HORSEMEAT AS A PROMISING RAW MATERIAL FOR PRODUCTION OF CANNED MEAT FOR CHILDREN

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Background

Horsemeat is not a traditional raw material for production of canned meat products for children. Pediatricians recommend beef for infants because it corresponds best to their nutrient status.
But it is known that horsemeat has pronounced dietetic properties. Protein of horsemeat by its amino acid balance is not inferior to beef. Horse fat is easily melted (melting point of lamb fat – 44-55^{0}C, beef fat – 40-50^{0}C, pork fat – 33-46^{0}C, horse fat – 30-43^{0}C), contains more than 50% of unsaturated fatty acids, among them - up to 20% linoleic and linolenic which are indispensable.
Horsemeat possesses hypoallergenic properties, high therapeutic efficiency in cases of celiac diseases, lactase deficiency and ability to decrease cholesterol level in blood that was confirmed by many clinical tests, carried out by technologists of the Institute together with pediatricians and specialists in nutrition.
Besides, horsemeat is more wholesome from hygiene point of view because horses are not sensitive to parasite diseases as well as to spongiform encephalopathy.

Objectives

The evaluation of nutrients adequacy, biological value of horsemeat as compared to beef and pork and substantiation of usefulness of horsemeat for child nutrition.

Materials and methods

Calculation of amino acid and fatty acid balance was carried out according to computer technique of Lipatov N.N. /1/ as compared to the reference - mature woman's milk.
Medical and biological evaluation of canned pork and horsemeat samples for children was carried out at the Chair of ecology of a man and environment hygiene of the I.M.Sechenov Moscow medical academy with the use of growth-mass and biochemical indices (Sukhanov B.P., 1987, Korolev A.A., 1997) on model groups of animals: growing white male rats of Vistar line with the initial body weight 70±5 g during 28 days. Biological value was judged from the value of coefficient of protein efficiency /2/. The content of available lysin was determined by the method of binding of color "orange", based on combination of two reactions: the first one between negatively charged group of azo dye and positively charged main nitrogen containing groups of lysin, histidine, arginin and the end groups of food proteins suspended in acid medium; the second reaction of propionilation of free amino groups of lysin with propionic anhydride, providing their blocking. The content of available lysin was determined by difference of the amount of dye for the first and second reaction.
Determination of taurin was carried out on liquid amino acid analyzer Biotronic LC-5000.

Results and discussion

A characteristic of amino acid balance of meat raw materials proteins is presented in Table 1.

Table 1.

№	Trimmed meat	Indispensable amino acids, g/100 g of protein									Cmin, %	Rp, Un.	σ, g/100g of product
		Protein, %	iso	leu	lys	meth+cys	phen+tyr	thre	trp	val			
1	Horse meat	19.5	4.6	9.8	7.5	4.0	8.6	4.6	1.5	5.2	78.16	0.84	6.96
2	Beef	18.7	4.2	7.95	8.54	3.87	7.81	4.32	1.13	5.86	75.33	0.79	9.18
3	Non-fat Pork	16.4	4.7	7.79	8.75	3.79	7.68	4.73	1.37	6.1	79.49	0.81	8.5
4	Semi-Fat Pork	14.4	4.95	7.51	8.66	3.76	7.69	4.57	1.34	5.81	76.63	0.79	9.19
Reference													
Mature woman milk		1.4	4.5	9.0	7.0	3.9	8.6	4.0	4.6	5.0	100.0	1.0	0

As follows from presented data the protein of horsemeat as evaluated with the help of such indices of amino acid composition as minimum score (Cmin), coefficient of utility (R_p), coefficient of comparable redundancy (σ), shows rather high amino acid balance and is not inferior to beef and pork.

To describe the amino acid composition more completely investigations for determination of taurin - non-protein amino acid that is essential for infants - were carried out. Taurin is formed from sulfur-containing amino acids – methionine and cystine. It is a part of bile acids, relates to non-volatile compounds of meat and comes to the organism with foods of animal origin. Vegetable foods (vegetables, fruit, cereals etc.) and milk do not contain taurin. For children of this age conjugation of bile acids with taurin is typical, because taurin conjugates do not deposit under the conditions of acid medium in proximal part of small intestines, thus assisting in better fat absorption. Thus, with sufficient supply of taurin with foods biological value of protein increases at the expense of economic use of sulfur-containing amino acids, and assimilatiom of fats improves as well. The investigations carried out demonstrate a higher level of taurin in horsemeat - 134±5.3 mg/100g of product as compared to beef - 102±3.0 mg/100g of product.

Characteristic of fatty acid balance of fat in different kinds of meat is presented in Table 2.

Table 2.

№	Trimmed meat	Fat, %	**Fatty acids, g/100g of fat**						**Coefficient Of fatty acid** Balance, R_L, fract.units	
			Σ SFA	**Σ** MUFA	**Σ** PUFA	**lino-**leic	**lino-**lenic	**arachi-**donic	I=1..3	i =1..6
1	Horsemeat	8.3	33.87	45.66	14.94	11.2	0.35	0.24	0.86	0.93
2	Beef	16.0	44.5	46.4	3.5	2.5	0.87	0.13	0.63	0.43
3	Non-fat pork	15.8	36.54	47.26	11.19	10.07	0.684	0.432	0.89	0.80
4	Semi-fat pork	40.0	35.5	46.2	10.98	9.85	0.71	0.42	0.868	0.804
Reference										
Mature woman milk		3.8	41.78	43.03	12.42	10.85	0.62	0.95	1.0	1.0

Fatty acid composition of horsemeat as evaluated from the coefficient of fatty acid balance, by the content of sums of saturated, monounsaturated and polyunsaturated fatty acids (I = 1 … 3) and especially linoleic, linolenic and arachidonic (i = 1…6) is not inferior than the fat of beef and pork and can be acknowledged as highly adapted to fat of woman's milk.

Table 3 presents the composition of elements of beef, pork, horsemeat which are used for production of canned foods for children.
As is seen from Table 3, by its microelement composition horsemeat is close to beef, but contains more iron and copper which take part in the process of blood forming, which is a positive factor in curing and prophylactics of anemia.
Results of medical and biological evaluation of canned pork and horsemeat are presented in Table 4.
Analysis of data presented in Table 4 shows that canned horsemeat is not inferior by its biological value to canned pork and beef, and the available lysin tends to increase.
According to clinical tests carried out under the supervision of Dr. Sc. (Med.) Ladodo M.S and Dr. Sci. (Med.) Borovik T.E. high therapeutic efficiency of horsemeat is shown in curing of patients suffering food allergy, anemia, different forms of malabsorbtion of intestines.

Conclusions

Comparative evaluation has shown that horsemeat by its food and biological value is not inferior to beef and pork and can be used not only for healthy children of early age, but also in curative nutrition of children suffering food allergy, anemia, different forms malabsorbtion of intestines.

Table 3. Composition of elements

Mineral elements	Mature woman milk	Horsemeat	Beef	Pork
Macroelements(mg/100g)				
Potassium (K)	45.5	370.0	355.0	316.0
Sodium (Na)	18.0	50.0	73.0	64.8
Calcium (Ca)	25.5	13.0	10.2	8.0
Magnesium (Mg)	3.0	23.0	22.0	27.0
Sulfur (S)	-	-	230.0	220.0
Phosphorus (P)	13.0	185.0	188.0	170.0
Chlorine (Cl)	39.0	-	59.0	48.6
Microelements (µg/100g)				
Iron (Fe)	40.0	3100.0	2900.0	1940.0
Iodine (J)	10.0	-	7.2	6.6
Cobalt (Co)	-	3.0	7.0	8.0
Manganese (Mn)	0.35	30.0	35.0	28.0
Copper (Cu)	30.0	206.0	182.0	96.0
Molybdenum (Mo)	-	-	11.6	13.0
Fluorine (F)	10.0	-	63.0	69.3
Chromium (Cr)	-	-	8.2	13.5
Zinc	140.0	-	3240,0	2070.0
Vitamins				
A, mg/100g	0.055	-	Traces	Traces
E, mg/100g	0.43	0.8	0.57	0.54
B_6, mg/100g	0.018	-	0.37	0.4
B_{12},µg/100g	0.05	-	2.6	-
Biotin, µg/100g	0.48	-	3.04	-
Niacin, mg/100g	0.2	3.0	4.7	2.8
Pantothenic acid,mg/100g	0.45		0.5	-
Riboflavin, mg/100g	0.06	0.1	0.15	0.16
Tiamin, mg/100g	0.02	0.07	0.06	0.6
Folacin, µg/100g	1.4	-	8.4	4.4
Choline, mg/100g	14.0	-	70.0	-

Table 4

Indices	**Puree from horsemeat**	**Puree from pork**	**Puree from beef**
Coefficient of protein efficiency (KEB)	2.92 (0.27)	2.98 (0.31)	3.00 (0.3)
Net utilization of protein	74.80 (1.72)	75.23 (1.44)	69.83 (1.3)
Digestibility (D), %	95.60 (1.40)	96.70 (1.24)	91.80 (0.9)
Cholesterol in blood serum, mg %	80.31 (4.08)	86.95 (3.81)	85.60 (3.7)
Available lysin, mg/100g of product	51.78 (0.51)	51.76 (0.53)	51.78 (0.50)

References

1. Lipatov N.N., Sazhinov G.Yu.,.Bashkirov O.I. Formalized analysis of amino- and fatty acid balance of raw materials which have good prospects for design of foods with pre-determined food value for child nutrition // Khraneniye i pererabotka selkhozsyrya. -–2001, №8, 11-14
2. Korolev A.A., Sukhanov B.P. Influence of alimentary calcium on adaptation level of organism under loading of caesium-137 and lead. // Voprosy pitaniya, 1996, №3, pp. 34-38