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ScienceDirect

Procedia Food Science 5 (2015) 316 – 319

Procedia Food Science

International 58th Meat Industry Conference "Meat Safety and Quality: Where it goes?"

Chemical composition and cholesterol content in *M. longissimus dorsi* from free-range reared Swallow-belly Mangalitsa: the effect of gender

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Abstract

The objective of this study was to determine chemical composition and cholesterol content in *M. longissimus dorsi* (MLD) of Swallow-belly Mangalitsa, free-range reared, and to investigate possible effects of gender on these quality parameters of its meat. Average moisture and fat contents were significantly different in male and female pig muscles. The differences in average values of ash, protein and cholesterol contents between the two groups (genders) of meat samples were not significant. In MLD samples of female pigs, total fat had a significant influence on cholesterol content, while this influence was not established in MLD of male pigs.

Peer-review under responsibility of scientific committee of The 58th International Meat Industry Conference (MeatCon2015)

Keywords: Mangalitsa; *m.longissimus dorsi*; chemical; composition; cholesterol; gender

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doi:10.1016/j.profoo.2015.09.066

1. Introduction

In the recent years, there has been an increasing demand for products obtained from so-called "organic", "natural" or "biologic" livestock production systems. Such animals are habitually free-reared and the principal differences from traditional indoors production systems are the environmental, biodiversity and animal welfare respects, and the procurement of high quality foodstuffs[1]. Consumers today are more interested in healthy, tasty meat with high nutritional quality. In the group of three native autochthonous pig breeds registered in Serbia (Mangalitsa, Moravka and Resavka), the first one is the most common. Mangalitsa is characterized by dark color, robust constitutions and slower growth rate with higher adiposity and reduced lean deposition compared to modern white pigs. It is one of the fattest pigs in the world, as generally 65-70% of the carcass is lard and with only 30-35% lean meat compared to over 50% in modern breeds. It is reared in farm conditions or in open systems and fed using complete mixtures or in traditional ways, respectively. Meat and products from traditional breeds, like Mangalitsa pig, have a good image and promotion in the public and media in Serbia, particularly over the last few years.

The objective of this paper was to establish proximate chemical composition and cholesterol content in *M. longissimus dorsi* (MLD) of Swallow-belly Mangalitsa (autochthonous pig breed), free-reared, typical for its pig breed. An assessment of possible effect of gender on chemical composition and cholesterol content in selected pork muscles was an integral part of the study.

2. Materials and methods

The study included 16 Swallow-belly Mangalitsa fatteners (9 male castrated pigs and 7 female pigs) reared in the open system (Bojcin forest, Srem, Vojvodina). They were free-reared being feed on grass, leaves, acorns, etc, with addition of a small quantity of corn during winter. During night and bad weather conditions, animals were kept in a wooden facility. Live weight (LW) of animals was measured at the farm and warm carcass weight (WC) was measured in the slaughterhouse. After dissection of left carcass sides, samples (around 300 g) of MLD were collected, marked and homogenized. Protein content (Kjeldahl nitrogen) was determined by using Kjeltec^{TM} 8400 Analyzer Unit (Foss, Sweden). Analyses of moisture, ash and total fat were determined according to standard ISO procedures[2,3,4]. Cholesterol determination was performed by using HPLC/PDA according to Maraschiello et al.[5] In order to investigate the influence of gender, a statistical analysis of the data was performed using One-Way Anova procedure of SPSS software (IBM corp., version 20.0). Additionally, Pearson's correlation coeffient (r) was determined by using the above mentioned software for mean values of the investigated variables.

3. Results and discussion

The results of live weight and warm carcass weight of pigs, proximate composition (content of moisture, total fat, ash and protein) as well as cholesterol content in MLD from Mangalitsa pigs are shown in Table 1.

Table 1.Live weight (LW), warm carcass weight (WC) and proximate chemical composition and cholesterol content in *M. longissimus dorsi* (MLD) of Swallow-belly Mangalitsa (mean±SD) and significance of differences between pig genders.

	Male (M) (n = 9)	Female (F) (n = 7)	p-value
LW, kg	64.67±12.80	87.71±37.89	0.108
WC, kg	51.89±9.89	70.14±29.54	0.103
Moisture content, %	64.60±5.08	69.81±3.09	0.032
Total fat content, %	12.75±5.94	6.93±4.31	0.047
Ash content, %	1.01±0.21	0.94±0.10	0.394
Protein content, %	20.82±1.73	22.31±2.18	0.150
Fat:protein ratio (calculated)	0.63±0.34	0.32±0.25	0.062
Cholesterol content, mg/100g	80.51±12.19	78.26±19.03	0.777

Average values of LW as well as of WC were not significantly different between male and female pigs ($p > 0.05$). Moisture content in MLD-M (64.60%) was significantly lower than that determined in MLD-F samples (69.81%), whereas the total fat content of 12.75% in MLD-M was significantly higher than total fat content of 6.93 % in MLD-F ($p < 0.05$). Obtained results for moisture content were in accordance with previous studies[6,7] which showed significantly less moisture content in MLD from male castrated pigs than females (68.65% compared to 71.47% and 69.41% compared to 70.85%, respectively). According to Butko et al.[8], pigs reared in an outdoor system have higher moisture content compared to the same breed of animals reared in an indoor system. Kim at el.[9] stated that there was no difference between animals reared in different conditions while Petrovic et al.[10] reported higher water in MLD reared in closed than in open system. Obtained average total fat content in MLD-M samples (12.75%) was higher than values for fat content cited in the studies[10,11] (8.09%, reared in open and 5.45% in closed housing system; 5.67%, extensively and 5.45%, intensively reared, respectively). Regarding gender of animals, in *longissimus* and *gluteus* muscles, male fatteners had higher share of fat compared with females[7]. Our results for fat content in examined MLD samples were similar to those in the mentioned study. Ash contents were similar in the both groups of meat samples, 1.01 % (M) and 0.94 % (F) and did not differ significantly ($p > 0.05$). Also, they were similar to results for ash content in MLD of Mangalitsa obtained by Petrovic et al.[6] (1.9%) and the value reported by Stanisic et al.[12] (1.02%). The differences in mean protein values (20.82%, M and 22.31%, F) between the groups were not significant ($p > 0.05$). Our results were in accordance with results for protein content in MLD of male pigs shown by Petrovic et al.[6] (22.39%) as well as results reported by Pugliese et al.[13] (23.5% and 22.8%). The calculated F:P ratios were 0.63 (MLD-M) and 0.32 (MLD-F), and were similar to those reported by Parunovic et al.[14] (0.68).

Table 2. Pearson's correlation coefficient (r) between live weight (kg), warm carcass weight (kg) and examined parameters of chemical composition (%) and cholesterol (mg/100g) contents in *M. longissimus dorsi* (MLD).

	Moisture content	Total fat content	Protein content	Ash content	Cholesterol content	F:P ratio	LW	WC
Males								
Moisture	1	-0.747*	0.729*	0.614	-0.196	-0.734*	0.158	0.111
Total fat		1	-0.899**	-0.679*	0.169	0.992**	-0.482	-0.467
Protein			1	0.483	-0.116	- 0.938**	0.620	0.625
Ash				1	0.039	-0.658	0.082	0.035
Cholesterol					1	0.176	0.049	0.045
Fat:protein ratio						1	-0.536	-0.527
LW							1	0.995**
Females								
Moisture	1	-0.889**	0.306	0.648	-0.616	-0.844*	0.303	0.300
Total fat		1	-0.701	-0.756*	0.770*	0.994**	-0.444	-0.454
Protein			1	0.567	-0.696	-0.766*	0.418	0.444
Ash				1	-0.290	-0.768*	0.179	0.190
Cholesterol					1	0.788*	-0.393	-0.400
Fat:protein ratio						1	-0.421	-0.434
LW							1	0.999**

Legend: LW: live weight; WC: warm carcass weight,*Correlation significant at the $p < 0.05$ level, **Correlation significant at the $p < 0.01$ level.

Average cholesterol content in MLD samples were 80.51 mg/100g (M) and 78.26 mg/100g (F) and no significant difference was established between these results ($p > 0.05$) (Table 1). In MLD-F samples, total fat had a significant ($p < 0.05$) influence on cholesterol content, while this influence was not established in MLD-M samples (Table 2). Our results for cholesterol contents were similar to those reported by Salvatori et al.[15], who observed that a higher weight of carcass results in lower cholesterol content, and, also, our results correspond well with measurements taken by Csapo et al.[16] (cholesterol content in meat of Mangalitsa varied between 71 mg/100g and 109 mg/100g).

For MLD samples of male pigs (Table 2), we registered moderate to strong negative significant correlations between content of moisture and total fat, protein and total fat, ash and total fat, F:P ratio and moisture as well as F:P ratio and protein. However, moderate to strong significant positive correlations were noted between protein and moisture, F:P ratio and total fat as well as WC and LW. For MLD samples of female pigs, we established strong negative significant correlations between content of moisture and total fat, ash and total fat, F:P ratio and moisture, F:P ratio and protein, and F:P ratio and ash. However, strong significant positive correlations were determined between cholesterol content and total fat, F:P ratio and cholesterol, as well as, WC and LW. Also, neither the LW nor the WC significantly influenced the fat content in MLD samples in the both examined groups of pigs (Table 2).

4. Conclusion

Our research reported significantly higher fat and lower moisture content in selected male in comparison with female muscles (*M. longissimus dorsi*) of Swallow-belly Mangalitsa free-range reared in the same conditions. In the both examined groups of meat samples, beside strong positive correlation between WC and LW, moderate to strong negative correlations between moisture and total fat, ash and total fat and F:P ratio and moisture were established. A strong significant positive correlation was determined between cholesterol and total fat content in female *M. longissimus dorsi.* In accordance with the present trend, with special emphasis on muscle quality, as well as fat quality, sensory and nutritional properties of meat, conservation and propagation of healthy products derived from autochthonous breeds, suitable for an extensive production system are very important.

Acknowledgement

This work was supported by grants from the Ministry of Education, Science and Technological Development of the Republic of Serbia (project no. III 46009).

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