

## Nutritional And Biological Value Of Horsemeat In Human Nutrition

Bibigul Abilmazhinova<sup>1\*</sup>, Venera Akhmetova<sup>2</sup>, Viktoriya Ivanova<sup>3</sup>, Tatyana Bezhinar<sup>4</sup>, Vladimir Ermolaev<sup>5</sup>, Sergei Safronov<sup>6</sup>, Irina Knysh<sup>6</sup>, Vera Gribkova<sup>7</sup>, Ekaterina Sepiashvili<sup>7</sup>

<sup>1</sup>Shakarim State University of Semey, Semey, Kazakhstan

<sup>2</sup>Saken Seifullin Kazakh Agrotechnical University, Nur-Sultan, Kazakhstan

<sup>3</sup>Russian Customs Academy, Saint-Petersburg, Russian Federation

<sup>4</sup>South-Ural State Agrarian University, Troitsk, Russian Federation

<sup>5</sup>T.F. Gorbachev Kuzbass State Technical University, Kemerovo, Russian Federation

<sup>6</sup>Saint-Petersburg State University of Veterinary Medicine, Saint-Petersburg, Russian Federation

<sup>7</sup>K.G. Razumovsky Moscow State University of technologies and management (the First Cossack University), Moscow, Russian Federation

E-mail: eras71@mail.ru

### Abstract

This article presents a review of the nutritional value of horsemeat. Chemical, amino acid, vitamin and mineral compositions of horsemeat are characterized. The role of consumption of horsemeat in medical and preventive and dietary nutrition is emphasized. The information on the use of horsemeat in meat products technology is given.

**Keywords:** horsemeat, amino acids, national products, dietary nutrition

### 1. Introduction

The countries of Central Asia (Kazakhstan, Kyrgyzstan), Mongolia and the peoples of Eastern Russia (Buryats, Bashkirs, Yakuts, Tatars, etc.) for a long time consumed horse meat and willingly eat it now, and they have always valued horse meat above beef and lamb.

Horsemeat is a high quality meat product, containing most of the necessary nutrients for the body, which are well balanced and well assimilated. The nutritional and biological value of horsemeat is very high due to its high content of protein and other vital substances. Horse meat is classified as a food with dietary properties [1, 2].

Nowadays there is a lot of information about physical-chemical, biochemical, technological properties of horsemeat which demonstrate its high nutritional value [3-8]. The chemical composition of horse meat significantly changes depending on breed, age, fatness state, part of carcass where the sample is taken, conditions of keeping, season of year, etc. In terms of fatness, horse meat is classified into two categories - I and II. Table 1 shows the chemical composition of horse and cattle meat depending on the category [3-9].

**Table 1 - Chemical composition of horsemeat and beef, depending on the meat grade**

Meat	Content, g/100g of meat				Calorie	
	Water	Protein	Fat	Ash	kJ	kCal
Horsemeat of I grade	69.6	19.5	9.9	1.0	669	160
Horsemeat of II grade	37.9	20.9	4.1	1.1	502	120
Beef of I grade	67.7	18.9	12.4	1.0	782	187
Beef of II grade	71.1	20.2	7.0	1.1	602	141

### 2. Nutritive value of horsemeat

Horsemeat has dietary properties, increased nutritional value. In terms of protein quality, horse meat is close to beef, but the amount of connective tissue in horse meat is 30% higher, so it is

more tough compared to beef and has lower technological properties [10]. Horse meat comes close to beef in content of essential amino acids. But horse meat proteins contain more such essential amino acids as tryptophan, isoleucine and lysine. Horsemeat also contains an increased amount of histidine - an amino acid, essential for the child's body. Horsemeat lipids contain a significant amount of polyunsaturated fatty acids with adjacent double bonds, which determines the high nutritional value of horse fat.

Scientists (V.M. Gorbatov, G.F. Sergienko, E.T. Tuleuov, etc.) investigated the amino acid composition of horse meat and showed that proteins in horse muscle tissue have a full set of amino acids with a favourable ratio of essential amino acids, while the content of tryptophan, histidine, tyrosine, phenylalanine and methionine is higher than in beef [11, 12].

**Table 2 - Comparison of amino acids of different animals**

Amino acid	Content, % to protein powder			
	beef	pork	lamb	horsemeat
Lysine	3.1	7.8	7.6	8.47
Tryptophan	1.1	1.4	1.3	1.62
Methionine	2.3	2.5	2.3	3.82
Valine	5.7	5.0	5.4	5.41
Leucine	8.4	7.5	7.4	8.47
Isoleucine	5.1	4.9	4.8	6.29
Phenylalanine	4.0	4.1	3.9	5.77
Threonin	4.0	5.1	4.9	4.77
Arginine	6.1	6.4	5.9	5.79
Histidine	2.9	3.2	2.7	3.74
Tyrosine	3.2	3.0	4.2	3.71

By the content of tryptophan horsemeat proteins are close to the proteins of chicken egg and female milk, in which its content is 1.65 and 1.9%, respectively. It is known that tryptophan is an essential amino acid and necessary for normalization of reproductive function, for hemoglobin synthesis [13].

There is a significant amount of vitamin A in horsemeat - up to 20 mg%. In beef, vitamin A is found only in the form of traces. From other vitamins contained in horsemeat: thiamine 0.16 mg%, riboflavin 0.26 mg%, niacin 3.5 mg%, vitamin E 0.82 mg%, in beef these values are respectively - 0.06 mg%, 0.15 mg%, 4.7 mg%, 0.57 mg%. Vitamin C in horsemeat is 0.8 mg%, while in beef it is only found as trace amounts. Consequently, horsemeat is significantly superior to beef meat in content of the majority of vitamins.

The biological value of horsemeat is also enhanced by high concentrations of necessary minerals: potassium - 370 mg%, sodium - 50 mg%, calcium - 13 mg%, magnesium - 25 mg%, phosphorus - 168 mg%. In beef the level of these macroelements is 355, 73, 10 and 188 mg%, respectively. Among the trace elements the concentration of iron in horsemeat is 4150 µg%, zinc - 6200 µg%, copper - 206 µg%, cobalt - 30 µg%, in beef - 2900, 3240, 182 and 7 µg%, respectively. Thus, in horse meat there is more than in beef, potassium, calcium, magnesium, copper, almost 2 times more iron, 2 times more zinc, and 4 times more cobalt. In the liver of horses such rare microelements as vanadium, molybdenum are found [14].

Horse meat has a number of beneficial properties. It has a beneficial effect on the human body due to the content of large amounts of linoleic and linolenic fatty acids, which prevent the deposition of cholesterol on the blood vessel walls, contains a high iron content (8 mg per 100 g of meat), has a low stable pH (5.6 - 5.7) in contrast to the pH value of pork and beef (5.5 - 6.5), which makes horse meat a good source of meat for meat products [15].

### 3. Types of national horsemeat products

Qazy is a smoked product from a chest rib cut taken between the 5th and 18th ribs. Paired ribs with meat and fat are rubbed with dry curing mixture (for 100 kg of raw materials 3 kg of salt, 50 g of niter and 150 g of sugar) and kept in kegs of 200 liters for 1 - 3 days at a temperature of 4 - 6

0C. Then the kazy is filled into small horse intestines and suspended for 2 - 4 hours for shrinkage. They are smoked at a temperature of no more than 40 C for 18 - 24 hours, dried at a temperature of 12 - 13 0C and 75% humidity for 2 - 3 days. Product yield is 90 % of the mass of raw materials. Caloric value is 5730 kcal.

Zhal is the smoked fat of the horse's neck top. Pieces of zhal is salted by the dry method (for 100 kg of raw materials 3 kg of salt and 30 g of nitrate) and smoked at a temperature not exceeding 30 0C for 18 - 24 h, then dried for 2 - 3 days at a temperature of 12-130C and 75% humidity. The product yield is 90 %.

Qarta is a smoked sausage cooked from the non-fatty bowel of horses of the first fat category. The bowels are turned out, well washed and salted (4 kg of salt per 100 kg of raw material). After that, it is kept at a temperature of 4 - 5 0C for 3 days, then smoked at 30 0C for 24 hours. The product yield is 90 %. Caloric value is 6050 kcal [16, 17].

#### 4. Use of horsemeat in production of meat products

The choice of horsemeat as the main ingredient in the production of meat products is based on its balance of all ingredients - proteins, fats, carbohydrates, minerals, as well as a balanced protein amino acid composition, which improves metabolism in patients with obesity, atherosclerosis, hypertension, heart, liver and pancreatic diseases. Horsemeat is characterized by high protein content: its level reaches 24.5%, in beef and veal - 20.59% and 19.86%, respectively. In addition, horsemeat contains biologically active substances with lipotropic and choleric properties [18].

The work describes the method of production of cooked sausages, including low voltage multi-electrode electrostimulation of horse hot half carcasses, deboning and trimming of horse meat, grinding, salting, minced meat preparation, forming sausage batons, binding, settling and heat treatment. Protein and fat emulsion are used in the preparation of minced meat in the amount of 10-15 percent. Biologically active additive in amount of 8-9% is added to emulsion. The biologically active additive is obtained by soaking wheat grains in sodium selenite solution with 0.03-0.04% concentration, germination, sprouts separation and grinding. This method provides enrichment of cooked sausages from horsemeat with selenium, increase of yield of finished product, improvement of functional and technological properties of cooked sausage [19].

A prospective trend is the use of horsemeat as a source of animal protein in the production of foods for patients with allergies. Two variants of canned food for such patients have been proposed by VNIKIMP specialists - from horsemeat and pork with addition of starch, salt and water; from horsemeat with addition of butter, starch, salt and water. The high biological value of these products is evidenced by amino acid score and the quantitative content of polyunsaturated fatty acids, which is 1.5-2.5 times higher than in beef canned food. The proposed canned foods contained macro- and microelements (calcium, iron and others), as well as B vitamins. The content of thiamine in these canned food was 2 times higher than in beef canned food. The clinical tests of canned food prototypes showed good tolerability of their patients, reduction of allergic reactions [20].

Horsemeat sausage is produced from horsemeat (65 %) with the addition of butter (10 %), rennet hard cheese (6 %), skimmed milk powder (4 %) and plasma or blood serum (15 %). The technology includes grinding of horsemeat on a chopper with a diameter of 2-3 mm plate holes, saline with brine containing plasma (10% to the mass of raw materials) [21].

Scientific Research Institute of Meat Industry. V.M. Gorbatov developed minced meat semi-finished products for dietary nutrition, consisting of horsemeat with the addition of poultry meat, spices, preventive iodized salt, dietary food supplement "Thistle meal", soya textured flour, soya fiber. The obtained specialized product is recommended for preventive nutrition, for example, in case of liver diseases [22].

Amirkhanov has developed a meat molded product for dietary nutrition, which includes horsemeat, lamb and topinambur. The chemical composition of the developed product was 16.12% protein and 12.4% fat. Determination of mineral composition showed that the ratio of certain elements such as calcium, phosphorus, magnesium Ca:P:Mg is 1:8:1, which corresponds to the requirements of dietary nutrition [23].

## 7. Conclusion

Thus, the use of horsemeat as a basic source in the production of meat products is due to its high nutritional and biological value, dietary properties. The uniqueness of horsemeat is based on its high energy consumption, balanced amino acid composition of proteins, vitamin content, presence of bioactive substances and high assimilability.

## References

### 11.1. Journal Article

1. Uzakov, Ya.M. Chemical composition and biological value of horse and lamb. *Meat Industry*, 2006, 9, pp. 52-55.
2. Tuleuov, E.T., Moldakhmetova, Z.K., Amanzholov, S.A. Technology of the horse cooked sausage production "Densaulyk" with use of the protein product from the eggs. *Coll.: Chemistry. Technology. Quality. Condition, problems and prospects of development. Proceedings of the international conference. - Magnitogorsk: 2004*, pp. 44-45.
3. Zhumanova, G., Amirkhanov, K., Okuskhanova, E., Grigoryeva, I., Skripnikova, L., Zhirova, V., Zhukovskaya S., Babaeva, M. Nutritive value of meat cutlets made with horse meat and poultry by-products. *Eurasian Journal of Biosciences*, 2019, 13 (2), pp. 1363-1367.
4. Kozhakhiev, M., Dragoev, S., Uzakov, Y., Nurgazezova, A. Improving of the oxidative stability and quality of new functional horse meat delicacy enriched with sea buckthorn (*hippophae rhamnoides*) fruit powder extracts or seed kernel pumpkin. *Comptes rendus de l'Academie bulgare des Sciences*, 2018, 70(1).
5. Tuleuov E.T., Amanzholov S.A., Moldahmetova Z.K., Khaimuldinova A.K. Products of ointment consistency using chicken, horsemeat and eggs. *Food and Processing Industry of Kazakhstan*, Almaty. 2003, 5, pp. 20-21.
6. Lorenzo, J. M., Sarriés, M. V., Tateo, A., Polidori, P., Franco, D., Lanza, M. Carcass characteristics, meat quality and nutritional value of horsemeat: A review. *Meat Science*, 2014, 96(4), pp. 1478-1488.
7. Belaunzaran, X., Bessa, R. J., Lavín, P., Mantecón, A. R., Kramer, J. K., Aldai, N. Horsemeat for human consumption—Current research and future opportunities. *Meat Science*, 2015, 108, pp. 74-81.
8. Kasymov S.K., Nurymkhan G.N., Nurgazezova A.N., Igenbaev A.K., Nabihan A.J., Rebezov M.B. Production of boiled-smoked sausages from horsemeat. *Young Scientist*, 2015, 10.3 (90.3), pp. 19-22.
9. Dyuyssembaev S, Serikova A, Iminova D, Omargaliev N, Serikov Z, Koigeldinova A, Kassenov K. Organoleptic indicators and chemical composition of horse meat, *Research Journal of Pharmaceutical, Biological and Chemical Sciences*, 2016, 7 (5), pp. 2444-2448.
10. Patent № 2281010, Russia. Composition on a meat basis for the production of food products for children of early age. Date of publication of the patent: 10.08.2006.
11. Tuleuov E.T., Zhauarova B.K. Improvement of the horsemeat dried products production technology: Problems of stabilization and development of agricultural production in Siberia, Mongolia and Kazakhstan in the XXI century. - *Novosibirsk*, 1999; 4.3, pp. 160-161.
12. Tuleuov, E.T. *Horsemeat production*. Moscow: Agropromizdat, 1986, 285 p.
13. Ustinova, A.V., Giro, T.M. Prospects for Using Horsemeat in Children's and Functional Meat Products. *Meat Industry*, 2010, (5), pp. 34-38.
14. Yartseva, O. S., Savelieva, M. I. *Cooking Secrets: cooking diet meat*. All about meat, 2015, (1), pp. 52-54.
15. Bazhenova, BA, Zabalueva, Yu, Kolesnikova, I.S., Melyoshkina, N.V. Development of Functional Horse Ham Technology. *News of the Timiryazev Agricultural Academy*, 2017, (5), pp. 101-114.
16. Baimukanov, D., Akimbekov, A., Yuldashbaev, Yu, Iskhan, K. Technology for production of national products and dishes from horsemeat in Kazakhstan. *Food industry*, 2017.
17. Raisova, A.A., Kozhabergenov, A.T., Tursynbayeva, J.K., Alikhanov, K.D., & Nurgali, M.A. Improvement of structure and quality of national horse meat products through application of

- \ flour croups. In Europe and the Turkic World: Science, Engineering and Technology, 2018, pp. 482-487.
18. Patent No. 2279819, Russia. Semi-finished minced meat diet. Date of publication of the patent: 20.07.2006
  19. Patent No. 2464790, Russia. Method of production of cooked sausages from horsemeat Date of publication of the patent: 27.10.2012.
  20. Dzhangiroy, A.P. Production of products for dietary, therapeutic, baby food on a meat basis. Moscow: AgronIITEMP, 1987, pp.15-16.
  21. Bolshakov A.S., Toleuov E.T., Amirkhanov K.J., Vasiliev A.A., Luzan V.N. Manufacture of meat products from horse meat. Moscow: AgronITeIMMP, 1988, 48 p.
  22. V.M. Gorbatov Scientific Research Institute of Meat Industry.
  23. Amirkhanov, K.J. Rational use of horsemeat and lamb in production of meat products. Meat Industry, 2009, 9, pp. 34-36.