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Carcass characteristics and meat quality of extensive grazed Polish Heath Sheep

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Abstract: *Carcass characteristics and meat quality of extensive grazed Polish Heath Sheep***.** Slaughter value and fatty acid profile from group of rams and castrates, that were kept on fallow lands used for past 15 years only for sheep production were analyzed. Positive impact of extensive grazing on animals production results during grazing season have been shown. Slaughter analysis have shown beneficial effects of this form of grazing on fatty acid profile. Rams castration may be advantageous in case of conducting the production in such areas because number of animals groups is reduced and its affects cost reduction.

Key words: meat quality, extensive grazing, sheep production

INTRODUCTION

In Polish conditions main income from sheep production comes from sale of slaughter lambs for western markets. Knowledge of lamb meat values in Poland is unknown to wider society. There is still a belief that it is a meat having a specific taste and smell, inadequate for fast preparation such as chicken (Głowacz and Niżnikowski 2008). Meanwhile, the lamb meat is considered as a functional and health food characterized with many valuable qualities for a human health (Borys and Pisulewski 2001). In many European countries, lamb meat is considered a luxury product frequently bought by consumers. In Polish conditions, the average consumption of this meat is about 48 g for the average Pole in year or 0.02% of all meat consumed (http://faostat.fao.org). There are many factors that affect the quality and quantity of the received product. An important factor in the meat production is sex of fattened animals. Rams have a better suitability for fattening because of a faster growth rate and carcass weight (Todaro et al. 2004). Despite that fact, there is no need for young rams castration this procedure is used to avoid uncontrolled reproduction when space is limited or animals of both sexes are grazed together, also reduces aggression and sexual activity by lowering testosterone levels, which is particularly important in the period before slaughter, because reduces the depletion of energy resources necessary to lower the pH of muscle (Peinado et al. 2011, Nogalski et al. 2013). The aim of the study is to compare meat quality of two animals groups from extensive livestock production.

MATERIAL AND METHODS

Two groups of animals (rams and castrates) were selected to estimate meat value and the ability to conduct extensive sheep grazing on fallow lands. Af-

ter obtaining a appropriate body weight (33 kg ±1%) animals were slaughtered and their carcasses evaluated. Additionally the skin was weighed. In total nine rams and nine castrates were rated. Statistical calculations were done using SPSS software 14 and differences between experimental groups were evaluated with Student's t-test (Ruszczyc 1981).

Carcass quality

Obtained carcasses were weighed, divided into two halfs (Nawara et al. 1963) and following measurements were taken on left half part: classification by the EUROP system, estimation of color and texture of carcass fat, length and girth of leg, width of the ankle joint, pH (pH_0 and pH_{24}), slaughter yield (%), surfaces of "eye" loin.

Weight and percentage of parts – neck, middle neck, loin, rib steak, shoulder, hideshank and foreshank, tenderloin and leg, were rated. Share of valuable parts (leg, foreshank and rib steak) of half-carcass was determined. Weight and the percentage of each tissue (meat, bones and fat) of leg were checked.

Meat quality

Samples of meat were taken from *longissimus dorsi* muscle (*musculus longissimus dorsi*) and were tested for color (L*a*b* parameters) using Konica Minolta CR-400, where L * parameter meant brightness of meat, and a* – share of red, b* – share of yellow (Strzyżewski at al. 2008, Juarez et al. 2009). Water absorption with Grau–Hamm method (Hamm 1986) and the dry matter according to PN-73/A-82110 were determined (Horoszewicz et al. 2008). Protein and fat content was determined according to standard methods AOAC (1990). From the part of meat sample was taken to analyze fatty acid profile with gas chromatography on a Hewlett–Packard (Radzik-Rant 2005, Nałęcz-Tarwacka 2006).

RESULTS AND DISCUSION

There has been observed a higher weight of the carcass, half-carcass and skin in ram group. Also slaughter yield (%) and daily weight increase (g) were higher in this group, but differences were no statistically significant. Slaughter yield at around 40% were similar to the result which gained by Khidir et al. (1998) and Niżnikowski (2002) but is lower than the results achieved from national population (Table 1).

In terms of EUROP classification and carcass fatness rams showed bet-

TABLE 1. Characteristics of slaughter and fattening

Traits	Rams (A) (N = 9)		Castrates (B) (N = 9)	
	AVG	*SE*	*AVG*	*SE*
Carcass (kg)	12.90	0.44	12.30	0.44
Pelt (kg)	2.77	0.18	2.56	0.18
Daily weight increase (g)	0.29	0.01	0.28	0.01
Half-carcass (kg)	6.45	0.30	6.15	0.30
Slaughter yield (%)	41.50	1.57	38.53	1.57

ter parameters than castrates. Most carcasses for both groups were classified in R category, while two rams were qualified for U category and three castrates to O category. Castrates carcasses had more colored fat and a greater cohesion than other group (Table 2).

TABLE 2. Results comparison of the classification of both groups

Item	Σ	Rams ($N = 9$)	Castrates ($N = 9$)
EUROP class (categories)			
E	0	0	0
U	2	2	0
R	13	7	6
O	3	0	3
P	0	0	0
Fat class (categories)			
1	13	8	5
2	5	1	4
3	0	0	0
4	0	0	0
5	0	0	0
Fat colour			
Coloured	10	3	7
White	8	6	2
Fat consistency			
Very	4	0	4
Cohesive	12	7	5
Tender	2	2	0
Very tender	0	0	0

A group of rams was characterized by a higher depth and length of the leg (cm) and the surface of the "eye" loin (cm^2). Other analyzed measurements were higher in castrates group. Differences were significant in the case of deep leg (cm) and the thickness of the fat cover on loin eye (mm) – Table 3. Measurements made on loin eye area of tenderloin were varied depending on the experimental group, however similar to the results presented by Niżnikowski (2002). Animals that were not castrated had greater depth and eye loin area. Other measurements were higher in the second group.

A greater weight of kidney with fat, loin, leg, tenderloin and valuable cuts in half-carcass in ram group was observed but weight of fore- and hideshank, shoulder, neck, middle neck, breast and rib steak was higher in castrated group. In case of leg dissection muscle and bone mass was greater at castrates and the fat in second group. However, these differences were not statistically significant. Only in case of percentage share of middle neck and lean in leg statistically significant differences were observed (Table 4). Cutting carcasses results were similar to the results of research which gained Johnson et al. (2005) for lambs kept on pasture. A similar relationship in relation to the percentage of the most valuable fellings (round, loin, steak) in a half-carcass was observed in works of Priolo et al. (2002).

Higher pH after slaughter and after 24 h of cooling was observed in group of castrates, also measurements of meat color showed a higher brightness (L* parameter) and share of yellow spectrum (b* parameter) were higher in this group. Parameter a* (share of red color). Higher value of water absorption and the crude fat content and dry matter was higher in rams group. Only in the case of crude protein content analyzed differences were significant (Table 5). The obtained results of pH immediately after slaughter at level of 5.82 in ram group and 5.87 in castrates were lower than in other authors (Rodriguez et al. 2008, Ekiz et al. 2009, D'Alessandro et al. 2013), where the results oscillated in the range of

TABLE 3. Comparison measurements of rams and castrates carcasses

Traits	Rams (A) ($N = 9$)		Castrates (B) ($N = 9$)	
	AVG	*SE*	*AVG*	*SE*
Spread of hock joint (cm)	2.96	0.10	3.03	0.10
Depth of leg (cm)	20.73^{b}	0.44	19.29^{a}	0.44
Length of leg (cm)	25.81	0.50	25.97	0.50
Round of leg (cm)	34.14	0.68	34.92	0.68
Index of leg (%)	132.45	3.03	134.80	3.03
Loin eye area (cm^2)	11.06	0.71	9.38	0.71
Height of the loin eye (cm)	2.52	0.10	2.62	0.10
Spread of the loin eye (cm)	4.61	0.17	5.01	0.17
Fat cover over loin eye (mm)	0.38^{b}	0.13	0.77^{a}	0.13

a, b – $P < 0.05$.

TABLE 4. The results left half-carcass cuttings and leg dissection

Traits	Rams (A) ($N = 9$)		Castrates (B) ($N = 9$)	
	AVG	*SE*	*AVG*	*SE*
1	2	3	4	5
Kidney with fat (kg)	0.15	0.02	0.13	0.02
Kidney with fat (%)	2.33	0.40	2.24	0.40
Neck (kg)	0.63	0.04	0.67	0.04
Neck (%)	9.66	0.57	10.72	0.57
Shoulder (kg)	0.92	0.03	0.98	0.03
Shoulder (%)	14.65	0.84	16.12	0.84
Foreshank (kg)	0.19	0.01	0.20	0.01
Foreshank (%)	2.98	0.17	3.35	0.17
Hideshank (kg)	0.24	0.02	0.25	0.02
Hideshank (%)	3.48	0.25	4.15	0.25
Middle neck (kg)	0.47	0.03	0.53	0.03
Middle neck (%)	7.27^{b}	0.36	8.69^{a}	0.36
Breast (kg)	0.75	0.04	0.81	0.04
Breast (%)	11.63	0.58	13.18	0.58
Rib steak (kg)	0.46	0.02	0.49	0.02
Rib steak (%)	7.30	0.35	7.88	0.35
Loin (kg)	0.38	0.03	0.37	0.03
Loin (%)	6.20	0.38	6.38	0.38

TABLE 4 cont.

1	2	3	4	5
Leg (kg)	1.73	0.08	1.72	0.08
Leg (%)	27.02	0.69	28.24	0.69
Tenderloin (kg)	0.11	0.01	0.10	0.01
Tenderloin (%)	1.17	0.13	1.61	0.13
Valuable cuts (kg)	2.57	0.10	2.58	0.10
Valuable cuts (%)	40.52	1.06	42.50	1.06
Tissue composition of leg				
Lean (kg)	1.32	0.07	1.35	0.07
Lean (%)	75.00^{b}	1.06	79.05^{a}	1.06
Fat (kg)	0.17	0.02	0.13	0.02
Fat (%)	9.75	1.21	7.57	1.21
Bone (kg)	0.21	0.01	0.22	0.01
Bone (%)	12.35	0.68	12.55	0.68

a, b – $P \leq 0.05$.

TABLE 5. Comparison of chemical and physicochemical composition of *musculus longissimus dorsi* (*mld*)

Traits	Rams (A) ($N = 9$)		Castrats (B) ($N = 9$)	
	AVG	*SE*	*AVG*	*SE*
Chemical characteristics of *mld* (%)				
Dry matter	26.72	1.01	25.64	1.01
Crude protein	21.00^{b}	0.28	22.14^{a}	0.28
Fat	3.29	0.48	2.40	0.49
Physical characteristics of *mld*				
Water holding capacity (cm^2)	14.50	1.18	13.56	1.18
pH_0	5.82	0.04	5.87	0.04
pH_{24}	5.59	0.05	5.62	0.05
Meat color				
L* (brightness)	47.78	1.65	48.74	1.65
a* (share of red)	13.72	0.56	12.35	0.56
b* (share of yellow)	6.34	0.86	6.59	0.86

a, b – $P < 0.05$.

5.99–6.49. The same trend was observed with pH level after 24 h after slaughter. Measurements of meat color for a L* parameter (brightness) were similar to results of Ripoll et al. (2008) and Luciano et al. (2009), as well as Ekiz et al. (2009) and D'Alessandro et al. (2013), for lambs kept on pasture without the

addition of nutritive fodder. Parameters a* and b* achieved levels similar to the results obtained by Ádnøy et al. (2005) and Ekiz et al. (2009) for animals kept on mountain pastures and were higher in case of animals kept indoors.

Between both groups of animals highly significant difference in the content of C17:0 and C17:1 acids was observed. This difference was significant for acid: C14:1, C16:1, C18:2n6 and acid group – PUFAn6. In case of other acids such differences were no significant. An acid content of C10:0, C15:0, C16:0, C16:1. C17:0, C17:1, C18:1c9. MUFACIS was higher in ram meat, however rest were defined in second group (Table 6). Lamb production in Poland currently is the basic section of sheep production, therefore these animals need to obtain the best performance of growth and slaughter capacity, but economic aspect is also very important. Production of good quality lamb meat on wastelands is possible. This meat in Poland is underestimated and even forgotten, characterized by many positive features

TABLE 6. Fatty acids profile in meat

Traits	Rams (A) ($N = 9$)		Castrates (B) ($N = 9$)	
	AVG	*SE*	*AVG*	*SE*
1	2	3	4	5
C10:0	0.15	0.01	0.13	0.01
C12:0	0.09	0.02	0.12	0.02
C14:0	2.20	0.20	2.64	0.20
C14:1	0.22^{b}	0.01	0.27^{a}	0.01
C15:0	0.69	0.08	0.49	0.08
C15:1	0.25	0.03	0.26	0.03
C16:0	21.22	0.70	20.90	0.70
C16:1	2.18^{b}	0.19	1.39^{a}	0.19
C17:0	1.91^{B}	0.14	1.33^{A}	0.14
C17:1	1.34^{B}	0.15	0.67^{A}	0.15
C18:0	17.00	0.89	19.61	0.89
C18:1tr11	2.72	0.42	3.55	0.42
C18:1c9	34.79	0.92	34.50	0.92
C18:2n6	2.36^{b}	0.21	3.17^{a}	0.21
C18:3n6	0.10	0.05	0.17	0.05
C18:3n3	0.93	0.13	1.26	0.13
CLA	0.92	0.12	1.09	0.12
C20:1	0.08	0.01	0.10	0.01
C20:3n3	0.05	0.01	0.09	0.01
C20:4n6	0.40	0.11	0.70	0.11
C20:5n3	0.24	0.07	0.35	0.07

TABLE 6 cont.

1	2	3	4	5
C22:5n3	0.25	0.06	0.42	0.06
C22:6n3	0.05	0.02	0.06	0.02
SFA	43.26	1.20	44.85	1.20
MUFA-cis	38.86	0.80	37.19	0.80
MUFA-trans	2.72	0.42	3.55	0.42
PUFAn3	1.52	0.26	2.18	0.26
PUFAn6	2.87[b]	0.31	4.04[a]	0.31

a, b – $P < 0.05$; A, B – $P < 0.01$.

among others positive profile of fatty acids (Głowacz and Niżnikowski 2008). It characterized by a high content of linoleic acid which protects against cancer, limits the concentration of "bad" cholesterol in the blood, regulates metabolism and affects the growth of muscle mass (Reklewska et al. 2002). The obtained acid levels of the group SFA, MUFA and PUFA were similar to the results received by Radzik-Rant (1996) analyzing the fatty acid profile from Polish heath sheep from RZD Żelazna.

Content of the various fatty acids was different depending on the experimental group. The level of both groups. was similar to the results received by Horoszewicz et al. (2008). Difference of 10% in content of SFA was observed than the results obtained by Juarez et al. (2009) which might have resulted to the feeding system of individual groups of animals.

CONCLUSIONS

1. Results showed that fallow lands can become a good base for livestock production, especially extensive races such as Polish Heath Sheep. Continuous grazing leads to a reduction of shrubs and trees succession and it is economically feasible.
2. Polish Heath Sheep is predisposed for the such grazing areas. Costs could be reduced because nutrition is based on cheap and ecological feeds.
3. Slaughter analyses showed no contraindications for rams castration and the results of the profile of fatty acids have shown that it is possible to produce good-quality lamb meat based on fallow lands.
4. Animals maintenance on such land can improve the profitability of production and enable production of healthy food.

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Streszczenie: *Charakterystyka tusz oraz jakość mięsa ekstensywnie wypasanych owiec rasy wrzosówka polska.* Przeanalizowano wartość rzeźną i profil kwasów tłuszczowych od grupy tryczków i kastratów, które utrzymywane były na terenie odłogowanym, na którym od 15 lat prowadzona była produkcja owczarska. Wykazano pozytywny wpływ ekstensywnego wypasu na wyniki produkcyjne zwierząt w trakcie sezonu pastwiskowego. Analizy rzeźne dowiodły korzystnego wpływu takiej formy wypasu na profil kwasów tłuszczowych. Wykazano, iż zabieg kastracji tryczków może okazać się korzystny w przypadku prowadzenia produkcji na takich terenach, gdyż ogranicza liczbę grup zwierząt, a przez to wpływa na ograniczenie kosztów.

Słowa kluczowe: jakość mięsa, ekstensywny wypas, produkcja owczarska

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