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Evaluation of Protein Composition of Game Meat in Latvian Farms and Wildlife

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Abstract. The meat of wild animals is highly favourable for human health because it has lower SFA content than domestic animals but higher protein content. In recent years consumption and assortment of game meat products has significantly increased. Deer farms are being established. There have been few investigations of the biochemical composition of game meat, therefore, the aim of the investigation was to evaluate protein composition of game meat in Latvian farms and wildlife. The investigations were carried out in different regions of Latvia. The chemical analyses of 76 samples were made, i.e. wild deer (18), farm deer (12), roe deer (16), elk (18), wild boar (12) meat samples were collected after hunting in the Vidzeme and Latgale regions of Latvia. Protein, amino acids and the content of connective tissue (4-hidroxiproline) were determined in the studied samples. Protein protein ranged from 22.21–23.59%. The content of connective tissue ranged from 2.22% in elk meat up to 3.09% in roe deer. The sum of essential amino acids in game meat samples was determined from 27.06–45.70 g 100 g^{-1}. Elk meat had the highest protein content and lowest content of connective tissues among the game meat.

Key words: amino acids, connective tissue, dietetic product, game meat, protein

INTRODUCTION

Protein varies among the meat animal species: its content ranges between 13 and 23% of the fresh weight (Honikel, 2009). The amino acid profile is important because some amino acids cannot be synthesized by human organisms 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 high-quality protein (Young et al., 2001). Consumers expect the meat products on the market to have the required nutritional value, to be wholesome, lean, and have adequate juiciness and tenderness. Connective tissue is an extracellular network of proteins, which is also decisive for meat tenderness. The most esteemed cuts of meat in a carcass are those that have a low content of connective tissue. That is why in many countries, in addition to protein content, a value for connective tissue is determined and used as a part of the quality characteristic of the meat.

In recent years the assortment and consumption of game meat products have significantly increased, but investigations about the biochemical composition of game meat are few. Deer farms have been established, and the biochemical composition of farm deer meat has been analysed in recent years, but data about the nutritive value and composition of elk, roe deer or wild boar are not sufficient. Therefore the aim of the

investigation was to evaluate the protein composition of game meat in Latvian farms and wildlife and to compare different game species.

MATERIAL AND METHODS

Experimental design

The chemical analyses of 76 samples were made, i.e. wild deer (18), farm deer (12), roe deer (16), elk (18), wild boar meat (12) using samples collected after hunting in the Vidzeme and Latgale regions of Latvia. Meat samples (*m. logissimus lumborum*) were collected in the autumn-winter seasons from 2007-10. The research was conducted at the laboratory of Biochemistry and Microbiology of the Research Institute of Biotechnology and Veterinary Medicine 'Sigra'. In the studied samples, protein, amino acids and protein of connective tissue were determined. Sample preparation was made within 48 hours after slaughtering or hunting. Meat samples of 200–400 g were homogenized with BŰCHI B-400.

Methods

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

Amino acids: dried, defatted meat samples were treated with constant boiling 6N hydrochloric acid in an oven at around 110°C for 23 h. Hydrolyzate was diluted with 0.1% formic acid. The sample (2 ml) was filtered using a syringe filter with 0.45 μm nylon membrane. Amino acids were detected using reversed-phase HPLC/MS (Waters Alliance 2695, Waters 3100, column XTerra MS C18 5 μm, 1 x 100 mm). Mobile phase (90% acetonitrile: 10% dejonized water) 0.5 ml min^{-1}, column temperature. 40ºC. Data acquisition used programme Empower pro.

Connective tissue protein was calculated via determination of specific amino acid 4-hydroxiproline, which is exclusively present in collagen. Meat samples were hydrolyzed in acid (3.5 M H_2SO_4 at ~105ºC). The 4-hydroxiproline was oxidized with chloramine-T to a pyrrole. With 4- dimethylaminobenzaldehyde a red color develops, which is measured spectrometrically at 560 nm (ISO 3496:1994(E)). Collagen is calculated by 8x the concentration of 4-hydroxiproline and expressed as % of total protein (Honikel, 2009).

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

RESULTS AND DISCUSSION

The calculated content of protein in samples of game meat was 22.21–23.59%; elk meat samples were the richest. The protein content of farm deer meat samples has a wider interval of varieties than the wild deer meat samples, which could be the result of additional feed portions from October till March for farm deer. The results of the statistical analysis showed that the total protein content in the ruminants' meat did not differ significantly ($F = 1.286$; $P = 0.297 > 0.05$). The results of our investigation are similar with other research findings, where protein content in raw deer meat samples was reported as 21.7%, in boar meat samples 21.9% (Paleari et al., 2003) Protein composition and fat content of game meat samples are compared in Table 1.

Table 1. Biochemical composition of meat samples.

Species	*n*	Protein content, %	Minimum	Maximum	Connective tissue content, %	Fat content, %
Wild deer	18	22.36	19.64	23.94	2.50	1.60
Farm deer	12	21.84	19.76	23.41	2.31	2.44
Roe deer	16	22.82	18.61	25.40	3.09	1.59
Elk	18	22.72	21.69	23.27	2.22	1.31
Wild boar	12	22.92	18.16	25.88	2.86	2.82

Connective tissue is decisive for meat tenderness, therefore the connective tissue content in game meat samples was determined; it ranged from 2.22% in elk meat till 3.09% in roe deer meat. Meat protein generally contains 2.5–12% connective tissue protein (Honikel, 2009). Accordingly, game meat could be classified as high quality meat.

Average contents of amino acids in game are shown in Table 2; it significantly differed among species ($P < 0.05$).

Table 2. Content of amino acids in meat samples.

Amino acid	Average content of amino acid, g kg^{-1}				
	Wild deer Mean ± SD	Farm deer Mean ± SD	Roe deer Mean ± SD	Elk Mean ± SD	Wild boar Mean ± SD
n	18	12	16	18	12
Valine	3.47 ± 0.66	5.26 ± 0.79	3.88 ± 0.36	4.03 ± 0.58	3.22 ± 0.55
Isoleucine	3.22 ± 0.44	5.22 ± 0.51	3.68 ± 0.06	3.75 ± 0.34	2.71 ± 0.55
Leucine	5.55 ± 1.08	9.00 ± 0.94	6.15 ± 0.60	5.93 ± 0.95	5.42 ± 0.54
Lysine	6.19 ± 1.03	9.54 ± 0.98	6.4 ± 0.78	6.72 ± 0.98	5.03 ± 0.30
Threonine	3.73 ± 1.83	4.95 ± 0.72	4.2 ± 0.35	3.96 ± 0.36	2.46 ± 0.19
Tryptophan	1.13 ± 0.21	1.04 ± 0.18	1.10 ± 0.19	1.07 ± 0.31	0.98 ± 0.15
Phenylalanine	2.8 ± 0.73	5.04 ± 0.94	3.45 ± 0.37	3.08 ± 0.54	2.27 ± 0.52
Methionine	1.56 ± 0.71	2.53 ± 0.72	1.7 ± 0.30	1.78 ± 0.39	2.05 ± 0.28
Tyrosine	3.67 ± 1.02	4.53 ± 0.61	4.2 ± 0.31	4.2 ± 0.36	2.49 ± 0.63
Arginine	4.92 ± 1.52	5.94 ± 0.95	5.24 ± 0.81	4.34 ± 0.33	4.81 ± 0.21
Histidine	2.31 ± 0.79	2.68 ± 1.71	1.03 ± 0.51	2.41 ± 0.24	2.13 ± 0.33
Aspartic acid	6.76 ± 0.98	8.07 ± 0.73	7.54 ± 0.74	6.67 ± 0.72	6.41 ± 0.89
Serine	2.22 ± 0.52	3.01 ± 0.65	2.67 ± 0.36	12.12 ± 1.07	2.17 ± 0.18
Glutamine	14.95 ±2.17	14.11 ± 1.36	13.26 ± 1.28	14.88 ± 1.63	12.15 ± 0.93
Proline	2.44 ± 0.32	3.0 ± 0.52	2.73 ± 0.48	2.61 ± 0.44	2.38 ± 0.61
Glycine	2.86 ± 0.48	4.28 ± 0.63	3.48 ± 0.41	3.15 ± 0.42	3.59 ± 0.57
Alanine	4.77 ± 1.16	5.19 ± 0.49	4.48 ± 0.39	4.87 ± 0.61	3,68 ± 0.25

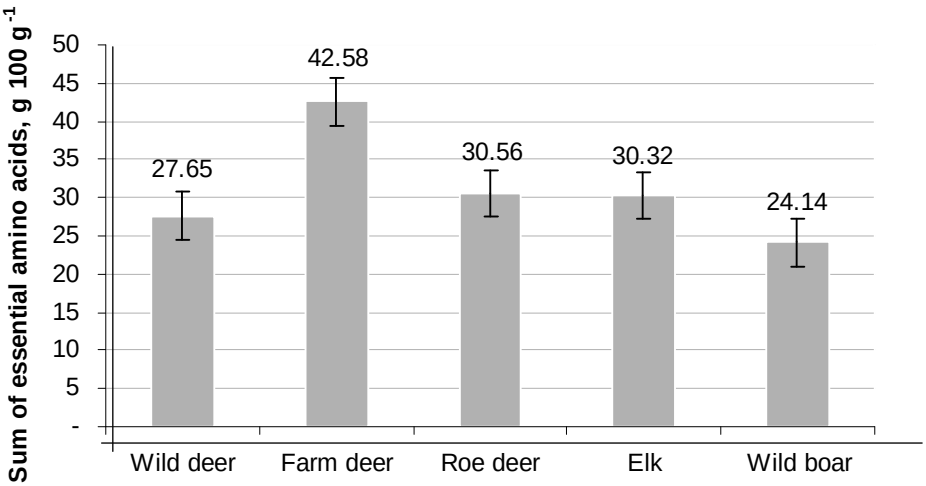

Figure 1. Comparison of sum of essential amino acids in meat samples

As we can see in Fig. 1, the amount of essential amino acids was higher in the farm deer meat samples (42.58 g 100 g^{-1}) than in wild deer samples (27.65 g 100 g^{-1}). It could be result of supplemental feeding of farm deer at the end of the winter season. The high quality protein of deer meat is a good supplement for a healthy daily human diet.

CONCLUSIONS

1. Content of protein in samples of game meat ranged from 22.21 up to 23.59%; it did not differ significantly among game meat species.
2. Elk meat had the highest protein content and lowest content of connective tissues among game meat.
3. The sum of essential amino acids in game meat samples was determined within limits from 27.06 up to 45.70 g 100 g^{-1}
4. The high quality protein of deer meat is good supplement for a healthy daily human diet.

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