The effect of slaughter weight and sex on carcass traits of Croatian Spotted goat kids

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Scientific paper

Summary

The Croatian Spotted goat is an indigenous breed which represents the major part of the goat population in Croatia. It is bred primarily for kid meat production in extensive pastoral systems. The aim of this study was to determine the slaughter and carcass traits of Croatian Spotted goat kids, as well as the effect of sex and slaughter weight on those traits. For that purpose 90 Croatian Spotted goat kids (34 males and 56 females) were slaughtered. According to slaughter weight, the kids were divided into two test groups: group I (average slaughter weight 21.5 kg) and group II (average slaughter weight 26.2 kg). The kids were slaughtered and processed in authorized abattoirs. Following slaughter, hot carcasses and non-carcass components were weighed. Also, the following body dimensions were measured: carcass length, chest width, chest depth, hind limb length and buttock width. Data were analysed using the general linear model (GLM) procedure of SAS statistical software. Male kids were slightly heavier at slaughter (P>0.05), but had a statistically significantly (P<0.01) lower dressing percentage than female kids (47.32: 48.79%). The carcasses derived from male kids were more developed than those from female kids, i.e. they had significantly deeper chest (P<0.01) and longer hind limbs (P<0.05). Kids of greater slaughter weight had heavier carcasses (P<0.01) and non-carcass components than lighter kids as well as a lower dressing percentage of hot carcass (P>0.05). Except for buttock width, all carcass measurements of kids of greater slaughter weight were statistically significantly greater (P<0.01).

Key words: *Croatian Spotted goat, slaughter weight, carcass measurements, dressing percentage*

Introduction

Goats are the most adaptable and geographically the most widespread breed of domestic animals (Joshi et al., 2004). They are bred in almost every country in the world and in all climatic zones – from the mountains of Siberia to the deserts and the tropical parts of Africa (Luikart et al., 2001). Goats typically inhabit areas where other livestock species cannot survive and are hence found in large populations in areas with scarce vegetation and water sources, where the conditions for breeding other domestic animals, especially bovine cattle, are far less favourable. Today there are various systems of goat breeding, from the most extensive to the intensive, all having different production goals (Mioč and Pavić, 2002).

In most countries goats are regarded primarily as meat-producing animals, although their meat production is not as effective as that of some other animal species (Huston, 1978). They have lower body growth rates and lesser feed usability in fenced breeding systems, but are more effective in other systems (feeding on various bushes, weeds and unwanted vegetation and collecting the remains after a harvest) than other domestic animals (McDowell and Woodward, 1982). In poor and arid parts of the world (Asia and Africa) goats are generally the main providers of meat and milk for the people, i.e. the main source of animal proteins.

Despite the fact that meat is economically the most important goat product, so far it has not been the subject of as much scientific research as the dairy, physiological and nutritional traits of goats. Research of meat traits of goats has been modest in comparison with that of meat traits of pigs, cows and sheep. The worldwide trend of continually growing goat meat production is not so much the result of scientific or breeding and selection advancement, of creating certain breeds and crossbreeds with better meat traits (greater daily body growth, greater slaughter weight, better carcass conformation, larger share of muscles in the carcass, juicier meat without certain smells etc.), as it is a reflection of the growth of the entire goat population worldwide, which has increased by 30 % in the last decade (FAOSTAT, 2010).

The most important category of goat meat in the world is kid meat. Goat kid carcasses are traditional

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products and their processing, organs included and presentation vary widely from one country to another, even from one to another part of the same country. In Croatia there are no unified standards for processing goat kid meat, but carcasses are generally delivered with head and kidneys, but without lungs, heart and liver (Mioč and Pavić, 2002). Goat kid carcass is considered a product gained after slaughter, blood drainage, and the removal of the thoracic, abdominal and pelvic cavity organs, of skin, head and lower limb parts, cut off at the carpal, i.e. tarsal joint. Goat kid carcasses are usually small, light (4 to 15 kg), narrow and shallow, but also suitable for preparation and consummation in one piece, without extra cutting and similar operations (Mioč and Pavić, 2002). Another significant advantage of goat kid meat is that it contains very little fat in the whole carcass, as well as intramuscular fat. The levels of subcutaneous and intramuscular fat are very low. Niedziółka et al. (2005) point out that goat meat contains 2.28% and lamb meat 4.15% intramuscular fat. Another significant difference is in the composition of fatty acids in intramuscular fat, since goat kid meat contains about 37% saturated fatty acids, and lamb about 45%.

Although the greatest number of goats is bred for meat production, there are no typical meat-producing breeds. Production is mainly based on various breeds, more or less locally determined, and one of these is the Croatian Spotted goat. The Croatian Spotted goat is an indigenous species of Croatia and forms the major part of the goat population in the country, with an estimated number of 35.000 head (HPA, 2010). Its original habitats are the rocky, arid and impenetrable grounds of the south Velebit, Dinara, Kamešnica and Biokovo mountains, which have remained its largest breeding areas. There is no record of significant and planned advancements of this species in the past, only of occasional attempts at such, hence the conclusion that it assumed its original traits in this area. The original traits of the Croatian Spotted goat (such as resilience, adaptability, mobility, liveliness, endurance and effective use of scarce vegetation) are highly adapted to the typical ecological, economical and cultural conditions of Dalmatinska Zagora (Mioč et al., 2008).

The size of the Croatian Spotted goat population was certainly negatively affected by the 1954_Ban on Keeping Goats. This law was, fortunately, never fully implemented, but resulted in a lack of knowledge of population size in the past and of traits of other breeds possibly having affected the genotype of the Croatian Spotted goat (Mioč et al., 2008).

The body of the Croatian Spotted goat (except for the legs) is covered with long, thick, shiny, rough hair, usually multicoloured, rarely of one colour (black, brown or grey). The skin is pigmented, thin and elastic (Mioč and Pavić, 2002). The head is relatively small, mid-length, with a straight profile and the practically inevitable, usually backward inclined, dark, rough horns, which, along with the beard, are considered to be a typical trait of the species. The ears are mid-length, flexible and pigmented. The neck is long, thin, moderately muscular, and some goats have little wattles on the lower part of the neck. The chest is shallow and narrow, and the withers rather high. The rump is steep and moderately wide. The legs are thin but firm, while the hoofs are rather hard, well adapted to the rocky mountain areas. Average body weight of adult females is 44.01 kg, and of males 51.28 kg (Mioč et al., 2008).

The Croatian Spotted goat is bred primarily for meat production (kid carcasses), in extensive pastoral systems. Goats are usually let out on pastures in autumn, and kids toward the end of winter and at the beginning of spring. The average litter size is 1.26 kids (HPA, 2010). The average birth weight of goat kids is 1.78 to 2.45 kg, but varies greatly from one herd to another (Beran et al., 2010). With an average daily body growth of 112 grams, kids reach the weight of 24 kg within 190 days (Prpić et al., 2010). Goats are not milked and all the milk they produce in the lactation period is sucked by the kids.

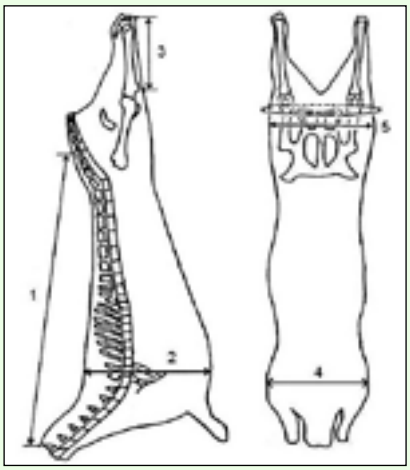

Figure 1. **Carcass measurements** (1 – carcass length, 2 – chest depth, 3 – hind limb length, 4 – chest width, 5 – buttock width)

Considering the fact that the primary goal of breeding Croatian Spotted goats is meat production, the purpose of this study was to determine the slaughter and carcass traits of male and female goat kids of different slaughter weights.

Materials and Methods

The research for this study included 90 Croatian Spotted goat kids (34 males and 56 females). In order to establish the effect of slaughter weight on slaughter traits and carcass measurements of dressed carcasses, the kids were divided according to slaughter weight into two test groups: group I (average slaughter

Table 1. **Slaughter characteristics of Croatian Spotted goat kids**

Traits	n	x̄	Sd	min.	max.
Slaughter weight, kg	90	24.14	3.09	18.00	33.50
Hot carcass weight, kg	90	11.63	1.53	8.18	16.60
Dressing percentage, %	90	48.20	2.15	40.63	52.50
Stomach and intestines, kg	90	7.60	1.17	5.46	10.86
Lungs and heart, kg	90	0.48	0.09	0.30	0.79
Spleen, kg	88	0.07	0.02	0.03	0.11
Liver, kg	90	0.45	0.06	0.31	0.66
Testicles, kg	34	0.19	0.07	0.06	0.33
Skin and lower legs, kg	90	2.23	0.26	1.73	2.93
Horns, kg	54	0.12	0.05	0.04	0.25

n – number of kids; x̄ – arithmetic mean; sd –standard deviation; min – minimum; max. – maximum.

Table 2. **Carcass measurements of Croatian Spotted goat kids (cm)**

Carcass measurements	n	x̄	sd	min.	max.
Carcass length	90	61.17	3.14	52.00	67.50
Chest width	90	11.51	0.72	9.80	13.50
Chest depth	90	23.72	1.10	21.50	26.50
Hind limb length	90	25.02	1.17	20.60	27.50
Buttock width	90	12.95	1.38	10.80	23.80

weight 21.5 kg) and group II (average slaughter weight 26.2 kg).

The kids were slaughtered in authorized abattoirs and the carcasses processed according to standards. After slaughter and bleeding, skin was peeled off the carcasses, lower limb parts were cut off (at the carpal, i.e. tarsal joint) and the abdominal (forestomachs, stomach, spleen, intestines and liver) and thoracic (trachea, lungs and heart) cavity organs were removed. Following these procedures, individual internal organs, skin with lower limb parts, horns and dressed carcasses were weighed separately.

Since the Croatian market usually sells goat kid meat as whole carcass with head and kidneys, these parts were not removed from the carcass or weighed separately.

After abattoir processing the following measurements of the carcasses were taken (Figure 1):

- carcass length – measured by a flexible measuring tape from the caudal edge of the last sacral vertebra to the dorso-cranial edge of the atlas (the first cervical vertebra)
- hind limb length – measured by a flexible measuring tape from the middle of the lump at the proximal end of the tibia to the distal end of the tarsus
- chest depth – the greatest depth, measured by calipers for measuring cavities at the horizontal level of the hanging carcass
- chest and buttock width – the greatest width, measured by calipers for measuring cavities at the horizontal level of the hanging carcass

Data were analysed with the GLM procedure of SAS statistical software (SAS, 1999). Statistical indicators of the analysed carcass traits were established by the MEANS procedure.

Results and Discussion

The slaughter weight of the examined Croatian Spotted goat kids, their hot carcass weight and the weights of are shown in Table 1.

The average carcass weight of the Croatian Spotted kids obtained in this research is similar to the carcass weight of Criollo (10.5 kg) and Creole goat kids (11,0 kg) at 5 months of age, bred in a similar, extensive fashion (Zimerman et al., 2008; Alexandre et al., 2010). Similarly, the average carcass weight of extensively bred Norduz kids at 4.5 months of age was 10.3 kg (Daskiran et al., 2006).

The dressing percentage of the surveyed kids ranged between 40.63% and 52.50%, while the weight of the non-carcass components (forestomachs, stomach and intestines, liver, spleen, testicles, lungs and heart, horns, skin and lower limb parts) was 11.14 kg on average. Similar average dressing percentages were found by Stanisz et al. (2009) and Alexandre et al. (2010) in goat kids of various genotypes. However, Koşum et al. (2003) found a slightly higher average dressing percentage in Saanen (52.20%) and Bornova kids (55.19%).

Statistical indicators of the carcass measurements of the surveyed Croatian Spotted goat kids are shown in Table 2.

The average carcass length of Croatian Spotted kids is similar to that of male Saanen kids (61.60 cm) and Bornova kids (60.61 cm) in Turkey (Koşum et al., 2003). Stanisz et al. (2009), however, determined shorter and shallower carcasses of White goat kids with varying ratios of Boer blood in comparison with Croatian Spotted kids. Ekiz et al. (2010) also found shorter (56.9 cm) carcasses of Saanen and Maltese kids in comparison with Croatian Spotted goat kids.

Table 3 illustrates the effect of sex on slaughter traits of Croatian Spotted goat kids. The research dem-

onstrated significant differences (P<0.01) in the dressing percentage between the sexes. In spite of having somewhat greater slaughter weight, and consequently greater carcass weight, the male kids had lower dressing percentage than the females. The reason for this is that the males had a significantly larger share of stomach and intestines (P<0.05), of lungs and heart (P<0.05), of horns and of skin with lower limb parts (P<0.01) than the females. Rodrigues et al. (2009) also established a slightly higher dressing percentage in female kids in spite of the greater slaughter and carcass weight of the males, and Johnson et al. (1995) pointed out the greater effect of sex than of breed on carcass weight and dressing percentage. However, Perez et al. (2001) found a higher dressing percentage in male than in female Creole kids of an average slaughter weight of 10 kg, while Peña et al. (2007) discovered no statistically significant influence of sex on the dressing percentage of Florida goat kids.

The average dressing percentages of male kids obtained in this research are similar to those found by Anous and Mourad (2001) in male Alpine kids (48.90%), while Daskiran et al. (2006) established a slightly lower dressing percentage (46.26%) in male Norduz kids. Similarly, Rodrigues et al. (2009) found a lower average dressing percentage (44%) in various crossbreed kids of both sexes, bred in extensive systems.

The share of individual organs in the carcass varied between the male and female kids (Table 3). Statistically significant differences between the sexes were found in the average weight of stomach and intestines and of lungs and heart (P<0.05), as well as in the average weight of skin and lower limb parts and of horns (P<0.01).

Table 3. **The effect of sex on slaughter characteristics of Croatian Spotted goat kids (LSM±SE)**

Traits	Sex		Level of significance
	Male (n=34)	Female (n=56)	
Slaughter weight, kg	24.85 ± 0.51	23.68 ± 0.42	NS
Hot carcass weight, kg	11.76 ± 0.26	11.54 ± 0.21	NS
Dressing percentage, %	47.32 ± 0.34	48.79 ± 0.28	**
Stomach and intestines, kg	7.93 ± 0.19	7.38 ± 0.16	*
Lungs and heart, kg	0.50 ± 0.01	0.47 ± 0.01	*
Spleen, kg	0.06 ± 0.01	0.07± 0.01	NS
Liver, kg	0.46 ± 0.01	0.44 ± 0.01	NS
Skin and lower legs, kg	2.39 ± 0.04	2.11 ± 0.03	**
Horns, kg	0.6 ± 0.01	0.07 ± 0.01	**

NS – not significant; * P<0.05; **P<0.01

Table 4. **The effect of sex on carcass measurements of Croatian Spotted goat kids (cm)**

Traits	Sex		Level of significance
	Male (n=34)	Female (n=56)	
Carcass length	61.63 ± 0.52	60.87 ± 0.43	NZ
Chest width	11.49 ± 0.12	11.52 ± 0.10	NZ
Chest depth	24.14 ± 0.18	23.44 ± 0.14	**
Hind limb length	25.38 ± 0.19	24.78 ± 0.15	*
Buttock width	13.18 ± 0.23	12.80 ± 0.19	NZ

NS – not significant; * P<0.05; **P<0.01

Table 5. **Influence of slaughter weight on kids slaughter traits (LSM±SE)**

Traits	Slaughter weight		Level of significance
	Group I (n=39)	Group II (n=51)	
Hot carcass weight, kg	10.42 ± 0.18	12.55 ± 0.15	**
Dressing percentage, %	48.58 ± 0.34	47.91 ± 0.30	NZ
Stomach and intestines, kg	6.87 ± 0.16	8.16 ± 0.14	**
Lungs and heart, kg	0.44 ± 0.01	0.51 ± 0.01	**
Spleen, kg	0.06 ± 0.01	0.07 ± 0.01	NZ
Liver, kg	0.42 ± 0.01	0.48 ± 0.01	**
Testicles, kg	0.20 ± 0.02	0.19 ± 0.01	NZ
Skin and lower legs, kg	2.01 ± 0.04	2.32 ± 0.03	**
Horns, kg	0.09 ± 0.01	0.14 ± 0.01	**

NS – not significant; **P<0.01

The male kids had more developed carcasses (except for chest width) than the female kids (Table 4), which may be a result of greater slaughter weight. The carcasses derived from male kids had deeper chest (P<0.01) and longer hind limbs (P<0.05) than those derived from female kids. However, Peña et al. (2007) discovered no significant differences in hind limb length, chest depth, chest width or buttock width between male and female Florida kid carcasses. The Croatian Spotted goat kids had, on average, longer carcasses, but narrower chests and buttocks than male Creole kids examined by Alexandre et al. (2010), weighing an average 32.1 kg and being about 7 months old at slaughter.

Table 6. **Influence of slaughter weight on carcass measurements of Croatian Spotted goat kids (cm)**

Carcass measurements	Slaughter weight		Level of significance
	Group I (n=39)	Group II (n=51)	
Carcass length	60.19 ± 0.49	61.93 ± 0.43	**
Chest width	11.28 ± 0.11	11.68 ± 0.10	**
Chest depth	23.18 ± 0.16	24.14 ± 0.14	**
Hind limb length	24.59 ± 0.18	25.35 ± 0.16	**
Buttock width	12.69 ± 0.22	13.14 ± 0.19	NZ

NS – not significant; **P<0.01

Ekiz et al. (2010) established slightly lower average chest depth (23.2 cm), approximately equal buttock width (13.43 cm), but greater hind limb length (28.35 cm) in male Saanen kids.

The slaughter traits in kids of different average slaughter weights are shown in Table 5. The research has shown a significant (P<0.01) influence of slaughter weight on carcass weight, and on the weights of stomach and intestines, lungs and heart, liver, skin with lower limb parts and horns. Kids of greater slaughter weight had greater carcass weight and greater weight of internal organs than kids of smaller slaughter weight. Kids of greater slaughter weight also had a lower dressing percentage than lighter kids, although the differences were not statistically significant (P>0.05). Similarly, Marichal et al. (2003) established a lower dressing percentage in Canary kids of greater slaughter weight (25 kg) than in lighter kids (6 and 10 kg), which they explained with the fact that lighter kids did not have a fully developed digestive system. In comparison with the Croatian Spotted kids included in this research, male Balkan goat kids in Macedonia (Milevska et al., 2010) weighing an average 10.84 kg at slaughter had a higher average dressing percentage (53.55%).

Table 6 shows the carcass measurements of the examined Croatian Spotted kids according to test group. Slaughter weight had a statistically significant (P<0.01) influence on the analysed carcass measurements, except for buttock width. 21.8% greater slaughter weight resulted in an average increase of 2.9 % in carcass length, 3.5% in chest width, 4.1% in chest depth, 3.1% in hind limb length and 3.5% in buttock width. A similar influence of slaughter weight on carcass measurements was found by Marichal et al. (2003).

Conclusion

The Croatian Spotted goat is the largest goat population in Croatia, bred almost exclusively with the goal of kid meat production, mainly in extensive pastoral systems. The average slaughter weight of the surveyed goat kids was 24.14 kg, the average carcass weight 11.63 kg and the average dressing percentage 48.2%. Although the average slaughter and carcass weights did not differ much between the sexes, the females had a significantly (P<0.01) higher dressing percentage than the males (48.79: 47.32%). The carcasses derived from male kids were more developed than those from female kids, especially in chest depth (P<0.01) and the length of hind limbs (P<0.05). Kids of greater slaughter weight (26.2 kg on average) had heavier carcasses, but kids of smaller slaughter weight (21.5 kg on average) had a higher dressing percentage, although the differences were not statistically significant (P>0.05). Expectedly, the analysed carcass measurements, except for buttock width, were greater (P<0.01) in kids of greater slaughter weight.

This paper is an abstract from the degree paper of Valentin Držaić, MSc (Agr Eng), entitled 'Slaughter Characteristics and Carcass Traits of Croatian Spotted Goat Kids'

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