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Correlation between meat quality traits and cholesterol content in *M. longissimus dorsi* in pigs of different genotypes

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The objective of the study was to estimate a correlation between meat quality traits and cholesterol content in *M. longissimus dorsi* of pigs. The correlation between meat quality traits and cholesterol content varied from weak (0.01) to very strong (0.94). Significant phenotypic correlations were found between pH and meat colour intensity, water holding capacity, and cooking loss ($p < 0.05$). The lowest cholesterol amount was found in Lithuanian indigenous and the highest in Lithuanian White pig meat. A low correlation between cholesterol content and intramuscular fat content was determined ($r < 0.19$). Cholesterol is mostly correlated with meat colour yellowness, cooking loss, and the drip loss ($p < 0.01$).

Keywords: meat quality traits, pig, cholesterol, genotype

Introduction

Meat and meat products are important sources of proteins, vitamins, and minerals. However, they also contain elements that in certain circumstances and unsuitable proportion have a negative effect on human health. Today's consumers are more interested in knowing what they are really eating. Consumers of meat are worried that a diet containing red meat is rich in total fat, saturated fat, and cholesterol. Farmers try to offer 'healthier' meat for human consumption through changing the animal feed consumption and genetic improvement. The intramuscular fat plays an important role in meat quality. It is known that not only the amount but also the structure of the fat plays a major role in maintaining human health [1].

The amount of fat in meat can vary widely depending on various factors: the species of animal, the particular cut of meat, the degree of separation of fat from the meat in various handling phases, cooking technique, etc. [2]. Meat, especially red, is commonly identified as a major source of dietary cholesterol. However, the amount of cholesterol in lean meat in which the visible fat has been removed is low as compared to the amount which is produced each day in the human body [3].

In Lithuania, like in the whole Europe, the most popular sort of meat is pork.

The objective of the study was to estimate correlations between meat quality traits and cholesterol content in *M. longissimus dorsi* of pigs.

Materials and methods

The research was carried out in 2011 at the laboratory of meat characteristics and quality assessment of the Veterinary Academy. The breeds tested included Large White (LLW), Yorkshire (Y), Landrace (L), Lithuanian White (LW), and Lithuanian indigenous. The traits included cooking loss, water holding capacity, colour intensity, pH, dry matter, fat, and cholesterol content. All the studies were performed 48 hours after slaughter.

The common by accepted methods were used in the experiment. The pH values were measured with an Inolab 3 pH-meter with a contact electrode SenTix Sp according to the ISO standard ISO 2917:1999 [4], colour intensity with Minolta ChromaMeter 410, measuring values of L* for lightness, a* for redness and b* for yellowness. Protein content was determined by the Kjeldal method according to LST ISO 937:2000 [5]. Cooking loss values were determined by the Schilling method (1966), water holding capacity by the Grau and Hamm method described in 1953. The fat content analysis was performed by the Soxhlet method (AOAC International, 2007) and of dry matter according to LST ISO 1442:2000 [6]. The method by Folch et al. [7] was used for lipid extraction from meat samples. For the determination of cholesterol content, the chromatographic methodology approved in the EU was used.

The R statistical package version 2.0.1. [8] was used to estimate the data. The coefficient of correlation between fat, meat colour yellowness, cooking loss, drip loss, and cholesterol content were calculated.

Results and discussion

Data on meat chemical composition are presented in Table 1. Analysis has shown that Yorkshires had the highest content of dry matter and protein and Large White pigs had the lowest content of protein. The difference between them was 40.47 % ($p < 0.05$). The Lithuanian indigenous had the highest fat content and Yorkshire pigs had the smallest, the difference being 0.59 % ($p < 0.01$).

The highest cholesterol level was determined in Lithuanian White pig meat and in Yorkshires in comparison with the other pig breeds. The cholesterol content in them ranged from 37.3 to 57.15 mg/100 g. Despite the highest fat content, the cholesterol level in Lithuanian indigenous pig meat was found very low – 37.30 mg/100 g. A low correlation between the cholesterol content and intramuscular fat content was determined ($r < 0.32$).

Table 1. Chemical composition of pork

	Symbols	Large White (LLW)	Yorkshires (Y)	Landrace (L)	Lithuanian White (LW)	Lithuanian indigenous
Dry matter, %	X	26.22	26.69	26.25	26.53	26.41
	m_x	±1.56	±1.41	±1.47	±1.76	±1.52
	C_v	5.96	5.27	5.61	6.65	5.75
Protein, %	X	23.33	24.15	23.54	23.77	23.25
	m_x	±1.51	±1.27	±1.55	±1.69	±1.48
	C_v	6.48	5.25	6.6	7.13	6.37
Fat, %	X	1.71	1.39	1.54	1.60	1.98
	m_x	±0.49	±0.52	±0.44	±0.54	±1.00
	C_v	28.83	37.55	28.25	33.55	50.61
Cholesterol, mg/100g	X	48.84	54.00	46.53	57.15	37.30
	m_x	±11.87	±14.07	±11.60	±12.93	±10.27
	C_v	24.3	26.06	24.92	22.62	27.55

Data on meat pH and quality traits are presented in Table 2.

Lithuanian indigenous pig meat had the highest pH and Yorkshires had the lowest, the difference being 0.11 % ($p < 0.01$). The highest water holding capacity was found in Yorkshire pig meat and the lowest in Lithuanian White, the difference being 10.42 % ($p < 0.01$). The high water content in muscles and meat makes water an important parameter affecting meat quality. On the market, meat is paid for according to its weight, and loss of fluid during storage and processing naturally leads to a less end profit [9]. Lithuanian White pig meat had the highest and Lithuanian indigenous pig meat had the lowest cooking loss, the difference being 5.96 % ($p < 0.01$).

Table 2. Meat pH and quality traits

	Symbols	Large White (LLW)	Yorkshires (Y)	Landrace (L)	Lithuanian White (LW)	Lithuanian indigenous
pH	X	5.49	5.41	5.44	5.43	5.52
	m_x	±0.05	±0.07	±0.06	±0.07	±0.05
	C_v	0.84	1.24	1.06	1.21	0.97
Water holding capacity, mg %	X	50.11	59.65	50.12	49.23	53.75
	m_x	±4.12	±4.31	±5.07	±3.68	±5.26
	C_v	8.22	7.22	10.12	7.47	9.79
Cooking loss, %	X	26.45	25.32	25.76	27.33	21.37
	m_x	±2.44	±1.90	±2.82	±2.39	±0.92
	C_v	9.22	7.49	10.95	8.76	4.30

Results obtained from the study of pH, L* and the meat quality are comparable with literature data [10–14]. There are no data about meat quality traits of our studied Lithuanian pig breeds, but in our study meat pH (at 48 h post mortem) highly correlated ($p < 0,01$) with lightness L*, water holding capacity, and cooking loss. Meat lightness L* significantly correlated with yellowness b*, while Aberle [15] presented that L* values had a positive correlation with hue angle, b* and chroma ($p < 0.01$), however, a* had a slight negative correlation ($p < 0.01$) with L* values [15]. In agreement with Jeremiah [16] and Davis [17], meat lightness L* significantly correlated

with water-holding capacity and cooking loss ($p < 0,01$). These data indicate that meat has the highest L* value and the highest b* value.

Conclusions

The correlation between meat quality traits and cholesterol content varied from week (0.01) to very strong (0.94). Significant phenotypic correlations were found between pH and meat colour intensity, water holding capacity and cooking loss ($p < 0.05$). High differences of various indexes of meat quality are observed inside a breed. The lowest cholesterol amount was found in Lithuanian indigenous and the highest in Lithuanian White pigs. A low correlation between cholesterol and fat contents was determined ($r < 0.19$). Cholesterol is mostly correlated with meat colour yellowness, cooking loss, and the drip loss ($p < 0.01$).

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KORELIACIJA TARP MĖSOS KOKYBĖS RODIKLIŲ IR CHOLESTEROLIO KIEKIO *M. LONGISSIMUS DORSI* SKIRTINGŲ GENOTIPŲ KIAULIŲ MĖSOJE

S a n t r a u k a

Tyrimo tikslas nustatyti koreliacijas tarp mėsos kokybės rodiklių ir cholesterolio kiekio kiaulių ilgiausiame nugaros raumenyje (*M. longissimus dorsi*). Koreliacija tarp mėsos kokybės rodiklių ir cholesterolio kiekio svyravo nuo labai silpnos (0,01) iki labai stiprios (0,94). Buvo rasta reikšminga fenotipinių požymių koreliacija tarp pH ir mėsos spalvos intensyvumo, vandens rišlumo ir virimo nuostolių ($p < 0,05$). Mažiausias cholesterolio kiekis buvo rastas Lietuvos vietinių ir didžiausias Lietuvos baltųjų kiaulių mėsoje. Silpna koreliacija nustatyta tarp cholesterolio ir tarpraumeninių riebalų kiekio ($r < 0,19$). Reikšminga priklausomybė nustatyta tarp cholesterolio kiekio ir mėsos spalvos geltonumo, virimo nuostolių ir vandeningumo ($p < 0,01$).