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Nutrition Value of Deer, Wild Boar and Beaver Meat Hunted in Latvia

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Abstract. A game animals – deer (*Cervus elaphus*), wild boar (*Sus scrofa scrofa*) or beaver (*Castor fiber*) - every autumn and winter period provide an excellent investment, diversification of many consumer meals. In last years consumption and assortiment of game meat products significantly increase. Investigations about biochemical composition of game meat are not very much. The meat of wild animals is more favourable for human health because it has lower saturated fatty acids content, but higher content of protein. Investigations were carried out in wild animals different regions of Latvia. In the studied samples protein, intramuscular fat, fatty acids, cholesterol and microelement content were determined. The results of the conducted research suggest, that game meat samples have higher protein and essential fatty acid content in comparison with domestic animals. The amount of fat in all analyzed samples does not differ greatly, allthough the fatty acid composition in wild game meat differs significantly. It was calculated the ratio of total saturated fatty acids, ω-6 and ω-3. When evaluating the microelement content of the meat there is a great difference in iron and manganese.

Keywords: Game meat, Dietetic product

1. Introduction

The statistics show that there are registered around 33.000 hunters, out of which 17.000th are actively huntsmens in Latvia. During the hunting produced an average of around 2624 tons (2548 – auhiliaries service) of game meat in Latvia. Wild game meat is considered as significant source of healthy food, and its share in consumption in recent years, increasing in size. Currently among consumers there is increased interest in meat from animals kept in conditions as close as possible to the natural ones. Such a requirement is undoubtedly fulfilled by game meat characterized by high nutritional value and special sensory properties, desired by consumers [1] and [2].

In food pyramid meat is one of the products to be used moderately - about one-fifth of all food. It provides the organism with the wholesome, highly digestible proteins. Protein varies among the meat animal species, its content ranges between 13 and 23% of the fresh weight [3].

The amino acid profile is important because some amino acids cannot be synthesized by human organism and therefore must be supplied by the diet. Meat is rich in so-called essential or indispensable amino acids –lysine, leucine, isoleucine, and sulfur-containing amino acids – and in this sense meat has a highly-quality protein [4]. Meat is important iron, phosphorus, copper and manganese source. Depending on the type of meat there also are 1 - 10% fat. Meat quality is a wide-ranging term, encompassing such diverse issues as technological, nutritional, hygienic and sensoric. Many factors have an impact on ruminant, wild boar and beaver meat quality; they can generally be divided into two categories: somatic factors (e.g. breed, age, sex) and environmental factors (e.g. diet, climate, hunting procedures) [5]. Meat characteristics may be changed due to the dietary components particularly fat content and composition [6] and [7].Any improvement of meat production by nutritional means should take into consideration the composition and

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palatability of the meat and human health. Polyunsaturated fatty acids are not produced in human organism therefor these must be commited with products of animal origin mostly fish, but wild animals meat also is one of good source, specialy meat of beaver.

Composition of fatty acids, especially ratio of polyunsaturated fatty acids (PUFA) to saturated fatty acids (SFA) PUFA/SFA, is more significant for human health than total fat content. MacRae et al. noted that lowering content of saturated fatty acids, especially myristic acid (C14:0) and lauric acid (C12:0) improve level of cholesterol in blood and lowered risk of heart diseases [8]. Wood reported that recommended ratio PUFA/SFA must be higher than 0.4 and that domestic animals it has too low 0 [9]. On other hand too much polyunsaturated ω-6 fatty acids level give undiserable impact to human health because produced eicoasanoids (C20:3) of inflammation, but inflammation are involved in the development of heart diseases and cancer. Enriching diet with polyunsaturated ω-3 fatty acids lowered risk of atherosclerosis, hipertension and artrite in human organism. Both ω-6 and ω-3 fatty acids are essential for humans, and our diet must contain balanced amounts [10] and [11]. Therefore ratio ω-6/ω-3 is such significant. World Health Organization [12] suggest mentioned ratio lower than 4. This ratio is lower if animals are grazed because green forage has higher content of linoleic acid [9].

Typical for meat are saturated fatty acids. Such ruminants as cattle and sheep has higher content of SFA 44-46%, wild animals has lower content of its 41% [13].Strategies that lead to an increase in the PUFA/SFA ratio in intramuscular fat would improve the healthiness of meat from a consumer perspective [14].

The aim of our investigation was to analyse the composition of deer, wild boar and beaver meat and to compare the amount of essential amino acids, composition of fatty acids and microelement content.

2. Material and Methods

Meat samples (*m. logissimus lumborum*) were collected in the autumn-winter season. The research was conducted at the laboratory of Biochemistry and Microbiology of the Research institute of Biotechnology and Veterinary Medicine „Sigra". The chemical analyses of 40 samples were done, i.e. deer, wild boar and beaver meat samples after hunting in whole regions in Latvia were collected. In the studied samples protein, fat, ash,cholesterol content amino and fatty acids composition were determined. Sample preparation was made in 48 hours after slaughtering or hunting. Meat samples of abaut 300 g were homogenized with BŰCHI B-400 (ISO 3100-1).

Protein content was determined as total nitrogen content by Kieldahl method and using coefficient 6.25 for calculation (ISO 937:1974).

Intramuscular fat content was made by Sochlet method with hidrolysis procedure (boiling in the hydrochloric acid) using SoxCap 2047 and SOX TEH 2055 equipment (FOSS) (LVS ISO 1443:1973).

Cholesterol content was detected by Blur colorimetric method using spectrometer [15].

Fatty acids analysis of meat. Homogenized meat samples were prepared for GLC (gas-liquid chromatography) analysis using direct saponification with KOH/methanol followed by a derivatization with (trimethylsilyl) diazomethane by the method of Aldai et al [16] An ACME, model 6100, GLC (Young Lin Instrument Co.) equipped with a flame ionisation detector, an automatic sample injector, and an Alltech AT-FAME analytical column (fused silica 30m×0.25mm i.d.) was used. As the carrier gas He was used with a flow rate approximately 2 mL/min. Temperature conditions of the oven, injector and detector was the same as in the method of Aldai et al. [16]. Results were evaluated with an conventional integrator program (Autochro-2000, Young Lin Instrument Co.) The individual fatty acid methyl esters were identified according to similar peak retention times using standard mixture Supelco 37 Component FAME Mix.

Micronutrient amount of meat are measured according to ISO 6869-2002. Methods are based on comparision of radiation absorption emmited by free metal atoms, that are forming by spraying ashed sample and the concentrations of certain metal solutions in the flames. In the laboratory to determine the atomic absorption is used spectrometer Analyst 200.

The statistical analysis was performed using SPSS 17. One-way ANOVA was used for comparison mean values. Statistical significance was declared at $p < 0.05$.

3. Results and Discussion

Biochemical composition of meat samples were evaluated and results are assumed in the Table I. From results of investigation we can conclude that calculated content of protein in samples of game meet was 21.81–22.92%, richest were samples of wild boar meet.

Table I: Biochemical composition of game meat

Group	Protein, %	Fat, %	Ash, %	Cholesterol, mg $100g^{-1}$
Deer	22.36 ±1.37	1.90 ±1.29	1.13 ±0.07	70.57 ±2.49
Wild Boar	22.92 ±2.88	2.82 ±1.26	1.15 ±0.14	95.07 ±7.88
Beaver	21.81±2.93	3.63±1.70	1.2 ±0.03	49.54 ±2.02

Results of the investigation showed that fat content of meat samples varied from 1.90% till 3.63%. Intramuscular fat content determined in meat samples of deer was the lowest and the highest in meat samples of beaver. Results of statistical analysis showed that content of intramuscular fat content in game meat samples differ significantly ($p = 0.021 < 0.05$). Content of cholesterol in game meat samples varied from 49.54 mg $100g^{-1}$ in meat samples of beaver till 95.07 mg $100g^{-1}$ in meat samples of wild boar. The results of our investigation are similar with other research findings, where protein content in raw deer meat samples was reported 21.7%, in wild boar meat samples 21.9% [17] and in beaver meat samples 20.9 – 21.8% [18]. Game meat possesses profitable chemical composition as a raw material of high content of protein and low content of intramuscular fat in comparison with beef. The investigation of beef samples obtained in organic production sistem in Latvia showed that average protein content was 19.61%, but content of intramuscular fat was 1.48% [19].

At the human body vitally necessary (essential) amino acids is added lysine, isoleucine, phenylalanine, tryptophan, leucine, methionine, threonine, valine. Each of these amino acids have a role to play in the body. Comparison of essential amino acids among deer, wild boar and beaver meat samples showed in Figure 1.

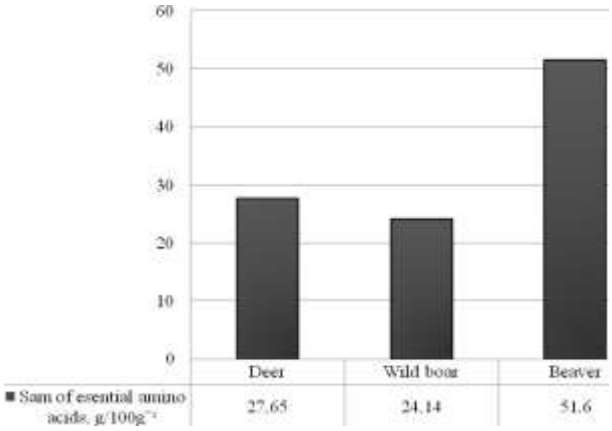

Fig. 1:Comparison of sum of essential amino acids among meat samples of animal species.

As we can see in Figure 1. amount of essential amino acids has higher in beaver meat samples (51.6 $g100g^{-1}$) than in deer samples (27.65 $g100g^{-1}$). According to all of the detected amino acid scores the protein in game meat muscle is well-balanced in essential amino acid composition and is of high quality, specifically beaver.

Composition of dietary fat is more significant for consumers than total fat content, therefore were compared composition of fatty acids, sum of saturated, monounsaturated, polyunsaturated fatty acids. Comparison is shown in Table II. Results of investigation showed that lowest content of saturated fatty acids

has meat samples of beaver meat – 26.37%. Highest sum of saturated fatty acids had deer meat samples – 42.13% and it is in agreement with Petkov [6].

Table II: Comparison of fatty acids composition of meat

Fatty acid class	Deer	Wild Boar	Beaver
Sum **saturated**	**42.13**	**34.79**	**26.37**
Stearic (C 12 :0)	0.30	0.11	0.15
Myristic (C 14 :0)	4.57	2.92	1.26
Palmitic, (C 16 :0)	21.02	23.12	17.08
Sum **mono-unsaturated**	**26.57**	**35.63**	**22.11**
Sum **polyunsaturated**	**23.47**	**17.25**	**41.00**
Sum Omega-3*	6.20	2.89	19.19
Sum Omega-6**	17.05	13.89	21.57
ω-6/ω-3	2.75	4.81	1.1
P/S ratio	0.68	0.50	1.6

* Linoleic and arachidonic acids

** Linolenic acid

Increases in dietary levels of saturated fat, particularly 12:0, 14:0 and 16:0 (palmitic acid) have been identified as the major dietary factor responsible for raising total and LDL serum cholesterol concentrations [20]. From the results of investigation we can establish that average content of myristic and lauric acids that more of all influenced cholesterol level in human blood, significantly lower determined in meat samples of beaver. The content of palmitic acid in samples of beaver meat was detected 17.08 %, but content of myristic acid – 1.26%.

The sum of PUFA in game meat samples variet from 17.25% till 41.00%. The highest content of the sum of PUFA had meat samples of beaver. Although ω-6 fatty acids are essential for health, people tend to consume too much of these substances, and arachidonic acid in particular is associated with inflammation. Inflammation can contribute to accumulation of plaque in arteries, which may increase the risk of coronary artery disease, heart attack and stroke [21].

The ratio ω-6/ω-3 lower than 4 was suggested by World Health Organization. From results of investigation we can see that in samples of game meat this ratio varied from 1.1 in beaver meat till 4.81 in wild boar meat samples, Medeiros et al [22] reported that ratio ω-6/ω-3 of deer meat is 3.45. Wild boar meat samles are exception, it does not the size of the proposed by WHO.

As mentioned above, recommended ratio P/S must be higher than 0.4. High relative percentages of PUFA are characteristic of all wild ruminant muscle tissue, whereas the relative percentage of PUFA in the muscle tissue of wild boar lower than that found in wild ruminants and beaver. Results of investigation show that P/S ratio higher than 0.4 has all game meat samples, it varied from 0.50 till 1.6. Medeiros et.al. reported that ratio P/S of beef samples is 0.38 [22].

Iron in meat depends on the amount of fat and blood. Meat samples of wild animal species contained iron from 2.3 mg kg^{-1} in dear meat samples to 3.44mg kg^{-1} in wild boar meat samples, whereas beef samples contained 1.69 mg kg^{-1} [19]. Manganese detected up to two times more from 0.02 to 0.27 mg kg^{-1}, than beef samples of 0.009 mg kg^{-1}. Most zinc contains wild boar samples from 3.73 mg kg^{-1}. More copper containing beaver (0.19 mg kg^{-1}) than dear (0.09 mg kg^{-1}) and wild boar (0.07 mg kg^{-1}) meat samples. All animal species meat samples are excellent sources of trace elements.

Meat of wild animals is more favorable for human health because it has lower SFA content but higher content of polyunsaturated fatty acids [23], also, wild boar meat. Meat and fat of wild animals has significantly higher content of long chain fatty acids ω-3, iron and manganese than meat of domestic animals [24].

4. Conclusions

Protein content in samples of game meat were detected 22.36 - 22.92%, richest were samples of wild boar meat. Fat content of game meat samples varied from 1.33 - 3.23%.

The sum of essential amino acids in game meet samples were determined from 27.06 – 45.70 g 100g-1

From the dietetic point of view the best composition of fatty acids has meat samples of beaver, it could be n-3 PUFA-rich food in human diets.

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