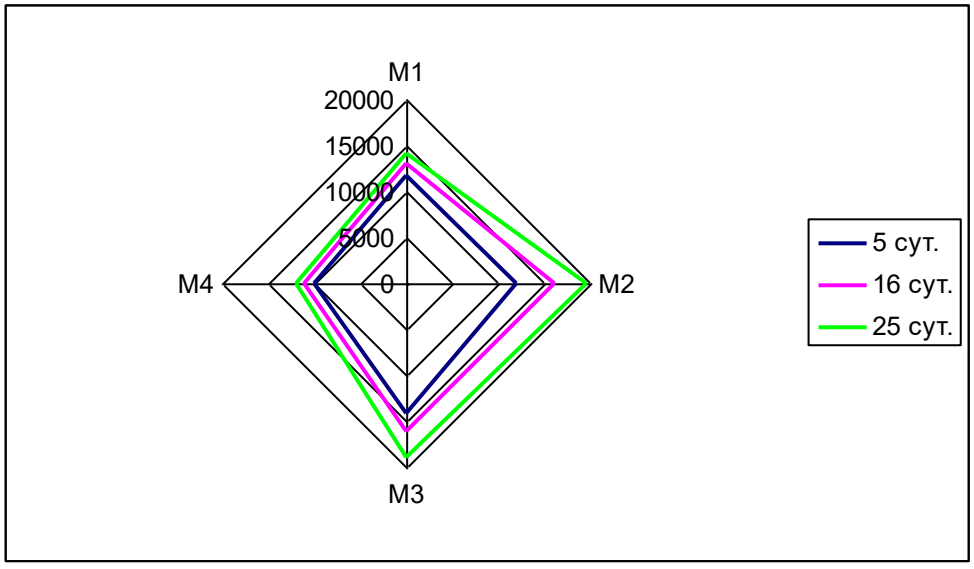

Figure 1 - "Visual prints" smell of samples of raw meat during aging

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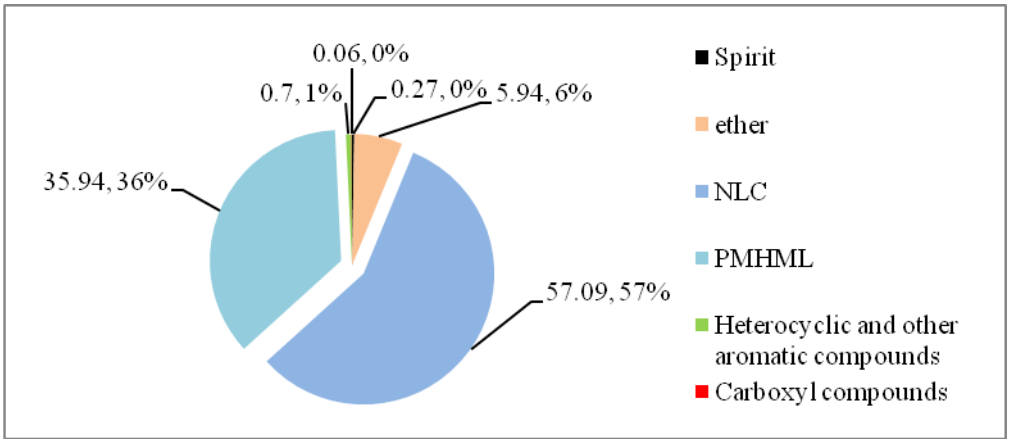


Figure 2 - The qualitative composition and ratio of volatile components in the gas phase of beef samples on the 5th day of autolysis (NLC - saturated, P and MFA - poly- and monounsaturated fatty acids)

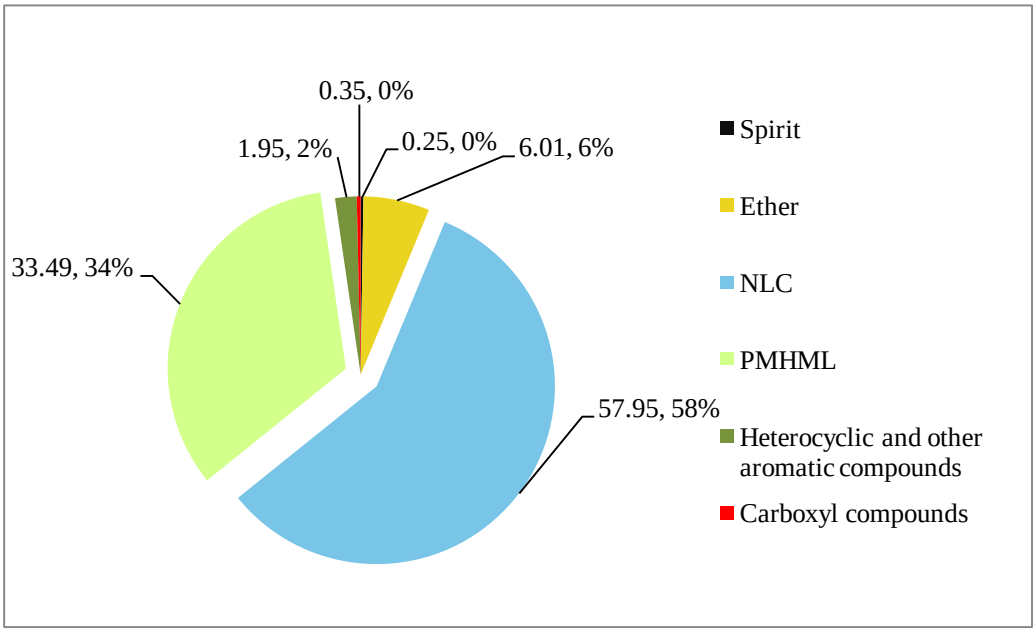


Figure 3 - The qualitative composition and ratio of volatile components in the gas phase of beef samples on the 16th day of autolysis

The data obtained chromato-mass spectrometric investigations have shown that the beef flavor due to the content of the gas mixture more than 200 volatile compounds comprising different groups of chemicals (Figures 2, 3). The qualitative composition of the gas phase characterized by the presence of beef of volatile fatty acids with chain length C8-C12 - octanoic, metildekanovoy, pelargonic, metildodekanovoy acids and others, as well as limiting the carboxylic acidity of lactic, butyric, propionic, possessing a pronounced odor resulting from oxidation unsaturated higher acids in the post-mortem period. A significant contribution to the formation of the characteristic odor of beef making aromatic heterocyclic compounds, aldehydes and ketones,

For example, if on day 5 in the gas phase of autolysis samples revealed the presence of characteristic aldehydes - 2-hexanal, 2-nonenal, sensorially perceived as "fresh, greasy, sweet" flavor and ketone - 2,5-dihydro-5propi- 2 (3H) -furanone and the alcohol 1-octanol, which imparts "a sweet, roasted," "oily penetrating, waxy" hue flavor of meat, then to 16 days of storage contents of these volatile components decreases.

Simultaneously increasing aldehyde content - propenal and nonenal, whose presence in the gas phase is added to the beef flavor notes meat "sweet, boiled, bouillon hue" and "sweet, greasy, fresh".

It is found that the flavor of the meat by increasing its shelf life up to 25 days is enhanced due to the morehigh in most aromatic compounds, including volatile fatty acids having lower thresholds for odor, and greater reactivity. The amount of unsaturated hydrocarbons, carboxylic and heterocyclic compounds increased over this period by 9.9%, respectively, 73.5% and 85.7%. The composition of the gas phase meat at these stages of aging contained pelargonic, capric and butyric acids, esters of caprylic and valeric acids, free amino acids, thiazoles and imidazoles. Educationsubstances belonging to condensed heterocyclic compounds associated with the interaction of aldehydes, alcohols, ketones intermediates rearrangement products of sugars, amino acids, indicating activation of oxidation of long chain fatty acids. Contribute to the formation of meat flavor for 25 hours autolysis makes benzothiazol imparting flavor meat "metallic" color and hydrocarbon pentane perceived as "very light, oxidized". Thus, a long period of storage may adversely affect the taste and smell of the meat after cooking, by reducing the chemical compounds providing positive aromatic notes meat raw material.

Sensory assessment of beef samples after heat treatment (boiling) is conducted at each stage of aging.

Analysis of the data showed that the sample of cooked meat after 5 days of storage has received a maximum score for all indicators, the overall evaluation was also 9 points that correspond to the excellent quality of the product. The sample was characterized by a very delicate texture, very nice strong flavor, juiciness. Bouillon also received the highest score of 9 points on the sensory characteristics assessed as very tasty, very nourishing, very nice strong flavor.

After 16 hours aging beef tasters there was a slight decrease in the quality of the product in terms of "texture" and "juiciness" total score was 8 points (very good). The consistency of the cooked meat sample differed from previous lower juiciness and tenderness evaluated by 7 points (sufficiently juicy) and 8 points (gentle). It should be noted that the reduction of quality broth was noted. Total sensory evaluation broth was 9 points (excellent).

Longer aging of beef up to 25 days resulted in a further reduction in the sensory characteristics of cooked meat. Tasters noted a lack of juiciness and over-sample "crumbiness" meat during chewing. As a result, the total score was 7 points (good), while the indicator "juiciness" product was evaluated by 6 points. At the same time the broth was characterized by high sensory properties, the overall evaluation was 9 points, which corresponds to excellent quality.

Since the sensory evaluation results using ball-method does not allow you to fully describe and evaluate all aspects of sensory perception, profile-descriptor analysis method was used. For this purpose, according to standard procedures was developed dictionary, which allows every step to identify descriptors describing integrally taste, smell and texture samples based on raw materials of animal (beef). The number of detected basic sensory descriptors was reduced by statistical processing. Examples of individual descriptors with established definitions are presented in Table. 2.

Table 2 - Examples of individual descriptors of beef sensory properties

Descriptors taste and smell	Determination descriptor sensory properties of the product
Taste and smell identical beef	The identity of the aroma and taste of beef in the sample
By-product smell and taste	Perception,associated with cooked meat products (Pluck)
Cardboardtaste and smell	Aromatics associated with a slightly oxidized fats and oils, reminiscent of wet cardboard packaging
Metallictaste and smell	Perception slightly oxidized metal, like iron, copper, or silver spoons
Bittertaste	The primary taste associated with caffeine solution
Saltytaste	Basic taste associated with sodium chloride
Sourtaste	Basic taste associated with citric acid
Mellowness	Perception, related to the content in the product of a relatively large amount of moisture present in the bound state.

ISSN: 0975-8585

After the tasting and validation taste panel assessment results, the sensory profiles of the initial sample were constructed for 5, 16 and 25 hours autolysis (Figure 5).

Analysis results describe sensory characteristics of cooked beef profile method showed that depending on the autolysis stage observed qualitative change and quantitative descriptors varying intensity. Regarding qualitative changes can be noted the appearance of a 25 day aging of such descriptors as a negative by-product and cardboard taste and smell, sour taste, "graininess" and "crumbiness" consistency perceived in the mouth.

To study the sensory characteristics due to interconnections between beef samples and their descriptors adapted multivariate statistical analysis by principal component. Analysis yielded graphical maps showing the relationship of objects (beef samples at different stages of aging) and loads (descriptors) in the space of two basic factors (component) Dim Dim 1 and 2 [26].

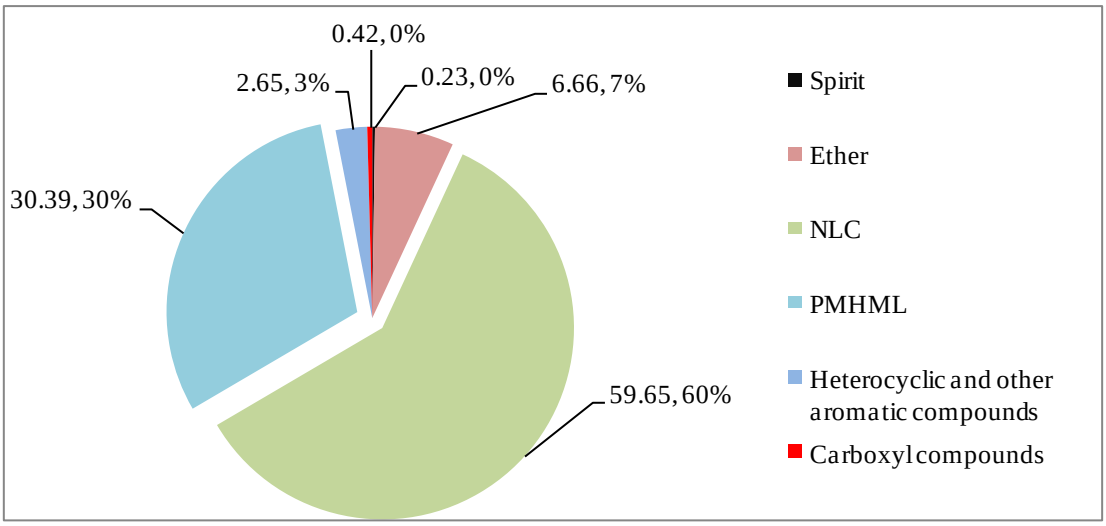


Figure 4 - The qualitative composition and ratio of volatile components in the gas phase of beef samples on the 25th day of autolysis

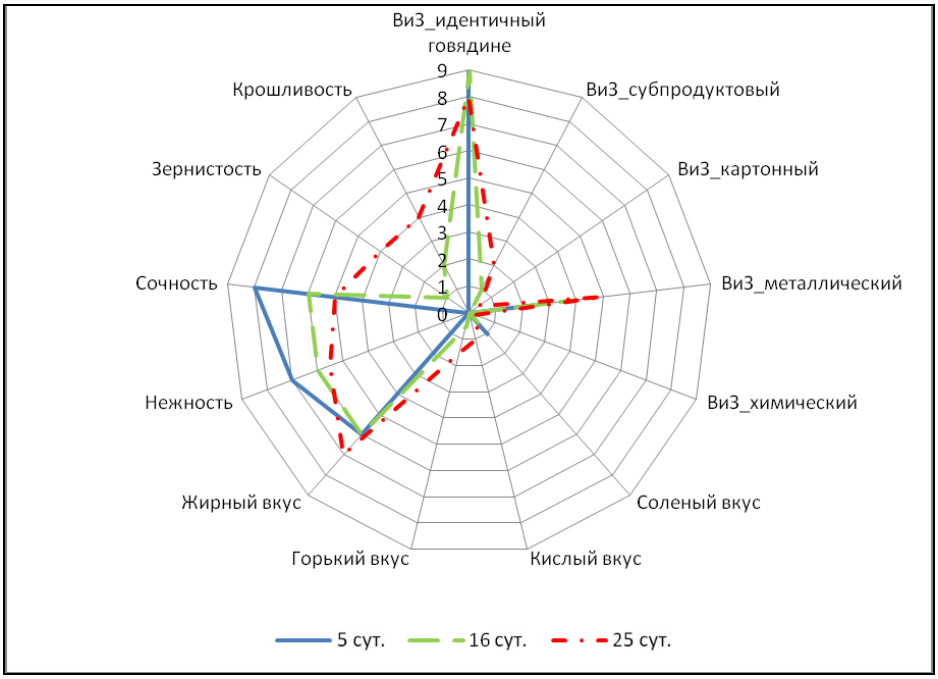
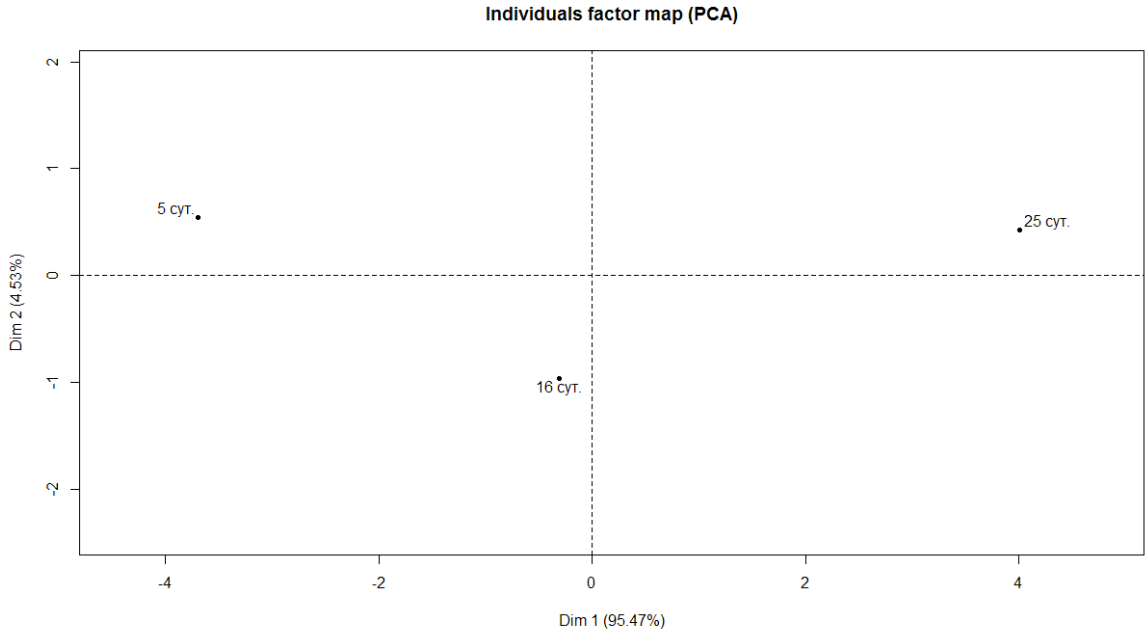
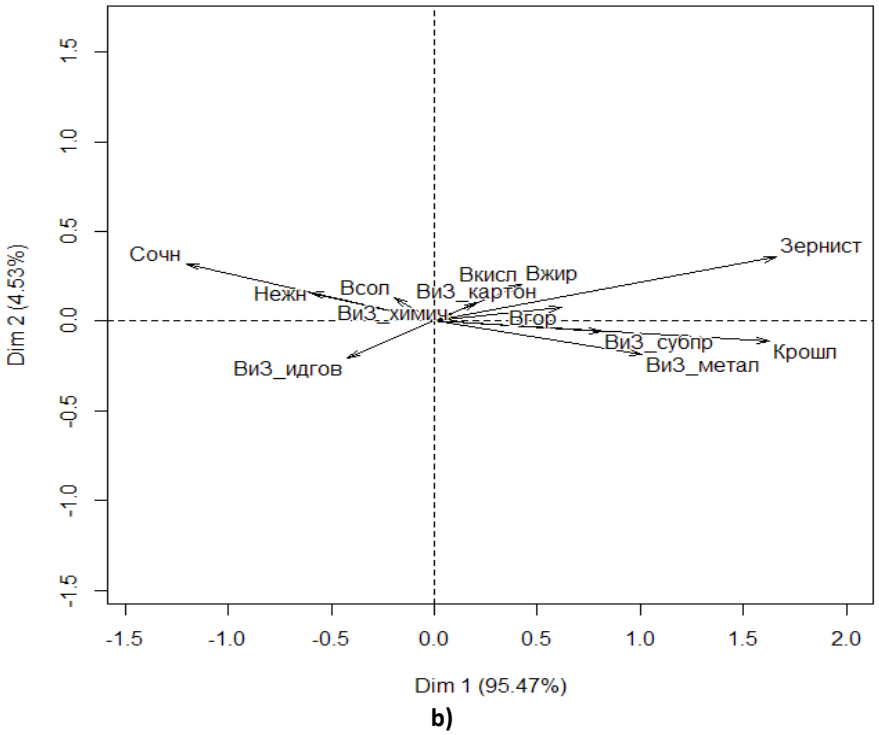


Figure 5 - Sensory profile of beef at different stages of aging

ISSN: 0975-8585



a)



b)

Figure 6 - Factor map with objects (a) and loads (b) for beef samples with different aging terms

Factor map objects and loads of beef samples are shown in Figures 6a and 6b.

Analysis of factor maps presented in Figure 6 showed significant differences in the sensory characteristics of beef samples at different stages of autolysis. The general trend for the beef after 25 days autolysis is to reduce the intensity of the majority of positive descriptors (taste and smell identical beef, juiciness and tenderness al.) And increasing the intensity of the negative descriptors (graininess crumbiness, and metallic taste and smell by-product et al.). Thus, in the initial sample of beef tasters noted the high degree of juiciness and tenderness, perception which was very closely related to each other (r = 0,99). In addition, the sample differed pronounced taste and smell identical to the beef. The beef sample after 16 days of aging is

ISSN: 0975-8585

enhanced metallic taste and odor, and reduced juiciness and tenderness, It appears crumbiness and grain consistency. By 25 days, with the overall reduction of tenderness, juiciness, and taste and odor identical beef observed appearance cardboard taste and smell (the result of the oxidation of fats), sourness and increased negative characteristics.

Analysis descriptors linkages reveals that during the aging of the key there is a negative relationship descriptor - flavoring identical descriptors subproduktovogo beef taste and odor (-0.9), cardboard taste and smell (-0.99), metallic taste and odor (- 0.8), sour, bitter taste and a fat (-0.99), grain (-0.99) and crumbinessi (-0.9). The positive association was observed only with the juiciness and tenderness (0.8). You can also note that many of the negative descriptors are positively correlated with each other. For example, by-product and metallic taste and smell (0.99); cardboard taste and smell and taste of fat (0.99); sour taste and smell and crumbiness (0.99), etc.

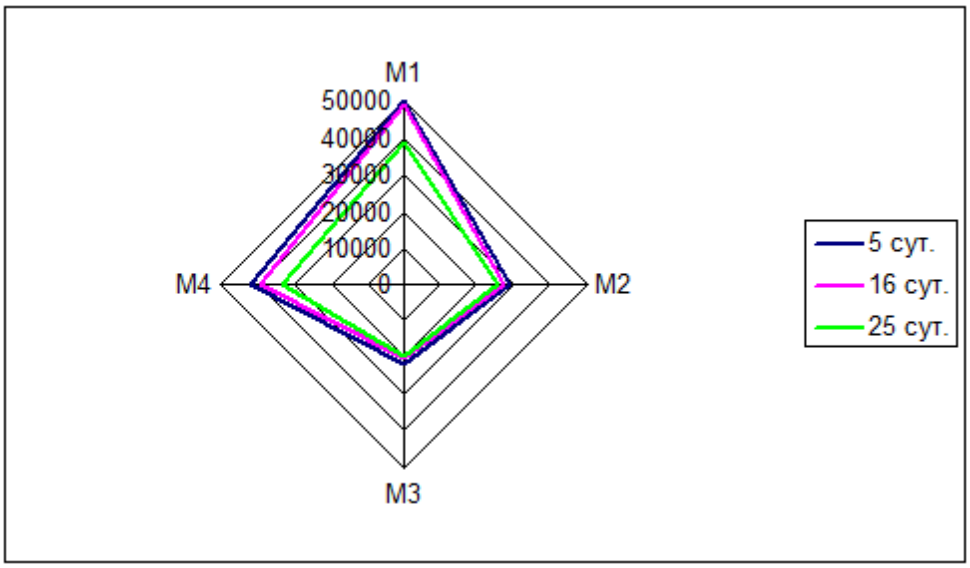


Figure 7 - "Visual prints" of the smell of boiled beef samples of different autolysis terms

The results of sensory evaluation of the samples were consistent with the data multisensory analysis (Figure 7). Squares "visual fingerprint" shown in table 3, characterized common perception sensor device aromatics complex.

Table 3 - Square "visual imprints" the smell of beef samples of different terms autolysis

Aging,hours	Square "visual imprints", cond. u · 107
5	252.06
16	231.63
25	171.26

Comparative multi analysis of odorless beef samples obtained after heat treatment at various stages autolysis found that odor intensity increases with the storage time, but at 25 day aging odor intensity of cooked meat is reduced, apparently due to the transition portion aromatics in broth. Odor intensity of sample boiled beef autolysis after 25 days was 32.1% compared to samples 5-day autolysis.

Table 4 - Composition change in lipid fraction basic substances during aging,% of the sum of components

Timetopeak, min	Acid	Aging, days		
		5	16	25
4.117	3-phenyl-1H-quinolin-2-one	- *	0.05	0.12
4.175	1-ethyl-2-phenyl-1H-indole	-	0.51	0.62

4,631	** decanoicacid	0.06	0.32	0.25
4.683	nonanoicacid	1.41	1.33	1.04
6.006	dodecanoicacid	0.57	1.64	1.75
7.215	tetradecanoicacid	7.63	6.84	7.87
7,729	pentadecanoicacid	0.48	-	-
8,149	9-hexadecenoic acid	-	0.51	2.22
8,274	hexadecanoicacid	13.47	13.53	10.19
8,689	*cis*-10-geptadetsenovaya acid	2.32	-	-
8,772	heptadecanoicacid	2.35	-	-
9.150	9-octadecenoic acid	23,00	22.96	22.61
9,669	*cis*-10-nonadetsenovaya acid	1.13	1.65	0.3
9,918	5,8,11,14-eicosatetraenoic acid	2.81	1.14	0.42
9,970	*cis*-5,8,11-eicosatetraenoic acid	1.65	-	-
10,027	Octadeca-9-en-1-ol dimethylacetal	-	-	2.70
10,053	6.17 oktadeadien-1-ol acetate	-	2.48	3.44
10,074	2-oktiltsiklopropanovaya acid	-	-	2.28
10,079	*cis*-13-eicosanoic acid	12.04	6.99	3.34
10.136	eicosanoicacid	1.82	2.12	2.78
10,147	3,7,11-trimethyl-2,6,10-dodekatrien-1-ol	-	-	0.46
10,235	arachidonicacid	-	2.65	3.45
10.250	Methyl-7,10,13-eykozatrienovaya acid	-	-	1.89
10,276	1,9-cyclohexadiene	1.87	2.17	-
10,282	5-nonadecyl-1-ol	-	-	1.46
10,307	11-hexadecene-1-ol acetate	-	6.66	8.34
10,411	6-octadecenoic acid	-	-	1.16
10,697	8,11,14,17-eykazatetraenovaya acid	0.61	0.4	1.73
10,774	9 oktadetsenal	4.46	-	-
10,832	5,8,11,14,17-eicosapentaenoic acid	-	4.04	7.21
10,847	palmitoylchloride	1.81	0.16	0.23
10,883	2,3-digidroksipropilelaidat	-	-	1.15
10,889	1 tsiklogeksilnonen	6.23	-	-
10,925	docosanoicacid	0.25	0.52	0.81
10,951	*D*-glyukopiranozid	-	2.59	2.99
11.885	tetracosanoicacid	-	-	0.17
15,382	Cholesterol	0.10	0.21	0.52
20,306	13-tetradecene-1-ol acetate	-	-	0.24

* - «-" level of less than 0.01 mg / kg

** - the identification of fatty acids in the form of methyl esters

Table 4 lists the major chemical components forming the change flavoring characteristics Beef in the process of aging. It is seen from the data that the main fraction of aroma forming substances are fatty acid derivatives in which expression of raw meat and products based on it due to the presence of internal fat, which is especially important in the marble beef. During the exposure of raw meat occur internal biochemical processes that lead to the transformation of the fatty acids and their derivatives. However, the pool of flavor components comprises a plurality of other impurities at a level of 0.001% or more. Their list included more than 250 identified substances, but in Table. 4 shows only the substances with the highest content.

MJ Colle et al [27], studying the processes of aging biceps and semitendinosus thigh muscles, came to a conclusion similar to our research, in respect of the biceps femoris - the best in terms of sensory evaluation, first of all, taste and aroma, is a period of aging from 14 to 21 days. However, for optimal semitendinosus it was called aging period from 21 to 42 days, which may be associated with greater physical activity, which is received by this muscle during the animal's life.

The same group of authors studied the aging gluteus medius muscle (gluteus medius) and the length of the loin muscle (longissimus lumborum); According to the authors, for the length of the muscles of the

lumbar sensory optimal aging period is the interval from 14 to 21 days, which is consistent with the results presented in this article [28].

Yuan H. Brad Kim et al. [29] in their work indicated that beef dry aging (subject to aging mode) is generally perceived by consumers more positive than beef wet aging. In beef dry aging were more pronounced 7 metabolites, including those responsible for the formation of flavor than beef wet and aging, in general, has been more preferred with sensory analysis beef dry aging.

CONCLUSION

Thus, studies have shown that the process of refrigeration extracts (aging) of beef accompanied by changes in the chemical composition of which has been analyzed subject of chromatography-mass spectrometry and correlated with data and expert sensory properties. Identified descriptors beef sensory properties allow to further develop the process of preparation of raw meat program for obtaining high-quality food products with desired taste and aroma characteristics.

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