

## **FATTY ACIDS PROFILE AND PHYSICOCHEMICAL PROPERTIES OF MUSCLE TISSUE FROM MALE KIDS AND RAM LAMBS OFFERED FEED SUPPLEMENTED WITH FLAXSEED**

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**Abstract.** The purpose of the paper was to assess the effect of administering a feed containing flax seeds on the fatty acid composition and cholesterol content in the meat of goat kids and ram lambs. The basic physicochemical properties of the meat were also determined. The analyses showed a significantly higher ( $p \leq 0.05$ ) protein content in the goat kids (20.20 g) as compared with the ram lambs (19.50 g). The other chemical composition parameters were similar. The  $pH_1$  and  $pH_2$  results confirmed correct glycolytic metabolism. The obtained values were 6.39 and 6.27 for the goat kids and ram lambs, respectively. The  $pH_2$  value was 5.70 for both groups of animals. The analysed goat kid meat was characterised by better UFA:SFA and PUFA:MUFA ratios. The addition of flax seeds significantly differentiated the CLA ( $p \leq 0.01$ ) and cholesterol ( $p \leq 0.05$ ) content.

**Keywords:** chemical parameters, fatty acids, goat kids, mea, ram lambs

### **INTRODUCTION**

In recent years, more and more discussion has been devoted to the “healthy” food, defined by many authors as functional food, containing ingredients favorably affecting selected functions of the human organism and improving both physical and mental condition. The separate criterion in the evaluation of the biological value of food products is the “health quality”, which can be modified by changing the amount, type and quality of the feed being fed [Zduńczyk 2000, Patkowski and Pięta 2007, Pięta and Patkowski 2007, Lee et al. 2008, Szewczyk et al. 2009].

The development of the health-enhancing properties of lamb and goat meat is aimed at decreasing fat content and modifying the profile of fatty acids (in particular omega-3 acids)

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as well as increasing the content of conjugated linoleic acid (CLA). Performed research has shown that the content of oil plants in the rations of animals produces positive results, improving the nutritional value of the meat obtained [Chiofalo et al. 2010].

The undertaken research was aimed at comparing the quality of meat from male kids and ram lambs fed a diet with 10% flaxseed.

## MATERIAL AND METHODS

The research was conducted on castrated White Improved male kids and ram lambs of the Polish Lowland sheep (10 individuals in each group). The animals were fattened indoors until the age of 150 days (body weight of 33.50 kg and 38.00 kg for male kids and ram lambs, respectively). A feed mixture containing 37% barley, 22% oats, 20% wheat middlings, 10% flaxseed, 10% soybean meal and 1% mineral mixture was fed to the animals. They were also offered medium-quality hay as a structural supplement. After fattening, the male kids and ram lambs were slaughtered. The obtained carcasses were chilled for 24 h at 4°C. For the analysis of the physicochemical properties of meat, the samples taken from the *adductor femoris* muscle were used. Dry matter content [oven-drying according to PN-73/A-82110], crude protein [Kjeldahl's method according to PN-73/A-04018], fat [Soxhlet's method according to PN-73/A-82111] and mineral content [combustion method according to PN-89/A-82115] were determined. The pH after 45 min and 24 h post-slaughter (using the CP-315 digital pH meter) and the color of the muscle tissue (using the Minolta CR-300 reflection colorimeter) were also measured. The fatty acids content of the intramuscular fat was determined with the gas chromatography.

Statistical analysis was performed using the ANOVA procedure of the Statistica® 6.0 PL software.

## RESULTS AND DISCUSSION

Meat is a mixture of more than several dozen chemical compounds that are present constantly but in different quantities and the protein is its most valuable constituent. In the conducted research (Table 1), a significantly higher ( $P \leq 0.05$ ) content of this constituent was found in the meat of male kids, whereas the remaining elements of the chemical composition were at the similar level in both the analyzed groups. Borowiec et al. [2004], investigating the effect of feeding flaxseed of different varieties on the chemical composition of meat from lambs, obtained similar results to those in the present study. In the experiments conducted by Lee et al. [2008], the protein content in the kid meat ranged between 20.10 and 20.78%, whereas the fat content ranged from 1.32 to 2.67%.

The pH is an important physical measurement characterizing the course of glycolytic changes and the level of acidity. The obtained results of the  $\text{pH}_1$  measurements in both the analyzed groups were similar and amounted to 6.30 and 6.27 in the groups of male kids and ram lambs, respectively. After 24 hours, an increase in acidity ( $\text{pH}_2 - 5.70$ ) in both

groups was observed, which proves the correct course of the process. The pH<sub>2</sub> value in the group of lambs in the study by Abidi et al. [2009] was 5.7 or 5.8 depending on the feed. These values were similar to those obtained in the present study. Obeidat et al. [2009] obtained pH<sub>1</sub> ranging from 6.10 to 6.16 in the meat of lambs.

Table 1. Average physical and chemical properties of goat kids and ram lambs meat  
Tabela 1. Właściwości fizykochemiczne mięsa koziołków i tryczków

Specyfication Wyszczególnienie	Goat kids Koziołki		Ram lambs Tryczki	
	$\bar{x}$	s	$\bar{x}$	s
Dry master, % Sucha masa, %	23.80	0.10	23.69	0.20
Total protein, % Białko ogólne, %	20.20*	0.36	19.50*	0.13
Fat, % Tłuszcz, %	2.40	0.48	2.80	0.16
Ash, % Popiół, %	1.10	0.008	1.10	0.009
pH <sub>1</sub>	6.30	0.05	6.27	0.002
pH <sub>2</sub>	5.70	0.12	5.70	0.001
Colour brightness Jasność barwy L*	42.80*	1.61	44.80*	1.36
Water absorption and kontent, % Wodochłonność, %	25.20	0.77	25.85	0.82

\*\* P<0.01, \* – (P<0.05).

Water holding capacity is one of the most important technological indicators affecting the usefulness of meat for processing purposes. As a result of the conducted research, a slightly higher value (25.85%) of this parameter in the group of ram lambs was found compared to the group of male kids (25.20%).

The evaluation of meat by consumers is influenced, among others, by the color brightness (L). This parameter depends on the species, but it is also associated with the changes occurring in the structures of muscles. The ram lambs meat was characterized by brighter color compared to the meat of male kids. The differences turned out to be statistically significant (P<0.05). The value of this parameter in the lamb meat, in the study by Osorio et al. [2008], ranged between 46.65 and 48.48 depending on the feeding system. These values were higher than those obtained in the present research.

The next factor affecting the dietary value and the flavor of meat is the fatty acids composition. The fatty acids composition for individual groups is presented in Table 2. Twenty-two fatty acids containing 10 to 22 carbon atoms were found. Statistically significant differences in the content of most fatty acids were observed. The meat from male kids was characterized by 5.5% higher content of saturated acids in comparison with the meat from ram lambs. In the study by Paleari et al. [2008], the SFA content in the kid meat was 40.95%. In the present study, the lower content of the so-called prothrombotic and

proatherogenic acids (i.e. 16:0, 18:0) in the meat from male kids (by 1.33 and 2.4, respectively) was found. Only the content of myristic acid was higher in this type of meat. In the fatty acids profile of lambs investigated by Perez et al. [2002], the lower values for individual acids were observed compared to those in the present study. In the work by Kaczor et al. [2010] no effect of the supplementation with the oil seeds on the fatty acids content was found. In the present study, the lower content of cholesterol in the male kids meat was observed. The difference was statistically significant ( $P \leq 0.05$ ). Borowiec et al. [2004] reported the significant effect of the flaxseed feeding on the decrease in the total cholesterol content in the lamb meat. In their experiment, it ranged between  $80.20 \text{ mg} \cdot \%^{-1}$  and  $98.00 \text{ \%}^{-1}$  in the groups of lambs fed different varieties of flaxseed.

Table 2. Fatty acids composition (%) and cholesterol of intramuscular lipid of male kids and ram lambs.

Tabela 2. Zawartość kwasów tłuszczowych (%) oraz cholesterolu w tłuszczu śródmięśniowym koziołków i tryczków

Specyfification Wyszczególnienie	Goat kids Koziołki		Ram lambs Tryczki	
	$\bar{x}$	s	$\bar{x}$	s
C10:0	0.11*	0.03	0.15*	0.05
C12:0	0.20*	0.05	0.22*	0.12
C14:0	3.02	0.60	2.72	0.47
C14:1	0.40**	0.14	0.25**	0.05
C15:0	0.77**	0.12	0.85**	0.05
C15:1	0.25	0.05	0.22	0.05
C16:0	21.17	1.09	22.5	0.48
C16:1	2.90**	0.08	2.57**	0.10
C17:0	2.15**	0.20	2.07**	0.10
C17:1	0.52	0.10	0.52	0.05
C18:0	17.77**	2.76	20.17**	0.54
C18:1	39.97**	1.32	37.27**	1.12
C18:2	5.45	0.52	5.50	0.37
C18:3	0.67*	0.12	0.7*	0.08
SKL	0.77**	0.10	0.55**	0.05
C20:1	0.17	0.05	0.20	0.05
C20:2	0.45**	0.12	0.27**	0.05
C20:3	0.15	0.05	0.15	0.05
C20:4	1.67*	0.51	1.55*	0.33
C20:5	0.37*	0.10	0.22*	0.10
C22:4	0.20*	0.0025	0.17*	0.05
C22:5	0.62**	0.17	0.42**	0.10
C22:6	0.20*	0.0025	0.12*	0.05
SFA	54.20**	2.76	48.70**	0.68

cont. Table 2 – cd. tab. 2

UFA	54.80**	2.76	51.3**	0.68
MUFA	44.2**	1.40	41.6**	0.40
PUFA	10.6	1.42	9.65	0.93
UFA/SFA	1.22**	0.10	1.05**	0.05
CHOLESTEROL, mg · % <sup>-1</sup>	59.42*	0.77	59.38*	0.58

\*\* P≤0.01, \* – (P≤0.05).

## CONCLUSIONS

As a result of the performed research, it was found that the animal species significantly (P≤0.05) affected the crude protein content and color of meat. From the health point of view, the more advantageous ratio of UFA:SFA and PUFA:MUFA was characteristic of the intramuscular fat of male kids compared with ram lambs. Also, the significant differences in the SKL and cholesterol contents in favor of the meat from male kids, were found.

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## PROFIL KWASÓW TŁUSZCZOWYCH I WŁAŚCIWOŚCI FIZYKOCHEMICZNE TKANKI MIĘSNIOWEJ KOZIOŁKÓW I TRYCZKÓW OTRZYMUJĄCYCH PASZĘ Z DODATKIEM NASION LNU

**Streszczenie.** Celem pracy było porównanie jakości mięsa koziołków i tryczków otrzymujących w paszy nasiona lnu. W przeprowadzonych badaniach wykazano istotnie wyższą ( $P \leq 0,05$ ) zawartość białka w grupie koziołków (20,20 g) w porównaniu z grupami tryczków (19,50 g). Pozostałe elementy składu chemicznego utrzymywały się na podobnym poziomie. Uzyskane wyniki  $pH_1$  oraz  $pH_2$  świadczyły o prawidłowych przemianach glikolitycznych i wyniosły odpowiednio w grupie koziołków 6,39 i 6,27 w grupie tryczków. Wartość  $pH_2$  wyniosła w obu grupach 5,70. Uzyskano korzystniejszy stosunek kwasów UFA:SFA oraz PUFA:MUFA w analizowanym mięsie koziołków. Dodatek ziarna lnu różnicował istotnie ( $P \leq 0,01$ ) zawartość SKL oraz ( $P \leq 0,05$ ) cholesterolu.

**Słowa kluczowe:** cechy fizykochemiczne, koziołki, kwasy tłuszczowe, mięso, tryczki

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