EVALUATION OF NUTRITION VALUE OF ROMAN SNAIL'S (*HELIX POMATIA*) MEAT OBTAINED IN LATVIA

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Abstract

Roman snail (*Helix pomatia*) meat is a favoured product in many European countries as well as in other continents. Of late, its consumption is growing also in Latvia. Investigations about biochemical composition and nutritional value of snail meat are few. Therefore the following objective was set forth for our research: evaluate the nutrition value of the Roman Snail meat obtained in Latvia. Investigations were performed at the Research Institute of Biotechnology and Veterinary Medicine „Sigra", of Latvia University of Agriculture from 2011 to 2013. The chemical analyses of 35 samples were done. In the studied samples protein, amino acids, intramuscular fat, fatty acids and cholesterol content were by standard methods determined. The average protein content detected in snail meat samples were 12.86 mg 100 g^{-1} fat content 1.11 mg 100 g^{-1}. It was calculated the ratio of total saturated and polyunsaturated fatty acids, results are 20.39 and 44.06% of total fatty acids content respectively. Research shows that Snail meat is low in lipids. It could be recommended as meat with excellent nutritional qualities.

***Keywords*:** *Helix pomatia*, nutritional value, biochemical composition.

Introduction

Roman snail (*Helix pomatia*) is one of totally 91 terrestrial snail species found in Latvia. As part of the local fauna Roman Snail has been known since 16th century.

The snail meat is mainly consumed as delicacy characterized by a high dietetic value and excellent nutritious traits (Cîrlan, Sindilar, 2009). Research shows that it is rich in protein at the same time being low in lipids (Okonkwo, Anyaene, 2009; Ligaszewski et al., 2005; Miletic et al., 1991). Cultivation of Roman snails is rapidly growing in Latvia of late as one of alternative types of non-traditional agricultural production. The society of snail breeders already incorporates 200 snail farms. The breeders associate their market outlet with export of the snail meat. To ensure the competitiveness of locally produced snail meat on European markets, the research needs to be carried out on the quality of the obtained product and ways of improving it.

Objective of the research study: evaluation of the composition of fatty acids in pedal mass of Roman snails found in Latvia in the wild versus that of snails cultivated in a trial farm with an aim of use the results obtained for acquisition of high quality product with excellent organoleptic features.

Materials and Methods

The trial was performed in May-September of 2011 at the Roman Snail Research Facility of the Research Institute of Biotechnology and Veterinary Medicine „Sigra", of Latvia University of Agriculture LLU. The sampling was performed simultaneously from the wild and from snail farm - snails having received the special supplementary Roman snail feed and snails fed wheat meal and bran. The samples of the pedal mass of Roman snails were drawn three times per season: in spring (May), summer (July) and autumn (September). One aggregate sample consisted of 40–50 snails. After sampling, the snails were refrigerated for 24 hours (+4 °C). Post refrigeration the snails were slaughtered by mechanically breaking the shell and separating the pedal mass and visceral mass. The snail pedal fraction was analysed. The chemical analyses of 35 samples were done. Wild snail meat samples collected in the spring in May. In the studied samples protein, fat, cholesterol content, amino acids and fatty acids composition were determined.

Crude 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 hidrocloric acid) using SoxCap 2047 and SOX TEH 2055 equipment (FOSS).

Amino acids. Dried, defatted meat samples were hydrolysed with 6N HCl in sealed glas tubes at10 °C for 23 h. 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% dejonized water) 0.5 mL min^{-1}, column temperature. 40 °C was used. The identity and quantitative analysis of the amino acids were assessed by comparison with the retention times and peak areas of the standard amino acid mixture.

Fatty acids. For the pedal fraction, the percentage of saturated (SFA), mono-unsaturated (MUFA) and poly-unsaturated (PUFA) fatty acids were determined. Previously 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).

The statistical processing of data was performed with the data statistical processing software SPSS 17.0 (probability 95% or significance level – $p<0.05$). For

the evaluation of fatty acid level differences in different snail groups the two sampled populations T-test was used.

Results and Discussion

Study established in meat of wild Roman snails and breeding snails (*Helix* pomatia) amount of total protein and total fat (see Fig.1).

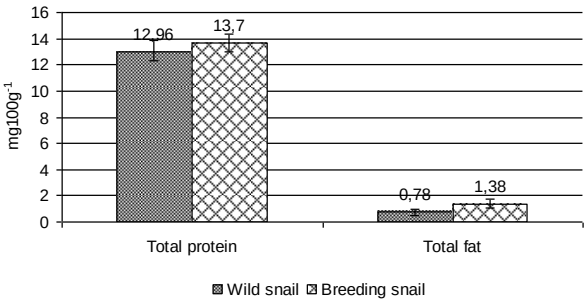

Figure 1. Total protein and total fat content (g 100 g^{-1}) in meat of wild snails and breeding snails

The content of crude protein for wild snails was 12.96±0.95 mg 100 $g^{-1}$and while the cultivated snails, wich are fed with concentrated feed protein was 13.70±0.66 mg 100 g^{-1}. In Roman snail meat total fat content is very low and can be considered as a dietetic product. The research of Fagbuaro et al. (2006) shows that in pedal mass of snails the crude protein content varies from 18.66±0.57% (*Limicolaria* spp.) to 20.56±0.05% (*Achachatina marginata*). The research results of Ligaszewski et al. (2005), on the other hand indicate that crude protein level in pedal mass of wild snail population was higher than that of snails cultivated in breeding facilities for all age groups, while protein level for wild snails at 2–3 years of age was essentially higher ($p<0.01$). Some authors (Okonkwo, Anyaene, 2009), examining *Helix pomatia* meat content in different regions of Lithuania have established the crude protein level from 11.51±0.03% to 16.60±0.03%. According to data of Zymantiene et al. (2006), the crude protein level in pedal mass of *Helix pomatia* is essentially ($p<0.001$) lower (14.15±0.76%) than that of pig meat (22.80±0.21). A relatively high protein content was established also in the pedal mass of the snail species *Archachatina*, *Archatina* and *Limiclaria* (Adeyeye, Afolabi, 1996).

At the same time in snails' meat it was also determined cholesterol level (Fig. 2).

Our sudy confirms that cholesterol content in meat of wild snail (150.93±11.56) and cultivated snail (174.69±0.21) was relatively high.

Differnces in cholesterol levels in wild snails meat and breeding snails meat is not essential ($p>0.05$). Different results were obtained in studies of Turkish scientists (Özogul, 2005). Studies with *Archachatina marginata* snail show relativly low cholesterol level.

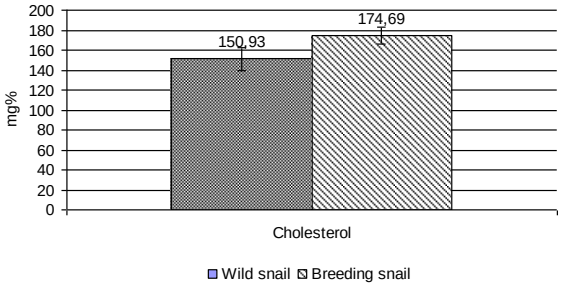

Figure 2. Cholesterol content (mg %) in meat of wild snails and breeding snails

The protein composition was determined and results assumed in Table 1.

Table 1

Amino acid content in snail pedal mass, mg 100 g^{-1}

Amino acid symbols	Wild snail (mean±SEM)	Breeding snail (mean±SEM)
*Val	0.441±0.08	0.378±0.02
*Leu	0.600±0.12	0.496±0.02
*Ile	0.408±0.08	0.308±0.02
*Phe	0.429±0.08	0.416±0.03
*Lys	0.567±0.13	0.409±0.02
*Thr	0.399±0,06	0.351±0.02
*Met	0.131±0.02	0.109±0.01
*Trp	0.417±0.01	0.849±0.01
Arg	0.465±0.06	1.146±0.63
Asp	0.748±0.11	0.651±0.03
Ser	0.365±0.05	0.319±0.02
Glu	1.110±0.16	1.002±0.07
Gly	0.541±0.08	0.502±0.04
Ala	0.559±0.08	0.550±0.03
Pro	0.426±0.07	0.394±0.02
Tyr	0.326±0.06	0.288±0.01
His	0.212±0.04	0.241±0.05
Hyp	0.451±0.01	0.845±0.01
ΣEAA	3.392±0.56	3.316±0.42

* – Essential amino acids (EAA)

The data summarized in Table 1 shows that wild snails meat has more aspartic acid (Asp), serine (Ser), glutamic acid (Glu), glycine (Gly), proline (Pro) and tyrosine (Tyr) than in meat of breeding snail, however the diferences between snails groups are not significant ($p>0.05$). Typically, the hydroxyproline (0.845 g 100 g^{-1}) has more in cultivated snails meat. The content of Leucine detected 0.600 g 100 g^{-1} in wild snail meat and 0.496 g 100 g^{-1} in cultivated snails meat. The content of Lysine detected 0.567 g 100 g^{-1} in wild snail meat and 0.409 g 100 g^{-1} in cultivated snails meat.

Helix pomatia meat is the greatest amount of non essential amino acid glutamic acid – 1.110 g 100 g^{-1} (wild snail) and 1.002 g 100 g^{-1} (cultivated snail).

Scientific literature references stating that it was snail meat contains essential amino acids leucine (Leu), izoleucine (Ile), fenilalanine (Phe) and tryptophane (Trp) (Imevbore, Ademosun, 1988; Imevbore, 1990; Stievenart, 1996; Ebenebe, 2000). Researchers believe that the snail meat contains very high quality protein (Ferhat et al., 2011).

The results of the fatty acid composition in pedal mass of the wild and breeding snails are summarised in Figure 3.

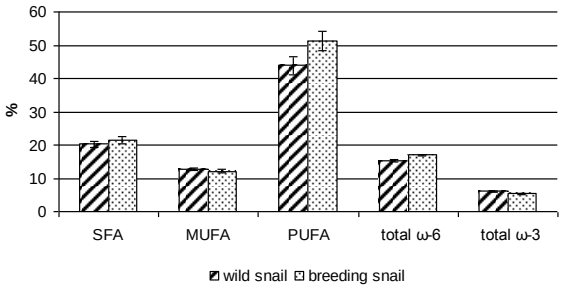

Figure 3. Comparison of fatty acid content (% of total fatty acids) in meat of wild snails and breeding snails

The research data revealed that there are significant differences in levels of the polyunsaturated fatty acids (PUFA) and long-chain poly-unsaturated ω-3 fatty acids (ω=3 PUFA) between wild and breeding snails meet samples ($p<0.05$).

The content of the poly-unsaturated ω-3 fatty acids (ω=3 PUFA) was slightly higher for the wild Roman snails – 6.03±0.29%, while the amount of ω-6 fatty acids (ω=6 PUFA) is higher for the cultivated snails - 16.36±0.16%. It was found that the meat of cultivated snails contained higher level of PUFA (51.17% on the average), than meat of the wild snails (44.06%). The content of MUFA (12.16±0.24%) and total ω-3 fatty acids (5.66±0.17%) in the meat of cultivated snails is lower, than in meat of the wild snails – MUFA 12.81±0.26% and total ω-3 fatty acids 6.03±0.29% ($p>0.05$). Content of SFA in the meat of the breeding snails detected 20.84±0.38% higher, than in meat of the wild snails – SFA 20.39±0.81 ($p>0.05$).

Research data of other scientists on the content of fatty acids both, in the pedal mass of wild *Helix pomatia* (Özogul et al., 2005), and *Helix aspersa maxima* (Çaġiltay et al., 2011; Milinsk at al. 2003) are available. In studies of Özogul et al. (2005), for wild *Helix pomatia* the saturated SFA are dominant (37.87%), while the poly-unsaturated PUFA are a minority (25.83%). In our case, the results are different: Roman snails (*Helix pomatia*) subjected to a feeding trial, showed higher levels of PUFA (44.06±2.59% and 51.17±1.65% accordingly) than SFA (20.39±0.80% and 20.84±0.38% accordingly). At the same time, the trials of Milinsk (2003) with feeding of plant oils, for snails *Helix aspersa maxima* have produced data which are very close to those obtained by us. The poly-unsaturated PUFAs are dominant (49.90–57.06%), while SFA content is relatively lower (22.20–26.26%). Different fatty acid contents have been obtained in trials of other authors (Çaġiltay et al., 2011) establishing PUFAs at the level of 34.38% and SFAs of 28.76% in pedal mass of *Helix aspersa*. However data on biochemical indicators of visceral mass of snails are noticeably less available.

Evaluating the levels of separate fatty acids, the highest content by percentage was established for SFAs – palmitic acid (C16:0) and stearic acid (C18:0), MUFA – oleic acid (C18:1 ω-9), and PUFAs – eicosadienoic acid (C20:2 ω-6) and eicosatrienoic acid (C20:3 ω-3) (see Table 2).

Table 2

Contents of separate fatty acids (%) in meat of Roman snails

Fatty acids	Wild snail (mean±SEM)	Breeding snail (mean±SEM)
C16:0	4.27±0.11	3.74±0.20
C18:0	11.62±0.50	12.92±0.85
C18:1 ω-9	11.47±0.26	10.88±0.47
C20:2 ω-6	11.92±0.32	13.43±0.35
C20:3 ω-3	14.24±0.21	14.38±0.33

SEM – Standard Error of Mean

The levels of fatty acids C20:2 ω-6 and C20:3 ω-3 were not significant higher in cultivated snail meat, than in wild snail meat.

Polyunsaturated fatty acids were found in the highest proportion by percentage, which determines also a higher PUFA amount. We found that the proportion of poly-unsaturated fatty acids for all snails is the highest.

Analysing separate fatty acids in pedal mass, we found that the content of α-linolenic acid (C18:3 ω-3) for wild snails was 1.78±0.29%, which is very close to indicators obtained in trials of Özogul (2005) – 1.87±0.01%. Different results however are obtained for snails *Helix aspersa*. According to Çaġiltay (2011) the proportion of α-linolenic acid for these snails is by 3.85% higher while Milinsk et al. (2006) has obtained indicators by 0.74% lower than for wild *Helix pomatia* in Latvian trial. Our initial research data certify that the fatty acid content found in pedal mass of Latvia's *Helix pomatia* is not always similar to fatty acid content established by other authors (Özogul et al., 2005, Çaġiltay et al., 2011): similar results have been found in pedal mass of *Helix aspersa* (Milinsk et al., 2003).

Conclusions

1. Roman snail meat protein content detected 12.96–13.70 g 100 g^{-1} including essential amino acids 3.1–3.4 mg 100 g^{-1} and it is evaluated as low in fat 0.78 g 100 g^{-1} (wild snails) and 1.38 g 100 g^{-1} (cultivated snails).
2. Snail meat in the greatest amounts of non essential amino acid glutamic acid (1.110 mg 100 g^{-1} found in wild snail meat and 1.002 mg 100 g^{-1} in cultivated snail) and least contain methionine (0.131 mg 100 g^{-1} found in wild snail meat and

0.109 mg 100 g^{-1} in meat obtained from cultivated snail).

3. The results on the whole, do not contradict to the data found in literature and they certify the richness of meat obtained from Roman snails of Latvia in polyunsaturated fatty acids (44.06–51.17% on the average) and its high biological value.
4. Cholesterol content in meat of wild snail (150.93±11.56 mg%) and cultivated snail (174.69±0.21 mg%) was relatively high.

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