NUTRITIONAL CHARACTERISTICS OF WILD BOAR MEAT HUNTED IN LATVIA

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Abstract

Wild game meat is considered as significant source of healthy food, and its share in consumption in recent years, increasing in size. Investigations about biochemical composition of game meat, including wild boar (*Sus scrofa scrofa*) meat are not very much. Aim of our investigation was evaluate nutrition value of wild boar meet after hunting in Latvia. Nutritional characteristic of wild boar meat was based on the investigations carried out in different regions of Latvia. In the studied samples protein, amino acids, intramuscular fat, fatty acids, cholesterol and microelement content were determined. The average protein content detected in wild boar meat samples were 20.88 mg 100 g^{-1} fat content 3.45 mg 100 g^{-1}. It was calculated the ratio of total saturated fatty acids, ω-6 and ω-3, results are 42.98; 13.63 and 3.05% of total fatty acids content respectively. The content of microelements Fe and Zn in samples were 8.25 and 8.52 mg kg^{-1} it was higher than provides with meat of domestic animals. The results of investigation confirmed preference of wild boar meat in human health in comparison with beef or pork.

Keywords: game meat, nutritional value, dietetic product.

Introduction

Wild boar is a species that is utilised for food and sport hunting throughout the world and the potential of farming wild boars have stimulated interest in this species as a meat producer. In the last years consumption and assortiment of game meat products significantly increased. The public attention is especially paid to inhabitants health and value, through the consumption of wholesome food. Wild game meat characterized by high nutritional value and special sensory properties, desired by consumers is (Soriano et al., 2006; Rywotycki 2003) considered as significant source of healthy food. Since the amino acid composition of proteins from food animals is similar to human muscle and muscle makes up almost 50% of our body's weight, meat is an excellent source of the amino acids needed for growth, repair, and maintenance.

Similarly to other monogastric animals, meat fatty acid composition of wild boars depends on the diet provided (Di Matteo et al., 2003). This is also evident in depot fat from wild boars where, in contrast to ruminants, double bonds of fatty acids are not hydrogenated during digestion (Meyer et al., 1998). In nature, wild boars eat a great variety of indigenous plants, grains, seeds, roots, fruits, insects, earthworms, slugs and small mammals, with the bulk of food consumed consisting of plant material therefore their meat has balance in vitamins and microelements (Schley, Roper, 2003). The vitamin B_{12} is important for growth and development of human organism and can only be found in the food of animal origin. Investigations about biochemical composition of game meat, including wild boar (*Sus scrofa scrofa*) meat are not very much in Latvia.

Aim of our investigation was evaluate nutrition value of wild boar meet after hunting in Latvia.

Materials and Methods

Meat samples of wild boar (*Sus scrofa scrofa*) muscles (*m. logissimus lumborum*) were collected in the autumn-winter season. The investigations were conducted at the laboratory of Biochemistry and Microbiology of the Research institute of Biotechnology and Veterinary Medicine „Sigra". In the studied samples (n=12) protein, fat, ash and cholesterol content, amino acids and fatty acids composition and micronutrient amount were determined. Sample preparation was made in 48 hours after slaughtering or hunting. Meat samples of about 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).

Amino acids. Dried, defatted meat samples are treated with constant boiling 6N hydrochloric acid in an oven at around 110 °C for 23 h. Hydrolyzate diluted with 0.1% formic acid. Sample (2 mL) was filtered using siringe filter with 0.45 μm nylon membran. Amino acids were detected using reversed-phase HPLC/MS (Waters Alliance 2695, Waters 3100, column XTerra MS C18 5 μm, 1×100 mm). Mobile phase (90% acetonitrile: 10% deionized water) 0.5 mL min^{-1}, column temperature 40 °C. Data acquisition was done using programm Empower pro.

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 (Шманенков, 1973).

Fatty acids. 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 (2006) An ACME, model 6100, GLC (Young Lin Instrument Co.) equipped with a flame ionisation detector, and an Alltech AT-FAME analytical column (fused silica 30 m×0.25 mm i.d.) was used. The individual FAMEs (fatty acid methyl esters) were identified according to similar peak retention times using standard mixture Supelco 37 Component FAME Mix. The relative proportions of total saturated fatty acids and unsaturated and ω-6 fatty acids and ω-3 was calculated.

Micronutrient amount of meat are measured according to ISO 6869-2002. Methods are based on comparison 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 experimental design was randomised and data were evaluated by analysis was performed using SPSS 17. One-way ANOVA was used for comparison mean values. Statistical significance was declared at $p<0.05$. Research provides information on the biochemical composition of wild game meat: protein, fat, cholesterol, fatty acids, amino acids and trace amount that can eat any of us with 100 g of meat.

Results and Discussion

Obtained results of dry matter, protein, intramuscular fat, ash and cholesterol determined in wild boar meat samples assumed in Table 1.

Table 1

Biochemical composition of wild boar meat

Parameters	Wild boar meat	Standard deviation
Dry matter, %	25.38	0.62
Protein, %	20.88	2.99
Collagen content, %	30.24	1.42
Connective tissue protein, %	1.45	0.08
Intramuscular fat, %	3.45	1.67
Ash, %	1.14	0.13
Cholesterol, mg $100g^{-1}$	98.11	6.27

Content of protein in samples of wild boar meet was determined from 19.55% to 23.18%, average protein content 20.88±2.99%. The results of our investigation are similar with other research findings, where protein content in wild boar meat samples was reported 21.9% (Paleari et al., 2003) or 21.74–22.1% (Postolahe et al., 2011).

Results of investigation showed that the intramuscular fat content of wild boar meat determined from 1.63% to 4.27%, average content 3.45±1.67%. Scientific reports showed a wide range of results, depending of found feed intake the fat content determined: 1.23–4.27% (Quaresma et al., 2011), 3.5–5.2% (Zomborszky et al., 1996) or in the Poland 1.95% (Zmijewska, Korzeniowska, 2001).

The connective tissue protein, which in meat is also decisive for its tenderness, general contains 2.5–12.0% (Honikel, 2009). The connective tissue protein content determined in wild boar meet samples was 1.45%.

The meat samples of wild boar had higher cholesterol content – 98.11 mg 100 g^{-1} than determined in deer deer (74.23±2.49 mg 100 g^{-1}) or beef (67.92±7.99 mg 100 g^{-1}) samples (Strazdina, 2012). The cholesterol content in meat from wild boars hunted in Portugal was reported 55.6 mg 100 g^{-1} for female and 58.7 mg 100 g^{-1} for male (Quaresma et al., 2011)

The protein composition is more significant for human nutrition as protein content. Not all proteins have the same nutritional value; protein quality strongly depends on its amino acid composition and digestibility.

Table 2

Amino acid composition

Amino acid group	AA content, g 100 g^{-1}	Standard deviation
Σ Indispensible amino acids	7.30	1.12
Σ Partly indispensible amino acids	6.00	0.66
Σ Sulfur containing*	1.65	0.14

*(Phe + Tyr)

FAO/WHO recommended intake of total indispensable amino acids is 83.5 mg on kg of body weight per day (Essential amino acids) it is 5.8 g per human with body weight 70 kg

Since net protein utilization is affected by the limiting amino acid (the sum of phenylalanine and tyrosine or SCA), wild boar meat samples must be evaluated as source of protein with high biological value. The glutamic acid is the main one assigned meat taste. The content of glutamic acid determined 3.24 g 100 g^{-1} in wild boar meat samples.

The assumed essential amino acids in wild boar muscle protein – composition and scores are showed in Figure 1.

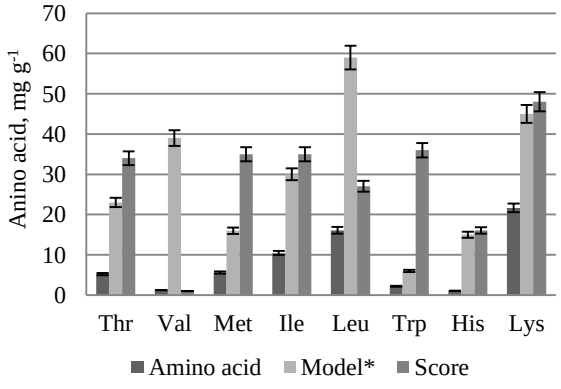

Figure 1. The sum of essential amino acids in wild boar muscle protein

*- model WHO/FAO/UNU (2007)

Amino acid score for SCA in the model protein defined 22, calculated score for wild boar meat is 75. The assumed amino acid score showed that biological value or the ability absorbed protein from wild boar meat to fulfil human amino acid requirements is high.
Evaluation of fatty acid composition of wild boar meat was made. Results of determined saturated, monounsaturated and polyunsaturated fatty acids demonstrated in Figure 2.

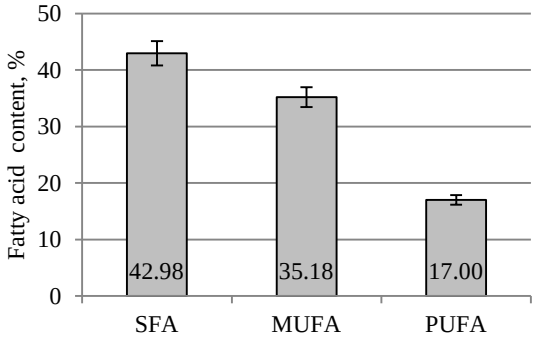

Figure 2. Fatty acid composition of wild boar meat samples, % of total fatty acids
SFA – saturated fatty acids, MUFA – monounaturated fatty acids, PUFA – polyunsaturated fatty acids

The results of investigation showed that average content of saturated fatty acids in wild boar meat assumed 42.98% of total fatty acids content. Saturated fatty acids content determined in pigs meat was higher – 45.97% (Jansons, Jemeljanovs, 2013), but not in wild deer meat – 33.34% (Strazdina et al., 2012). Scientific reports show lower saturated fatty acid proportion – 34.72% of total fatty acids in the *M. serratus anterior* from wild boars shot in the winter in a park in Hungary (Sales, Kotrba, 2013). Scientific reports show higher proportion of MUFA – 38–44% in wild boar meat (Quaresma et al., 2011, Razmaité et al., 2012) in comparison with our results. The proportion of polyunsaturated fatty acids determined in wild boar meat samples hunted in Latvia – 17% was in agreement with those obtained by Razmaité et al., – 17.9% PUFA determined in smples of male and 18.8% in samples of female (2012). Ratios ω-6 / ω-3 and PUFA / SFA showed in Table 3.

Table 3
Proportion of polyunsaturated fatty acids and ratios

Fatty acid	Wild boar meat	Standard deviation
ω-3, % of total fatty acid	3.05	0.21
ω-6, % of total fatty acid	13.63	0.20
ω-6/ω-3	6.13	0.31
PUFA/SFA	0.40	0.05

World Health Organization (2003) recommended ratio PUFA/SFA must be higher than 0.4 and scientific reports showed that domestic animals it has too low 0.1 (Wood et al., 2003). Quaresma reported higher ratio PUFA/SFA – 0.5 (males) to 0.6 (females) and higher ω-6 / ω-3 – 15.5 (females) to 17 (males) in wild boar meat hunted in Hungary because sum of ω-6 were detected 21–24% and sum of ω-3 just 1.4% (Quaresma et al., 2011).
Next to the favorable composition of fatty acids the game meat also contains B vitamins in large quantities. The following vitamins of the meat were examined: A, D, E, B_1, B_2, B_6, B_{12}, Niacin, Pantotenic, Folic acid, results are showen in Table 4.

Table 4
Vitamin content in wild boar meat, mg 100 g^{-1}

Parameters	Wild boar meat	Standard deviation
Fat-soluble vitamins		
Vitamin A	n.f.	0.00
Vitamin D	0.02	0.00
Vitamin E	0.38	0.03
Water-soluble vitamins		
Vitamin B_1	0.39	0.06
Vitamin B_2	0.26	0.02
Vitamin B_6	0.37	0.23
Vitamin B_{12}	0.01	0.02
Niacin	4.43	0.41
Pantotenic	0.68	0.04
Folic acid	0.01	0.00

n.f.-not found

In *M. psoas major* from wild boars, 71% of total vitamin E homologues were represented by α-tocopherol (Quaresma et al., 2011). Alpha-tocopherol was higher in adult males (19.2 μg g^{-1} meat) and females (18.1 μg g^{-1} meat), compared to youngsters (15.5 μg g^{-1} meat). Similarly, differences between maturity groups were detected in γ-tocopherol, with mean values of 1.75, 1.61 and 1.14 μg g^{-1} meat for adult males, adult females and youngsters, respectively. Alpha-tocopherol concentration in wild boar meat reported by Quaresma et al. (2011) was higher than concentrations of g 15.1–16.3 μg meat found by Jensen et al. (1997)
Red meat contains a number of B vitamins: thiamin (vitamin B_1), riboflavin (vitamin B_2), pantothenic acid, folate, niacin (vitamin B_3), vitamin B_6 and B_{12}. Meat, fish and animal-derived foods, such as milk, are the only foods that naturally provide vitamin B_{12}. For this reason, if you exclude such foods from your diet, you are at risk of having inadequate intakes. Red meat is a rich source of vitamin B_{12} (Mann, 2000) and about 35% of vitamin B_{12} intake comes from meat and meat products (Henderson, 2003). Dietary intakes of vitamin B_{12} are lower from vegetarian diets, and are particularly low in vegan diets (Phillips, 2005; Li et al., 2005) (which contain no animal foods), thus indicating the important contribution of meat and animal - derived products to B_{12} intake.
The following chemical parameters of the meat were examined: calcium, phosphorus, potassium, sodium, magnesium, iron, manganese, potassium, sodium,

magnesium showed in Table 5. The content of microelements Fe and Zn in samples were determined – 8.25 and 8.52 mg kg^{-1}. The amount of iron, phosphorus and potassium determined in the *m. longissimus dorsi* was 7.701 mg, 752 mg and 1114 mg per 100 grams of dry matter, respectively.

Table 5

The mineral content in wild boar meat

Parameters	Wild boar meat	Standard deviation
Macroelements, mg 100 g^{-1}		
Ca	3.22	0.21
P	91.15	0.31
K	930.71	3.17
Na	20.43	0.74
Mg	7.31	0.33
Fe	8.25	0.63
Trace elements, mg 100 g^{-1}		
Zn	8.52	0.45
Cu	0.04	0.00
Mn	0.03	0.00

According to Świergosz, Perzanowski, Makosz, and Biłek (1993), means for copper determine 6.4–7.4 mg kg^{-1} dry matter, iron 99.2–110.4 mg kg^{-1} dry matter and manganese 2.9–3.4 mg kg^{-1} dry matter did not vary to a large extent between two different regions in the south eastern part of Poland (Sales, Kotrba, 2013)

Conclusions

Result collected in the study revealed, that meat from wild boars, in many aspects, was characterised as higher quality in comparison to meat from domestic pigs. The percentage of proteins in meat is content 20.88±2.99%, and the proteins also have an above-average biological value- sum of Indispensible amino acids detected 7.30 g 100 g^{-1}. The most important vitamins are B_1 and B_2, as well as vitamin B_{12} that can be found only in food of animal origin. Nutritional value of game meat is completed with micro elements of vital essence: content of Fe, Zn was determined – 3.44 and 3.73 mg kg^{-1} respectively.

Acknowledgment

Publication and dissemination of research results has been made due to the funding of the ERAF Project „Promotion of scientific activities of LUA", Contract Nr. 2010/0198/2DP/2.1.1.2.0/10/APIA/VIAA/020.

References

1. Di Matteo S., Marsico G., Facciolongo A. M., Ragni M., Zezza F. (2003) Chemical and fatty acid composition of meat of wild boars fed on diets containing polyunsaturated fatty acids. *Italian Journal of Animal Science,* No. 2(Supplement 1), p. 418–420.
2. *Essential amino acids - HealthKnot health pages* [accessed on 2.09.2013.]. Available: http://www.healthknot.com/es sential_amino_acids.html
3. Henderson L., Irving K., Gregory J., Bates C. J., Prentice A., Perks J., Swan G., Farron M. (2003) *National Diet and Nutrition Survey. Adults aged 19 to 64 years.* London: The Stationery Office. Vol. 3. 160 p.
4. Honikel. K.O. (2009) Composition and Calories. **In**: Nollet, L.M., Toldra. (eds.): *Handbook of muscle foods analysis.* CRC Press-Book: eBook.ISBN 978-1-4200-4530-7 369-384 p. [accessed 04.02.2011].
5. Jansons I., Jemeljanovs A. (2013) Pork production. **In:** *Latvian population food producing meat characteristic.* Monograph. Research institute of Biotechnology and Veterinary Medicine "Sigra" Sigulda. 2013, p. 157–210. [in Latvian]
6. Li D., Siriamornpun S., Wahlqvist M. L., Mann N. J., and Sinclair A. J. (2005) Lean meat and heart health. *Asia Pacific Journal of Clinical Nutrition,* Vol. 14 No 2, p. 113–119.
7. Meyer H. H. D., Rowell A., Streich W. J., Stoffel B., Hofmann R. R. (1998) Accumulation of polyunsaturated fatty acids by concentrate selecting ruminants. *Comparative Biochemistry and Physiology, Vol.*°120 A,°p.°263–268.
8. Paleari M. A., Moretti V. M., Beretta G., Mentasti T., Bersanni C. (2003) Cured products from different animal species. *Meat sciences,* Vol. 63, No. 4, p. 485–489.
9. Phillips F (2005) Vegetarian nutrition. British Nutrition Foundation *Nutrition Bulletin* Vol. 30, p. 132–167.
10. Postolahe A. N., Ionescu O., Lazar R., Boisteanu P.C. (2011) Quality parameters of wild boar meat (sus scrofa ferus) harvested in northeastern Romania. *Lucrari Ştiintifice Medicina Veterinara,* Vol. XLIV(1), p. 213–222. [in Romanian]
11. Quaresma M. A. G., Alves S. P., Trigo-Rodrigues I., Pereira-Silva R., Santos N., Lemos J. P. C., Barreto A. S., Bessa R. J. B. (2011) Nutritional evaluation of the lipid fraction of feral wild boar (Sus scrofa scrofa) meat. *Meat Science,* Vol.89, p. 457–461.
12. Razmaitė V., Kerziene S., Jatkauskiene V., Nainiene R., Urbšiene D. (2009) Pork quality of male hybrids from Lithuanian Wattle pigs and wild boar intercross. *Agronomy Research,* Vol. 7. No. 1, p. 47–58.
13. Razmaitė V., Švirmickas G. J., Šiukščius A. (2012). Effect of weight, sex and hunting period on fatty acid composition of intramuscular and subcutaneous fat from wild boar. *Italian Journal of Animal Science,* Vol. 11, p. 174–179.
14. Rywotycki R. (2003) The influence of environment, mode of nutrition and animal species on level of nitrosamine contamination in venison. *Meat Science,* Vol. 65, p. 1045–1053.
15. Sales J., Kotrba R. (2013) Meat from wild boar (Sus scrofa L.): A review. *Meat science,* Vol. 94, p. 187–201.
16. Schley L., Roper T. J. (2003). Diet of wild boar Sus scrofa in Western Europe, with particular reference to consumption of agricultural crops. *Mammal Review,* Vol. 33, p. 43–56.
17. Soriano A., Cruz B., Gomez L., Mariscal C, Ruiz A. G. (2006) Proteolysis, physicochemical characteristics and free fatty acid composition of dry sausages made with deer (*Cervus elaphus*) or wild boar (*Sus scrofa*) meat: A preliminary study. *Food Chemistry,* Vol. 96, No.2, p. 173–184.
18. Strazdina V., Jemeljanovs A., Sterna V., Paeglitis D. (2012) Evaluation of nutrition value of deer meat

obtained in Latvian farms and wildlife. **In:** *Landbauforschung. vTI Agriculture and Forestry Research.* Special issue 362: 19.Tackling the Future Challenges of Organic Animal Husbandry. Proceedings of the 2nd Organic Animal Husbandry conference Hamburg/Trenthorst, Germany, p.°478–481.

19. Świergosz R., Perzanowski K., Makosz U., Bilek, I. (1993) The incidence of heavy metals and other toxic elements in big game tissue. *Science of the Total Environment,* Suppl., p. 225–231.
20. WHO/FAO/UNU (2007) *Protein and amino acid requirements in human nutrition*, Report of a Joint WHO/FAO/UNU Expert Consultation, World Health Organization Technical Report Series 935. WHO, Geneva.
21. World Health Organization (2003) *Diet, nutrition and the prevention of chonic diseases.* Report of a Joint WHO/FAO Expert Consultation, Geneva, 160.
22. Wood J. D., Enser M. (2003) Factors influencing fatty acids in meat and the role of antioxidants in improving meat quality. *British Journal of Nutrition*. Vol. 66. No. 1, p. 21–32.
23. Żmijewski T., Korzeniowski W. (2001). Technological properties of wild boars meat. *Electronic Journal of Polish Agricultural Universities* [accessed on 2.02.2014.]. Available online: *http://www.ejpau.media.pl/volume4/issue2/food/art-02.html*
24. Zomborsky Z., Sentmihályi G., Sarudi I., Horn P., Sabó C.S. (1996) Nutrient composition of muscle in deer and boar. *Journal of Food Science*, Vol. 61, p. 625–627.