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An effect on basic meat quality attributes of a balanced feed mixture with a 10 % share of flaxseed applied in goat kid feeding

Krystyna Pieniak-Lendzion, Roman Niedziółka, Elżbieta Horoszewicz and Magdalena Łukasiewicz[1]

[1]Department of Sheep and Goat Breeding, University of Podlasie in Siedlce, Poland

Abstract

The objective of the study was to analyse the slaughter value and physico-chemical properties of goat kids slaughtered at 150 days of age. After weaning, at 60 days of age a balanced feed mixture with a 10 % share of flaxseed was applied in feeding.

There was found a significant ($P \leq 0.05$) increase in slaughter performance (45.80 %) and primal cuts (leg, saddle joint) obtained in the experimental group. There was also found significantly ($P \leq 0.05$) less (by 1 %) fat in the carcass of the aforementioned group. In contrast, a percentage share of meat in the leg (70.60 %) and the carcass (60.71 %) was statistically insignificant although it was slightly higher in the experimental group.

The meat of male kids fed flaxseed was darker, (L* 42.60) at $P \leq 0.01$, and contained more ($P \leq 0.01$) dry matter (24.32 %) and protein (20.97 %) but less ($P \leq 0.05$) fat (1.92 %). The sensory assessment revealed similar cooking usefulness of goat kid meat and no statistically significant differences between the groups studied.

Keywords: goat kids, flax, slaughter value, cuttings, quality of meat

Zusammenfassung

Eine Auswirkung auf die grundlegende Fleischqualität wird einem ausgewogenen Futtergemisch mit einem Anteil von 10 % Flachssaat, die bei der Ziegenkitzfütterung eingesetzt wird, zugeschrieben

Das Ziel dieser Studie bestand darin, den Schlachtwert und die physico-chemischen Eigenschaften von Ziegenkitzen auszuwerten, die im Alter von 150 Tagen geschlachtet wurden. Nach dem Entwöhnen im Alter von 60 Tagen wurde zur Fütterung ein ausgewogenes Futtergemisch mit einen Anteil von 10 % Flachssaat eingesetzt.

Es wurde eine signifikante Zunahme ($P \leq 0{,}05$) in der Schlachtleistung (45,80 %) und an in den Versuchsgruppen erhaltenen Fleischstücken (Bein, Sattelgelenk) festgestellt. Zudem wurde an der Karkasse der zuvor genannten Gruppe signifikant weniger ($P \leq 0{,}05$) (um 1 %) Fett festgestellt. Im Gegensatz dazu war ein prozentualer Fleischanteil am Bein (70,60 %) und an der Karkasse (60,71 %) statistisch insignifikant, obwohl er in der Versuchsgruppe etwas höher lag. Das Fleisch von mit Flachssaat gefütterten männlichen Kitzen war dunkler, (L* 42,60) bei $P \leq 0{,}01$, und enthielt mehr ($P \leq 0{,}01$) Trockensubstanz (24,32 %) und Protein

(20,97 %) aber weniger ($P \leq 0,05$) Fett (1,92 %). Die sensorische Bewertung ergab eine vergleichbare Kochtauglichkeit des Ziegenkitzfleisches und keine statistisch signifikanten Unterschiede zwischen den untersuchten Gruppen.

Schlüsselwörter: Zicklein, Flachs, Schlachtwert, Proben, Fleischqualität

Introduction

Meat of young goat kids is characterised by excellent properties as far as its nutritional value is concerned because intramuscular fat content in the meat is low whereas protein and mineral content is high (Kędzior *et al.* 1997, Sen *et al.* 2004, Pieniak-Lendzion *et al.* 2006, Sikora & Borys 2006, Brzostowski *et al.* 2008).

Studies on slaughter value of goat kids butchered at different body weight have yielded varying results. In general, there was found a higher share of primal cuts and meat tissue in the carcass of animals slaughtered at higher weight standards, as well as more beneficial physico-chemical meat properties (Kasprzyk *et al.* 2000, Mioć *et al.* 2001, Ringdorfer 2001, Kuźnicka *et al.* 2004, Sikora & Borys 2006, Pieniak-Lendzion *et al.* 2009). An addition of oilseed plant seeds in a ration beneficially influences the slaughter value of the meat obtained, as well as basic quality attributes of meat of lambs and kids slaughtered (Borys *et al.* 2004, Borys *et al.* 2005, Pieniak-Lendzion 2006, Szymanowska *et al.* 2006).

The objective of the study was to determine an effect of an application in male goat kid feeding of a balanced feed mixture with a 10 % share of flaxseed on basic weight cuts in half-carcass, and physicochemical composition of muscle.

Material and methods

An experiment in the year 2008 was carried out on male goat kids (8 animals in a group) of the Polish White Improved breed fattened in confinement to 150 days of age. After weaning at 60 days of age a balanced feed mixture and meadow hay were applied in feeding. The goat kids were fed *ad libitum* during the fattening period. The experimental group mixture contained 37 % barley, 17 % oats, 25 % wheat bran, 10 % soybean meal, 10 % flaxseed, and 1 % mineral mixture. Control group mixture contained 36 % barley, 22 % oats, 18 % wheat bran, 13 % bean, 10 % soybean meal, and 1 % mineral mixture. One kg palleted feed contained 87.0-87.2 % dry matter, 156.4-158.4 g crude protein, and 6.59-6.04 MJ net energy. The animals were castrated and kept in confinement on deep bedding throughout the whole feeding period. Slaughter and slaughter analysis were performed according to the methodology for small ruminants prepared by the National Research Institute of Animal Production (Nawara 1963). After 24 h chilling at 4 °C carcasses were separated into cuts which were subjected to detailed dissection into meat, fat and bone tissues.

Samples of the longest back muscle (*m. longissimus dorsi*) were subjected to chemical analysis to determine dry matter, total protein, fat, and mineral compounds (in the form of ash) contents. The respective methods of determination were: oven-drying at 105 °C, Kieldahl, Soxhlet, and combustion methods. The adductor muscle (*m. adductor*) was used to determine meat water holding capacity by the Grau-Hamm method, at pH after 45 min and 24 h by

means of a CP-315 integrated electrode pH-meter, and muscle tissue (*m. semimembranosus*) darkening using the Minolta Chroma Meter CR-300.

Statistical analysis was carried out using the Anova procedure by means of the Statistica 6.0 PL package (Statistica 2002) and it included calculation of means and standard deviation. Significance of differences between means was checked by Tukey test.

Results and discussion

Goat kids offered a mixture containing 10 % flaxseed share had by 1.34 kg higher body weight prior to slaughter compared with the control group (31.66 kg) (Table 1). Also the chilled carcass weight in the experimental group was on average by 1 kg higher and amounted to 15.01 kg. A higher slaughter performance index (45.80 %) was obtained for the group of goat kids fed the mixture including flaxseed. The differences were statistically significant. Kasprzyk *et al.* (2005) obtained a higher index of chilled slaughter performance which equalled 47.39 %. In turn, in their studies on goat kids and lambs, Szymanowska *et al.* (2006), and Korniewicz *et al.* (1999) obtained the slaughter performance level of 45 %. The carcass weight losses during chilling were similar in both groups and averaged 3.66 and 3.85 %.

Table 1
Body weight and slaughter value

Traits	Experimental Group		Control Group	
	mean	SD	mean	SD
Body weight at the slaughter, kg	33.00	2.18	31.66	3.33
Chilled carcass weight, kg	15.01	0.93	14.00	1.45
Losses weight carcass during cooling, %	3.66	0.17	3.85	0.23
Cold dressing yield, %	45.80[a]	0.98	44.25[b]	1.08

[a,b]Mean values in columns with different letters are statistically different at $P \leq 0.05$, SD: standard deviation

In the experimental group there was observed a higher weight of the right side, including the fore, central and hind part, compared with the control group. Higher values of the right side weight (7.74 kg), the fore part (3.10 kg) and the hind part (2.34 kg) of the side had been obtained in earlier studies (Pieniak-Lendzion *et al.* 2005). In turn, lower weights of the fore, central and hind part in the carcass of lambs slaughtered at the body weight of 30-35 kg were obtained by Grześkowiak *et al.* (2004). There were detected statistically significant differences ($P \leq 0.05$) in the weight of the following cuts: chuck, shoulder, leg and saddle joint, in favour of the goat kids fed the mixture containing flaxseed (Table 2). The same goat kid group was characterised by a 0.30 kg higher weight of primal cuts, that is of leg, saddle joint and between-rib steak by respectively 0.14, 0.10 and 0.06 kg. In total, the weight of primal cuts was by 1.46 % lower in the control group (control group 2.51 kg, experimental group 2.81 kg). The share of leg in the side was slightly higher than 24 %, irrespective of the group, and was by about 4 % lower than share obtained Sen *et al.* (2004). By contrast, Stanisz *et al.* (2005) carried out studies on 5-month-old goat kids of crosses with the Boer breed, and obtained the 38.65 % share of primal cuts and 23.14 % share of leg. The amount of kidney fat may be an indicator of the carcass fatness level. The feed kind and flaxseed share in the ration may indirectly influence the fatness level, which

resulted in a higher fat weight (0.192 kg) in the experimental group. The differences proved to be statistically significant at $P \leq 0.01$. The share of kidney fat in the experimental sides was 2.56 % and was similar (2.49 %) to the value obtained in the studies (Kuźnicka *et al.* 2004).

Table 2
Weight of main cuts in half-carcass, kg

Traits	Experimental group		Control group	
	mean	SD	mean	SD
Body right half-carcass	7.50	0.45	6.90	0.64
Front	3.00	0.21	2.80	0.31
Middle	2.07[a]	0.12	1.92[b]	0.10
Rump	2.18	0.15	2.01	0.20
Weight of kidney	0.058	0.002	0.056	0.004
Kidney FAT	0.192[A]	0.01	0.114[B]	0.01
Weight cuts in half-carcass				
Neck	0.40	0.05	0.48	0.08
Middle neck	0.83[a]	0.06	0.67[b]	0.24
Shoulder	1.02[a]	0.07	0.86[b]	0.08
Flank with rias	0.94	0.12	0.95	0.09
Cuttlet	0.53	0.06	0.47	0.05
Leg	1.76[a]	0.13	1.62[b]	0.18
Loin	0.52[a]	0.03	0.42[b]	0.05
Breast	0.38	0.03	0.39	0.06
Fore shank	0.37	0.06	0.40	0.07
Hind shank	0.42	0.06	0.39	0.06
Tenderloin	0.08	0.004	0.08	0.01
Valuable cuts in half-carcass, %	38.76	3.18	37.30	3.55

[a,b]Mean values in columns with different letters are statistically different at $P \leq 0.05$, [A,B] Mean values in columns with different letters are statistically different at $P \leq 0.01$, SD: standard deviation

There was obtained significantly ($P \leq 0.05$) lower fat tissue content, on average by 1 %, in the carcass of goat kids fattened with the mixture containing flaxseed. As far as meat and bone tissues were concerned, the experimental group was characterised by slightly higher values compared with the control group (Table 3). Similar values for the share of meat tissue (60.22 %) in lamb sides were obtained by other authors (Strzelecki *et al.* 2001).

Table 3
Tissue composition of leg and half-carcass, %

Traits	Experimental group		Control group	
	mean	SD	mean	SD
Tissue structure of leg				
Muscle tissue	70.60	4.61	70.26	7.74
Fat tissue	9.29	1.44	9.48	1.74
eanBone tissue	20.11	2.68	20.26	2.48
Estimated contents in carcass				
Muscle tissue	60.71	7.10	59.84	7.28
Fat tissue	12.33[a]	0.61	13.33[b]	1.19
Bone tissue	26.96	1.34	26.83	2.36

[a,b]Mean values in columns with different letters are statistically different at $P \leq 0.05$, SD: standard deviation

Analysis of the leg tissue composition showed that the share of culinary meat was over 70 % and was similar to the results of other workers (Kędzior *et al.* 1997) as well as the present results. Also Szymanowska *et al.* (2006), in the studies on goat kids fed feeds including flaxseed, found a similar meat tissue content in the leg, that is 70.4 %. On the contrary, the results obtained by Borys & Pająk (2005) indicated a higher meat and fat shares (respectively, 73.08 and 9.60 %), and a lower bone share (17.33 %) in the carcass of lambs offered a feed containing flaxseed. An even higher meat tissue content in the leg, amounting to 76.77 %, was found by Sen *et al.* (2004).

Analysis of meat chemical composition (Table 4) indicated statistically significant differences between kid groups. A significantly ($P \leq 0.01$) dry matter and protein contents, by 0.57 and 0.85 % respectively, and by 0.20 % lower fat content was found in the experimental group of kid goats. Stanisz *et al.* (2004) obtained by 0.99 % higher dry matter content and by 2.42 % lower protein content compared with the present studies. The results obtained for dry matter and protein were similar to the results of studies on the Polish White Improved breed (23.53 and 20.21 %, respectively), Alpine breed (23.74 and 19.64 %) and Saanen breed (21.96 and 20.65 %) (Mioć *et al.* 2001, Pieniak-Lendzion 2005). As far as the physical meat attributes analysed were concerned, significant ($P \leq 0.01$) differences were found for meat darkness. The L* reading value indicated a darker colour of meat from male kids offered a mixture containing flaxseed. The darker meat colour may have result form lower intramuscular fat content, which was also mentioned in other studies (Kalinowska *et al.* 1997). In turn, Stanisz *et al.* (2004) obtained a darker colour in the group of the Boer breed cross-bred male kids in which there was also determined a higher intramuscular fat content. The values were similar to the results of this work and ranged from 45.7 to 46.3. Values of pH_1 and pH_2 measurements were slightly higher in the meat of control group and amounted to 6.39 and 5.67, respectively. Similar values of pH_1 and pH_2 measurements in the meat of kids slaughtered at different age were obtained in other studies (Kalinowska *et al.* 1997, Sen *et al.* 2004, Stanisz *et al.* 2005).

Table 4
Chemical composition and physical properties of muscles

Traits	Studied muscle	Experimental group		Control group	
		mean	SD	mean	SD
pH_1	*m. adductor*	6.32	0.74	6.39	0.12
pH_2	- „ -	5.55	0.20	5.67	0.15
Colour brightness L*	*m. semimembranosus*	42.60^{A}	1.41	45.65^{B}	1.65
Water holding capacity, %	*m. adductor*	26.28	1.04	25.18	0.80
Dry matter, %	*m. longissimus dorsi*	24.32^{A}	0.71	23.75^{B}	1.71
Crude protein, %	- „ -	20.97^{A}	1.20	20.12^{B}	0.49
Fat, %	- „ -	1.92^{a}	0.11	2.12^{b}	0.11
Ash, %	- „ -	1.11	0.09	1.09	0.08

^{a,b}Mean values in columns with different letters are statistically different at $P \leq 0.05$, ^{A,B}Mean values in columns with different letters are statistically different at $P \leq 0.01$, SD: standard deviation

Sensory analysis results showed a good culinary utility of meat of both kid groups studied, which was reflected by scores exceeding 4 points for each characteristic (Table 5). Other works indicate that in particular the intramuscular fat share influences meat tenderness and

juiciness (Kalinowska *et al.* 1997, Stanisz *et al.* 2004, Borys *et al.* 2005). There was found no significant effect on these characteristic in the goat kids examined. What seems interesting is the fact that meat smell of kid goats fed the mixture containing flaxseed was almost the same as for the control group (4.25 pt). It had previously been observed that the content of unsaturated fatty acids, which is in general higher in the meat of animals fed oilseed plant seeds, can negatively influence meat smell (Borys & Borys 2004, Borys *et al.* 2005, Pieniak-Lendzion 2006).

Table 5
Sensory evaluation of the kid meat (5 points scale)

Traits	Experimental group		Control group	
	mean	SD	mean	SD
Flavour	4.25	0.20	4.27	0.20
Juiciness	4.20	0.10	4.19	0.10
Tenderness	4.25	0.11	4.20	0.11
Palatability	4.28	0.10	4.22	0.10

SD: standard deviation

As conlusion of this study we note:

1. An application of flaxseeds in the ration allowed obtaining better parameters for most slaughter value properties analysed. A significant increase in slaughter performance and weight of primal cuts, in particular leg and saddle joint, were found.
2. Feeding did not significantly influence meat and bone tissues in the leg and carcass. In contrast, carcasses of experimental kid goats contained significantly ($P \leq 0.05$) less fat tissue (12.33 % versus 13.3 %).
3. The appropriate physico-chemical composition of kid goat meat underlines its dietary and culinary value. There was found a significant influence of male kid feeding on the dry matter, protein and fat contents as well as meat colour.

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Corresponding author:

Krystyna Pieniak-Lendzion
email: owce@ap.siedlce.pl

Department Sheep and Goat Breeding, University of Podlasie in Siedlce, Poland B. Prusa 14, 08-110 Siedlce, Poland