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Study of the digestibility of camel meat proteins by enzymes of the gastrointestinal tract

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Abstract. In this paper the technological properties of camel meat and the effect of enzymes of gastrointestinal tracton digestibility of camel meat proteins were studied. The rate of protein digestion in the gastrointestinal tract by proteolytic enzymes is one of the main indicators determining the biological value of food products. The results of determining the digestibility of proteins by digestive enzymes in vitro make it possible to predict the degree of protein utilization by human body. The amount of losses and the duration of heat treatment like boiling and roasting were studied to determine the technological properties of camel meat. The results of the conducted studies of the chemical composition, physicochemical and technological properties show that camel meat in its composition, quality, culinary virtues is close to beef, which makes it possible to use it for the production of a wide range of meat products, and to apply the technological regimes used beef processing.

1. Introduction

Camel farming for meat production is growing due to its nutritional and health aspects. Camel meat can be considered as a new alternative healthy meat for human consumption [1, 2].

This may lead to an increase in camel meat consumption but the level of consumption is currently not comparable to that of other meats [3]. Meat is generally considered as a major source of fat in human diets, which is associated with various cancers and coronary heart diseases.

At present, special attention is paid to the food ration, the problem of nutrition of the population of the Republic of Kazakhstan. To date, the state policy has been developed in the field of healthy nutrition, the main provisions of which include expanding the range, preserving the useful properties of products. The basic requirements for the food ration: the correspondence of caloric energy to the energy expenditure of the organism; The content of all essential nutrients, minerals and vitamins in amounts and ratios most beneficial to the body (nutrition balance); The maximum correspondence of the chemical structure of food to enzymatic digestive systems; health diet.

The Small Medical Encyclopedia interprets that: "Digestion is a combination of physical and chemical processing of food in the digestive tract, as a result of which its components, while retaining their energy and plastic value, lose their specificity and acquire properties that can be absorbed by the body and metabolized. Physical changes in food consist in its grinding, swelling, dissolution; Chemical - in the successive transformation of nutrients under the influence of the secretions of the digestive glands. The most important link in the process of transformation of nutrients is their depolymerization (splitting) under the influence of hydrolytic enzymes with the formation of monomers, which are absorbed into the blood and lymph and transported to the tissues of the body.

All nutrients are excreted except for water, mineral salts and vitamins, which are absorbed with any transformation" [4].

Moreover, camel meat is believed to have medicinal properties [5, 6, 2]. Published evidence suggests that quality characteristics and nutritive value of camel meat are not much different from beef when slaughtered at comparable ages [7, 8, 9, 10]. However, utilisation of camel meat is hampered by a lack of knowledge about its nutritive value overall and within individual muscles. Few studies have been carried out on this aspect [11, 3, 9, 10]. The available information is mainly related to just a few camel muscles [12, 13, 9, 10, 17, 18]

Leading nutrition specialists are solving the problem of searching for new sources of protein raw materials. An alternative to solving the problem of protein deficiency is the use of non-traditional meat raw materials, like camel meat in the production of food.

According to the literature data (Tuleuov E.T., Chomanov U.C., Rskeldiev B.A., Ilyukhina V.P., Karmyshova L.F., Shishkina N.N., Mglinets A.N., Ovezmuradov B. S., Morton R.H., Wilson E.D., Isam T. Kadim, Konuspaeva G., UzakovYa.M., KenenbaySh.Y. and others) camel meat is a good source of high-grade protein.

During the research, it was found that the camel meat is balanced in amino acid composition, also rich in phosphorus, potassium, iron, group of B vitamins, high level of vitamin E (1.33 and 1.23 times higher than in beef and horse meat, respectively) [14].

The composition of lean bactrian camel was shown to be highly desirable with a high nutrient density for many nutrients. Although lean meat samples from six muscles were similar in most nutrients detected, several significant differences were found. LT muscle had significantly higher dry matter and fat% than other muscles. The IS and LT muscles had significantly ($P<0.05$) higher cholesterol levels than TB, BF, ST and SM muscles. Concentrations of Myristic (C14:0), Palmitic (C16:0), Palmitoleic (C16:1) and Oleic acids (C18:1n9) were significantly ($P<0.05$) different between muscles. The LT muscle contained a significantly lower proportion of mono-unsaturated fatty acids than other muscles. The ratio of polyunsaturated to saturated fatty acids, which ranged from 0.40 to 0.50, was ≥ the minimum ratio of 0.40 recommended to reduce the risk of coronary diseases in humans. The amino acids and vitamin composition were similar for meat sample from six muscles. Consuming 150 to 200 g of camel meat will cover the daily requirement for an adult man weighing 70 kg for essential amino acids. This information on the nutritional value of camel meat is of great importance for promotion of the product [15].

Casein proteins of camel milk were obtained from skimmed milkby sedimentation (pH 4.6) at 24°C. To sediment proteins from mare milk, pH was increased to 4.6 and milk was centrifuged at 45,000 rpm for 30 minutes at 4°C. The supernatant obtained after centrifugation was heated up to 30°C for further fractionation of whey proteins [16].

The biological value of meat is very high. It is known that the speed of digestion with proteolytic enzymes protein meat occupy the second place (after fish and milk).

The degree of assimilation of dietary protein depends on the effectiveness of its decomposition under the influence of enzymes of the gastrointestinal tract.

Of particular importance in the life of organs and systems is the lack of highly digestible proteins, since many amino acids that make up the primary structure of proteins are not synthesized in the body and must enter the body together with food. Biological value reflects the ability of the protein components of the products to be digested when they enter into a balanced relationship with amino acids [14].

Digestibility of the studied meat systems Collagen-protein of connective tissue, whose popularity grows every year due to the discovery of its new role as a dietary fiber in nutrition. However, native collagen has low functionality in food systems and requires pre-treatment to increase its use. Therefore, controlled hydrolysis with obtaining products of a given composition and level of functional and technological properties can increase its digestibility with simultaneous increase in the volume of its use.

2. Materials and methods

Determination of the digestibility of meat products in-vitro is determined by the Pokrovsky-Etranov method. The method is based on enzymatic hydrolysis under conditions in which the availability of attacked peptide bonds is determined not only by the properties of the protein, but also by additional factors associated with the structure and chemical composition of the food product. The method consists in the sequential action on proteinaceous substances of the investigated product by a system of proteinases consisting of pepsin and trypsin, with continuous mixing and removal from the reaction sphere of the products of hydrolysis by dialysis. This avoids the inhibition of digestive enzymes by low molecular weight peptides and free amino acids. The degree of protein attack in the test product was evaluated by the increase in hydrolysis products as a result of enzymatic digestion. The values of the concentration of tyrosine, determined from the calibration schedule, were recalculated into the total volume of the fluid of the outer and inner vessels, and then these values were summed up. From the tyrosine concentration characterizing the degree of hydrolysis, the values obtained in the control experiments were subtracted: the first experiment was the enzyme solution, the second experiment was a slurry of the analyte in the buffer solution.

Calculations were carried out using the formula:

$$К = A - B - C$$

where, К - increase in hydrolysis products due to the action of the proteolytic enzyme, μg / cm^3;

A -the concentration of hydrolysis products in the digest, μg / cm3;

B -the concentration of the same products in the slurry of the food product, μg / cm^3;

C -the concentration of the same products in the enzyme solution, μg / cm^3.

Accumulation of products of hydrolysis, determined by the color reaction of Lowry, was expressed in micrograms of tyrosine per 1 g of dry matter [19].

3. Results and discussion

To study the technological properties of camel meat, the amount of losses and the duration of heat treatment during boiling and roasting were determined. Losses of camel meat during cooking vary within the limits of (40.5-41.9 %) (on average 41.2 %). When roasting camel meat loses weight (35.6-36.3 %) (an average of 35.95 %). When cooking, camel meat loses up to (48.1-48.5 %) moisture, and when roasting from (48.4-48.9 %) of its original quantity in meat.

Loss of fat (the transition to broth) when cooking camel meat is equal (12.80-18.30 %) of its original amount in meat. And, the more fat is contained in meat, the relatively much of it goes into the broth. When roasting meat is absorbed part of the fat on which the products are roasted. The greatest amount of soluble substances is extracted from meat during cooking. Thus, the loss of protein during cooking camel meat is (7.6-9.8 %), and when roasting (5.0-6.0 %) of the original content, that is, the loss when cooking is more (2.6-3.8 %), than when roasting due to the transition into the broth of a part of soluble proteins. To a large extent, the content of mineral, nitrogenous and extractive substances varies during cooking. As shown by the research data up to 36.9 % of nitrogenous and extractive and up to 18.1 % of mineral substances are converted into broth when cooking camel meat. When roasting camel meat, the loss of these substances is less than almost (1.5-1.7) times. The study of physicochemical parameters of boiled and roasted camel meat showed that the content of firmly bound moisture in the meat after cooking is (48.1-50.15 %), this compared to the raw meat is less by an average of 12 %. Thus, the calorie content of the camel is 160 kcal. At the same time, boiled meat contains 230 kcal per 100 grams. Hence, we can conclude that the camel can be attributed to dietary products [20].

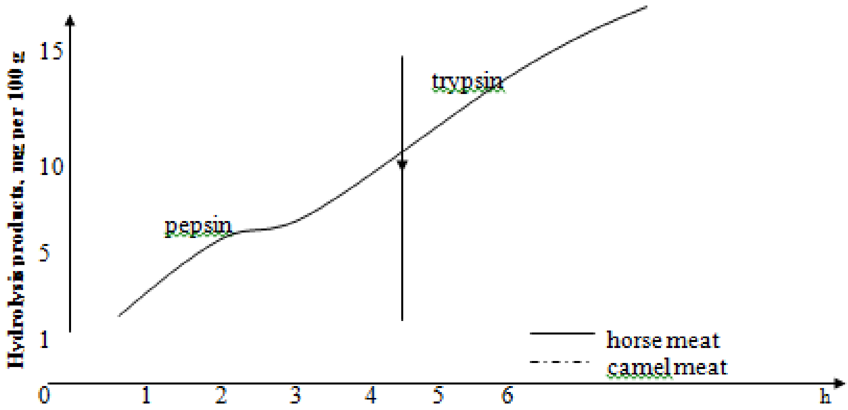

Figure 1. Attacking of camel and horse meat proteins (fried meat) with proteolytic enzymes.

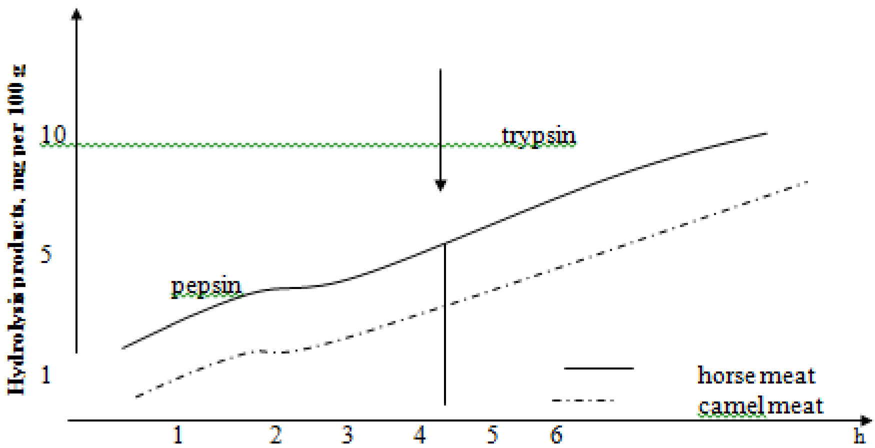

Figure 2. Attacking of camel and horse meat proteins (boiled meat) with proteolytic enzymes.

The rate of protein digestion in the gastrointestinal tract by proteolytic enzymes is one of the main indicators determining the biological value of food products. The results of determining the digestibility of proteins by digestive enzymes in vitro make it possible to predict the degree of protein utilization by the body.

The digestibility of camel meat proteins was studied in comparison with horse meat, using the example of the longest muscle of the back (a thick edge) and semitendinous (outer piece).

The fat edge, both from the carcass of the camel, and horsemeat was roasted in the form of entrecotes, and the outer piece - cooked in a large chunk.

The digestibility of the experimental samples was determined in in vitro experiments on pepsin and trypsin. The method consists in the sequential effect on proteinaceous substances of the investigated product by a system of proteinases consisting of pepsin and trypsin. Accumulation of the products of hydrolysis is determined by the color reaction of Lowry, expressed in μg / 1 g [14].

Mathematical processing of the results of experimental studies was carried out using the method of optimizing the mean square error.

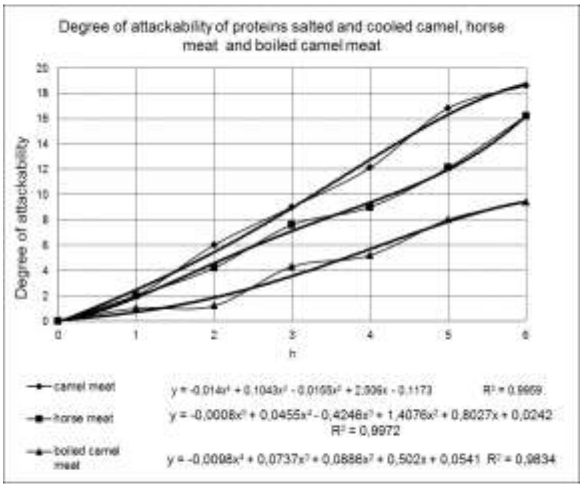

Figure 3. Degree of attackability of proteins salted and cooled camel, horse meat and boiled camel meat.

The obtained data show (figure 1-4) that the rate of hydrolysis by proteolytic enzymes (in vitro) of camel meat and horse meat (roast and boiled) does not differ significantly.

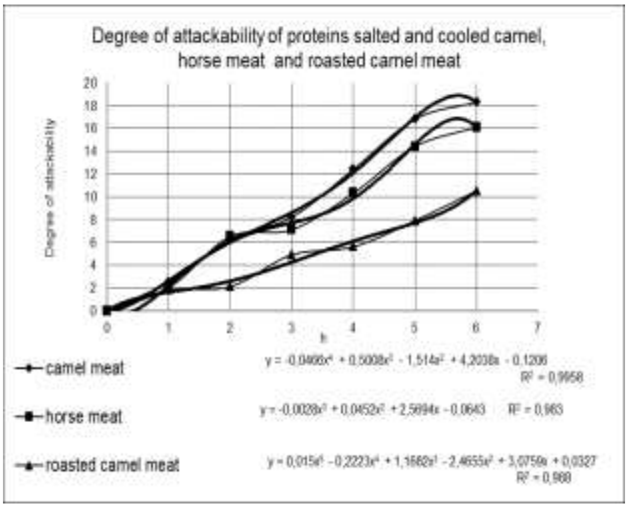

Figure 4. Degree of attackability of proteins salted and cooled camel, horse meat and roasted camel meat.

4. Conclusion

Thus, the results of the conducted studies of the chemical composition, physicochemical and technological properties show that camel meat in its composition, quality, culinary virtues is close to horse meat, which makes it possible to use it for the development of a wide range of meat products and to apply the technological regimes used for horse meat.

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