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Short communication

Correlations between cholesterol content, fatty acid composition and health lipid indices in fat of chosen tissues and organs of finishing pigs

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Abstract

The aim of this study was to estimate fatty acid composition, health related lipid indices (atherogenic-AI and thrombogenic-IT indices, h/H ratio) and the correlation between these traits and cholesterol content in various tissues of fatteners. The experiment involved 60 crossbred pigs (PL × PLW) × Duroc. The animals were slaughtered at 115 ± 2.0 kg body weight. The tissue samples (backfat, m. *longissimus*, liver, heart) were collected to analyze fatty acid profile and cholesterol content. The highest PUFA level was determined in the fat of the heart and liver. Weak to moderate correlations were observed between cholesterol content and most of the studied indices of fatty acid profile of the analyzed tissues. Importantly, the most significant correlations were established between the examined traits in the heart fat. Generally, irrespective of tissue type, the cholesterol level was negatively correlated with total PUFA, n-3 and n-6 FA content and h/H ratio.

Key words: fattener, tissue, fatty acid profile, cholesterol, correlation

Introduction

The increasing awareness of the role of unsaturated fatty acids in human health, particularly in preventing some disorders (i.e. cardiovascular disease, coronary heart disease, autoimmune disorders and cancer), has focused attention on the characterization of fat composition in various meat products (Gomez Candela et al. 2011). However, the fatty acid profile of each tissue and organ proves to be specific, dependent on its functional role in the organism (Razmaitė and Švirmickas 2012). Therefore, determining the lipidome (a set of lipids and their interactions in organism), is essential to better understand the nutritional value of animal products and the possibility of their modification. In this study, the research hypothesis regarded relationships between cholesterol and fatty acid contents in chosen tissues of pigs. The aim of the study was to evaluate the correlations between cholesterol content and fractions of fatty acid, including determining the atherogenicity indices (AI) and thrombogenicity indices (TI) as well as hypocholes-

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Table 1. Fatty acid profile (% of total FA), cholesterol, artherogenic (AI) and thrombogenicity indices (TI) and hypocholesterolemic/Hypercholesterolemic (h/H) ratio in different tissues of pigs.

Specification	Backfat	Muscle *longissimus*	Liver	Heart
SFA	$39.51^{a} \pm 1.95$	$35.13^{ab} \pm 2.34$	$42.66^{a} \pm 1.24$	$32.67^{b} \pm 0.98$
MUFA	$47.72^{a} \pm 2.19$	$45.26^{a} \pm 2.66$	$18.55^{c} \pm 1.92$	$27.46^{b} \pm 1.32$
PUFA	$12.77^{B} \pm 1.34$	$19.61^{B} \pm 2.06$	$38.79^{A} \pm 1.19$	$39.87^{A} \pm 0.89$
PUFA/SFA	$0.32^{C} \pm 0.07$	$0.56^{B} \pm 0.04$	$0.91^{A} \pm 0.08$	$1.22^{A} \pm 0.06$
Σ n-6/Σ n-3	$13.03^{a} \pm 0.94$	$7.95^{b} \pm 1.12$	$9.00^{b} \pm 0.56$	$9.01^{b} \pm 0.51$
AI	$0.51^{a} \pm 0.08$	$0.41^{ab} \pm 0.07$	$0.32^{b} \pm 0.04$	$0.30^{b} \pm 0.03$
TI	$1.22^{a} \pm 0.19$	$1.06^{a} \pm 0.21$	$1.12^{a} \pm 0.11$	$0.75^{b} \pm 0.08$
h/H	$2.04^{c} \pm 0.17$	$2.82^{b} \pm 0.19$	$3.14^{ab} \pm 0.28$	$3.64^{a} \pm 0.32$
Cholesterol, mg	$1.16^{b} \pm 0.17$	$0.61^{c} \pm 0.11$	$3,38^{a} \pm 0.21$	$1.37^{b} \pm 0.14$

$^{a, b, c}$ – values in the same rows with different letters differ significantly ($p \leq 0.05$)
$^{A, B, C}$ – values in the same rows with different letters differ significantly ($p \leq 0.01$)

Table 2. Correlation coefficients between cholesterol in chosen tissues and fatty acid profiles and some lipid indices.

Cholesterol	SFA	MUFA	PUFA	Σ n-3	Σ n-6	AI	TI	h/H
In backfat	0.278	0.258	-0.437*	-0.389	-0.412	0.324	0.218	-0.257
In muscle *LD*	0.271	0.245	-0.367	-0.234	-0.253	0,242	0.155	-0.169
In liver	0.218	0.211	-0.397	-0.314	-0.296	0.289	0.187	-0.211
In heart	0.457*	0.311	-0.579*	-0.612*	-0.419	0.416*	0.384	-0.589*

* $p < 0.05$

terolemic/ Hypercholesterolemic acids ratio (h/H), in *longissimus dorsi* muscle, heart, liver and subcutaneous fat of fatteners.

Materials and Methods

The experiment involved 60 crossbred pigs (PL × PLW) × Duroc with an initial body weight (BW) of 25.0 ± 0.5 kg housed in pens (10 pigs each). Fatteners were fed the standard grower (25-70 kg BW) and finisher (71-115 kg BW) mixtures balanced according to the recommended standards (Grela et al. 2009). The pigs were slaughtered at about 115 ± 2.0 kg BW. The samples of liver, heart, *longissimus* muscle (taken near the last thoracic and first lumbar vertebra) and backfat (obtained over the shoulder blade cutting out a lobe of 5 cm width and 10 cm length from a forequarter cut) were collected for laboratory analysis. To perform a fatty acid analysis, the total fat of liver, heart, loin and backfat, was extracted with a chloroform/methanol mixture according to the Folch et al. (1957) method. The percentage of fatty acid methyl esters was estimated using the gas chromatography procedure as described in Grela et al. (2013). Cholesterol content was measured using the colorimetric method of Rhee et al. (1982). Lipid quality indices, i.e. atherogenicity index (AI) and thrombogenicity index (TI), hypocholesterolemic/ Hypercholesterolemic ratio (h/H) were calculated according to Ulbricht and Southgate (1991) and Fernhndez et al. (2007). The obtained data were analyzed statistically (SAS 2009).

Results and Discussion

The chemical composition of meat and fatty tissue depends on the animal gender, nutrition, age and breed (Demeyer 2007). The analysis of fatty acid composition confirmed the significant differentiation between pig tissues and organs (Table 1). The highest SFA content was established in the fat of the liver and in backfat, while the lowest SFA as well as the best PUFA/SFA ratio was estimated for heart fat. The highest PUFA level was noted in the fat of the heart and liver, which is consistent with the research results reported in the literature (Mitchaothai et al. 2007). Besides, the most favorable values of AI and TI indices were also noted in the heart fat as well as h/H acid ratio. It has been observed that a higher AI value implies a lower PUFA/SFA ratio. In the human diet, the recommended ratio of n-6/n-3 fatty acids should

be in the range of 4-5:1, and not above 10:1 (Gomez Candela et al. 2011). Among the analyzed tissues, the lowest value of n3/n6 FA ratio was determined in the loin. The study demonstrated that, according to the relative contents of the particular groups of fatty acids, the liver and heart lipids showed the lowest values of atherogenic and thrombogenic indices as compared to fat of the loin and backfat (Table 1). Furthermore, more favorable values of h/H ratio were noted in the heart and liver. The obtained results are consistent with the data reported by other authors (Mitchaothai et al. 2007, Razmaitė and Švirmickas 2012). The highest cholesterol content was found in the fat of the liver, much less in the heart and backfat, and the lowest in the loin. Weak to moderate correlations were observed between cholesterol content and most of the evaluated indices describing the fatty acid profile of the analyzed tissues (Table 2). The correlations established between the cholesterol level in heart tissue and content of SFA, PUFA and n-3 FA as well as AI and h/H were statistically significant ($p \leq 0.05$). Generally, irrespective of a tissue type, the cholesterol content was negatively correlated with total PUFA, n-3 and n-6 FA content and h/H ratio.

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