

COMPARISON OF MEAT QUALITY CHARACTERISTICS BETWEEN COMMERCIAL PIGS AND SNAILS

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Nowadays traditional pork is still remaining the most popular meat in many European countries. In contrast, presently there is a growing interest in the production and marketing of non traditional snail meat. The aim of the present study was to compare the quality characteristics of pork and snails' meat, to determine an impact of animal species on meat quality and to analyse the correlation coefficients of some parameters of meat quality. The meat quality characteristics, as chemical composition and some physical properties, were evaluated after deep-freezing. It was determined that snail meat contained by 11.50% higher amount of water, by 14.60% higher amount of mineral substances and by 77.04% higher amount of amino acid hydroxyproline, but by 77.38% less fat, by 37.94% less protein and by 43.28% tryptophan if to compare to the pork meat. Besides, pH in snail meat tended to be alkaline while in pork meat – acid. Moreover, snail meat was darker, pale red and its yellowness was more intensive than that of the pork meat. The correlation between fat and protein in pork and snail meat, pH with tryptophan and hydroxyproline was negative, whereas pH with fat, and dry matter with ash – positive. However, in pork meat tryptophan and hydroxyproline correlated negatively, while in snail meat – positively. Meat chemical composition and physical properties were effected by animal species.

INTRODUCTION

Meat occupies an important place in human nutrition. Pork and its products show a high nutritive value and good sensory properties [Daszkiewicz *et al.*, 2005]. Meat quality may be influenced by multiple interacting factors before and after slaughter [Olsson & Pickova, 2005] and depend on pig's diets [Leikus & Norviliene, 2006; Koopmans *et al.*, 2006], feed supplements [Peeters *et al.*, 2006; Niculita *et al.*, 2007], conditions of meat storage [Jukna *et al.*, 2006] and others. Genetic factors do not show too high effect on meat quality among breeds [Kortz *et al.*, 2005], but the higher variety of different pork quality parameters is observed inside the breed [Jukna *et al.*, 2005]. Nowadays traditional pork is still remaining the most popular meat in many European countries.

In turn, presently there is a growing interest in the production and marketing of non traditional snail meat. Products from snail meat belong to foodstuffs with high nutritional value. The results of several investigations of fresh snail meat and its products have especially been described from the point of their microbiological and toxicological risks to human health [Bohuslava, 2001]. Proximate analysis of wild snails (*Helix pomatia L.*) showed that they are rich in major minerals, protein and low in lipids [Özogul & Olgunoglu, 2005]. Thus, snail meat gains an advantage over others [Yildirim *et al.*, 2004].

The species of snails like *Helix* spp., *Achatina* spp. are eaten and cultured mainly in the USA, Europe and Far East

[Yildirim *et al.*, 2004]. The vineyard snails' species *Helix pomatia L.* are commercially the most important. Every year snails are collected in various geographical regions of Lithuania, prepared and frozen, and snail meat is exported mainly to European countries. A vineyard snail is an exclusive dish in elite restaurants in European Union (EU), and snail meat (foot) is used in food production [Scheifler *et al.*, 2002].

The aim of the present study was to compare the quality characteristics of pork and snails' meat, to determine an impact of animal species on meat quality and to analyse the correlation coefficients of some parameters of meat quality.

MATERIALS AND METHODS

The research of chemical characteristics of pork and snail meat was carried out at the Laboratory of Meat Characteristics and Quality Assessment of Lithuanian Veterinary Academy. The meat quality was determined after deep freezing (at –86°C in a period of one month).

The samples of pork for analysis were taken from thirty Lithuanian White (LW), Lithuanian Large White (LLW) and Landrace (L) pig carcasses. Ten animals were chosen from each breed. Pigs were held at the Control Feeding Station of Pigs in Lithuania under standard feeding and keeping conditions. Pigs were slaughtered at the weight from 95 to 100 kg in the station. Slaughter and post-slaughter processing was car-

ried out in accordance with the EU regulations binding in the meat industry. Samples were taken from dorsal loin muscle *m. longissimus dorsi* and kept in deep-freeze (-86°C) storage till analysed.

Snails (n=210) used in this study were collected in May and June from seven different regions of Lithuania. Collected snails' shell height was from 28.55 mm to 31.13 mm and width of shell – from 38.55 to 40.71 mm. Snails were prepared according to the special requirements for the snails' meat intended for human consumption [VMVT, 2002] as described by Zymantiene *et al.* [2006]. The prepared meat samples were placed into hermetic waterproof bags and kept in deep-freeze (-86°C temperature) storage till analysed. The samples of pork and snail meat were prepared for analysis by thawing under natural conditions (at +18°C for twelve hours) and the quality characteristics, such as chemical composition and some physical properties, were evaluated. The content of dry matter was measured by the automatic scale for humidity assessment Scaltec SMO – 01, drying samples at 105°C; pH of the samples – with a pH-meter Inolab 3, with a contact electrode according to ISO standard [ISO 2917:1999]; meat colour with a Minolta Chroma Meter 410, measuring values of L* for lightness, a* – for redness and b* – for yellowness; fat content – with an automatic system for fat extraction Soxterm SE 416 macro according to ISO standard [ISO 1443:1973]; ash content – by organic matter incineration at 700°C according to ISO standard [ISO 936:1998]; protein content according to Kjeldal method; tryptophan content – with the Spies & Chambers method [Spies, 1967]; and hydroxyproline content – with Neuman & Logan method [1950].

Statistical analysis was carried out using “R” package [Venables & Smith, 2005].

RESULTS AND DISCUSSION

Chemical composition and physical properties of pigs' and snails' meat differed to a great extent (Table 1). The content of dry matter in pork meat was 1.6 times higher, the content of fat – 4.4 times and the content of protein – 1.6 times higher than those in snail meat ($p < 0.001$). The meat of snails was richer in mineral substances ($p < 0.01$), darker, pale red, its yellowness was more intensive and it had considerably higher pH value ($p < 0.001$). The pH value in snails' meat is similar to that in animals' muscles, defined immediately after

TABLE 1. Chemical composition and physical properties of pork and snail meat.

Parameters	Pork	Snail meat
Dry matter (%)	25.65±0.21	15.99±0.77***
Fat (%)	1.68±0.10	0.38±0.11***
Total protein (%)	22.80±0.21	14.15±0.76***
Tryptophan (mg/100 g)	285.81±6.55	162.11±3.62***
Hydroxyproline (mg/100 g)	43.66±1.41	190.15±6.15***
Tryptophan: hydroxyproline ratio	6.82±0.33	0.86±0.02***
Ash (%)	1.17±0.01	1.37±0.06**
Colour L* value	54.47±0.60	46.75±1.14***
Colour a* value	14.69±0.24	1.69±0.18***
Colour b* value	6.34±0.28	13.05±0.61***
pH value	5.48±0.02	7.46±0.12***

** statistically significant differences at $p < 0.01$; *** statistically significant differences at $p < 0.001$.

the slaughter [Warriss, 2004]. When the animal is slaughtered, highly intensive biochemical processes are observed in muscles, during which the glycogene breaks down. Consequently, higher amount of lactic acid responsible for lowering the pH value of mature meat, is produced [Wood *et al.*, 1994; Claeys *et al.*, 2001; D' Souza *et al.*, 2002]. We consider that when vital functions in snails are stopped similar fermentative processes as in pig muscles after slaughter are not observed and lactic acid is no longer produced.

Correlations between parameters of chemical composition and physical properties in meat are shown in Table 2. A positive correlation defined between contents of dry matter and ash in pork was insignificant ($r = 0.125$), and in snail meat – strong ($r = 0.594$; $p < 0.01$). Besides, the defined positive correlation between pH and fat content of pork meat was moderately positive ($r = 0.395$; $p < 0.01$), whereas in snails meat – strong ($r = 0.706$; $p < 0.01$). A negative correlation was found between contents of fat and protein. A low negative correlation coefficient ($r = -0.217$) was found between contents of fat and protein in pork meat, and in snail meat – the correlation coefficient was highly negative ($r = -0.625$; $p < 0.01$).

The biological value of meat is defined by fully valuable protein [Jukna *et al.*, 2005]. The full value of meat protein is calculated according to the ratios of irreplaceable amino

TABLE 2. The correlation coefficients of some parameters of meat quality (above diagonal – parameters of pork; below diagonal – parameters of snail meat).

	Pork	Snail meat	Dry matter	pH	Fat	Ash	Protein	Tryptophan	Hydroxyproline
Dry matter	X								
pH		X							
Fat			X						
Ash				X					
Protein					X				
Tryptophan						X			
Hydroxyproline							X		

* statistically significant differences at $p < 0.05$; ** statistically significant differences at $p < 0.01$.

acid tryptophan, which is found only in muscle tissue, and replaceable amino acid hydroxyproline, found only in connective tissue. The higher this ratio is the more biologically valuable meat protein is [Ribikauskienė, 2003]. Data compiled in Table 1 evidently demonstrate that snail meat contained 1.76 times less tryptophan and 4.35 times more hydroxyproline, that is why the ratio of these amino acids in pork meat was 7.9 times higher ($p < 0.001$). However, this field requires deeper and more precise investigations as it is not clear if the ratio of tryptophan and hydroxyproline is applicable for the evaluation of meat from other species.

The analysis of the results of the investigations revealed (Table 2) a strong negative correlation between tryptophan and hydroxyproline in pork meat ($r = -0.658$; $p < 0.01$) while this correlation in snail meat was strongly positive ($r = 0.745$; $p < 0.01$). A negative correlation of moderate strength was defined between pH and hydroxyproline in pork meat ($r = -0.300$; $p < 0.05$) and in snail meat ($r = -0.344$). We failed to define any correlation between pH and tryptophan in pork meat, however this correlation in snail meat was negative and moderately strong ($r = -0.444$; $p < 0.05$).

The one-way analysis of variance data enabled defining a statistically significant effect of animal species on the qualitative parameters of meat: fluctuation in the content of dry matter – 90.00%, pH – 96.00%, colour L^* – 49.50%, colour a^* – 96.20%, colour b^* – 77.80%, the content of fat – 60.40%, the content of ash – 41.60%, the content of protein – 87.70%, the content of tryptophan – 93.10%, the content of hydroxyproline – 98.5%, and the ratio of tryptophan to hydroxyproline – 96.50% ($p < 0.001$).

CONCLUSIONS

1. Chemical composition and physical properties of pork and snail meat differed:

- snail meat contained by 11.50% higher amount of water, by 14.60% higher amount of mineral substances and by 77.04% higher amount of amino acid hydroxyproline, but by 77.38% less fat, by 37.94% – less protein and by 43.28% – tryptophan if to compare to the pork meat. Besides, pH in snail meat tended to be alkaline while in pork meat – acid. Moreover, snail meat was darker, pale red and its yellowness was more intensive than that of pork meat.

- the correlation between fat and protein in pork and snail meat, pH with tryptophan and hydroxyproline was negative, and pH with fat, dry matter with ash – positive. However, in pork meat tryptophan and hydroxyproline correlated negatively, whereas in snail meat – positively.

2. The chemical composition and physical properties of meat were effected by animal species.

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