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Study on birth weight and pre-weaning growth of Croatian multicolored goat kids

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ABSTRACT

The aim of this research was to determine some production characteristics of Croatian multicolored goat kids (birth weight, age and body weight at weaning, and average daily gain) in extensive breeding conditions. The research included 530 goat kids from four family farms in the area of the Šibenik - Knin and Zadar County. The birth weight and body weight of the kids at weaning were determined by individual weighing on an electronic scale with accuracy of ±0.05 kg. The kids were with other goats from birth to weaning and they consumed pasture grass and browsed while consuming milk by suckling. The results of the research indicate that the kids' birth weights, their body weight at weaning and average daily gain are quite variable and under the influence of sex, type of birth and the season of kidding. After parturition, the kids weighed 2.28 kg on average, and 23.0 kg at weaning (on the 186th day). The kids gained 115.43 g on average daily in the period from birth to weaning, but in comparison to female kids, male kids had significantly ($P<0.001$) higher average daily weight gain (125.15 : 106.96 g) and significantly ($P<0.05$) higher body weight at weaning (23.46 : 22.58 kg). The lowest average daily gain (103.92 g) was determined in kids of low birth weight (<1.50 kg), and the highest (163.04 g) in kids of higher birth weight (≥3.50 kg). The significant ($P<0.001$) influence of the kidding season on birth weight and growth of kids from birth to weaning was determined.

Key words: kids, Croatian multicolored goat, birth weight, daily gain, weaning

Introduction

In spite of the long-standing legal prohibition of breeding, free pasturing and browsing, the Croatian multicolored goat is still the most numerous goat breed in Croatia.

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It originates from and is bred in karst areas of Dalmatinska zagora, Bukovica, Velebit, Dinara, Kamešnica and Biokovo, which are scarce in vegetation. It is of medium body development and average weight of 44 to 50 kg. Its body is covered in long, thick and shiny goat hair of different colors (MIOČ et al., 2008). The most important characteristics of the breed are resistance, stamina and modesty, then agility and ingenuity in moving and finding food in steep and inaccessible areas. This breed is mentioned in older professional literature as the Balkan, domestic, Dinara, Bukovica goat and the like. The meat, i.e. high quality kid carcasses, is the most important product of the breed and the milk secretion lasts for as long as the kids suckle.

Goat meat production systems around the world are extremely diverse. Breeds range in mature body weight from small tropical goat breeds (9-13 kg) to large European dairy breeds and Boer goats, which can exceed 100 kg. Environments cover the whole spectrum from arid desert to intensive pastures in temperate or cold climates. Management systems range from opportunistic harvesting of feral populations (Australia), through subsistence farming, to intensive commercial dairy systems (WARMINGTON and KIRTON, 1990). For goats in general, live weight is associated with reproductive performance and ovulation rate (SHELTON, 1978), carcass attributes, meat production and sale value at the end of their productive life (McGREGOR, 1990). The production of kid meat in Croatia is organized through two systems of breeding. The first system is extensive, represented in Karst areas and is mainly based on autochthonous breeds (the Croatian multicolored goat and the Croatian white goat). The other system is intensive and it is applied in continental areas in the production of milk based on dairy goat breeds (Saanen, Alpine), whereas non-breeding male and female kids are used for the production of meat.

Birth weight and the growth of kids until weaning, together with reproduction characteristics, dressing percentage, meat quality, certain tissue share and others, are reliable indicators of the breed efficiency in the production of meat. It is known that birth weight and the growth of kids are mostly under the influence of breed (MORAND-FEHR, 1981; MOURAD, 1993), then feeding (HADDAD, 2005), type of birth (ZHANG et al., 2009), sex (KUCHTIK and SEDLACKOVA, 2005) and season (JIMENEZ-BADILLO et al., 2009).

Considering the fact that the Croatian multicolored goat is the most numerous goat breed in Croatia, exclusively intended for the production of meat, especially kid meat, the aim of this study was to determine birth weight and daily weight gain of Croatian multicolored goat kids, bred in an indigenous environment in traditional, very extensive breeding conditions.

Materials and methods

The research included 530 kids in total (262 male and 268 female kids) from four family run agricultural farms in the area of the Šibenik - Knin and Zadar County which

are involved in goat breeding and the production of kid meat in a traditional way by using the extensive breeding system. The researched flocks were kept in identical housing and feeding conditions. The basic yearly meal for goats was pasture from natural karst pasture land and browsing. Meadow hay was consumed by the goats only at times when they could not be in the pasture land because of snow or bad weather conditions. There was no supplementary feeding of goats and kids by concentrated animal feed in any of the researched flocks. The breeding season lasted from mid September to the end of November, and the kidding season lasted from February to April. The kids' birth weight and the weight at weaning were determined by individual weighing on an electronic scale with accuracy of ± 0.05 kg. In the period from birth to weaning, which lasted for 186 days on average on the researched farms, kids were with other goats all the time and they consumed pasture grass and browsed while consuming milk by suckling. The average daily weight gain of kids was determined as the difference between the weight of kids at weaning and their birth weight, divided by the number of days of the period of suckling. The collected data were statistically processed using the GLM procedure of the SAS statistical program (1999) using the model:

$$Y_{ijkl} = \mu + S_i + L_j + W_k + K_l + e_{ijkl}$$

Y_{ijklm} = the observation for each trait;
μ = mean;
S_i = effect of sex;
L_j = effect of type of birth (j = 1 (singles), 2 (twins);
W_k = effect of birth weight (k = 1 (<1.5 kg), 2 (1.5-2.49 kg), 3 (2.5-3.49 kg), 4 (≥3.5 kg);
K_l = effect of kidding season (l = 1 (winter), 2 (spring);
e_{ijkl} = effect of residual.

Results

Table 1 shows the descriptive statistical indicators of the researched characteristics of birth weight, live weight at weaning and average daily weight gain of Croatian multicolored kids. The average kid birth weight was 2.28 kg, whereas the kids weighed 23.0 kg at weaning (on the 186th day). A relatively low average daily gain of only 115.43 g was realized in the period from birth to weaning.

Table 1. Production characteristics of Croatian multicolored breed kids

Parameter	n	$\overline{x}$	SD	Min	Max	CV, %
Birth weight, kg	530	2.28	0.72	1.00	4.00	31.58
Age at weaning, days	530	186	36.95	80	285	18.41
Body weight at weaning, kg	530	23.00	2.96	14.50	31.00	12.87
Daily gain, g	530	115.43	31.19	59.91	263.16	27.13

According to the data in Table 2, the average birth weight of male kids was higher than female kids (2.34 : 2.27 kg), although the differences were not significant (P>0.05). On the other hand, the research determined the significant influence of sex on average daily weight gain of kids in the period until weaning (P<0.001), and consequently on the age (P<0.001) and weight of kids at weaning (P<0.05).

Table 2. Influence of sex on birth weight, age at weaning, and body weight at weaning and average daily weight gain of kids (LSM ± SE)

Parameter	Male (n = 262)	Female (n = 268)	SL
Birth weight, kg	2.34 ± 0.04	2.27 ± 0.04	NS
Age at weaning, days	176.64 ± 2.29	194.18 ± 2.26	P<0.001
Body weight at weaning, kg	23.46 ± 0.21	22.58 ± 0.21	P<0.05
Daily gain, g	125.15 ± 2.09	106.96 ± 2.06	P<0.001

SL = significance level; NS = not significant.

Table 3. Influence of type of birth on body weight at birth, age at weaning, and body weight at weaning and average daily weight gain of kids (LSM ± SE)

	Type of birth		
Parameter	Singles (n = 260)	Twins (n = 270)	Significance level
Birth weight, kg	2.50 ± 0.04	1.93 ± 0.03	P<0.001
Age at the weaning, days	183.84 ± 2.27	192.40 ± 2.24	P<0.05
Body weight at weaning, kg	23.41 ± 0.18	22.60 ± 0.18	P<0.05
Daily weight gain, g	118.87 ± 1.88	110.85 ± 1.85	P<0.05

Table 3 shows the influence of type of birth on birth weight, age and weight at weaning, as well as on the average daily weight gain of kids in the period until weaning. The research determined the significantly (P<0.001) higher average birth weight of single kids (2.50 kg) in comparison to twin kids (1.93 kg). At weaning, at the average age of 183.84 days, single kids achieved an average body weight of 23.41 kg, with average daily weight gain of 118.87 g. The average daily weight gain of twin kids was significantly (P<0.05) lower than that of single kids, so consequently twin kids were weaned eight days later on average.

Table 4 shows the influence of birth weight on age and body weight of kids at weaning, as well as on the average daily weight gain until weaning. The research determined the significant (P<0.01) influence of birth weight on the age and body weight of kids at weaning, as well as on the average daily weight gain of kids until weaning. Namely, kids with birth weight higher than 2.5 kg had a significantly (P<0.001) higher average daily weight gain until weaning, and consequently were weaned earlier (P<0.01) than kids of lower birth weight. Kids of higher birth weight (≥ 3.50 kg) had the highest body weight at weaning (25.6 kg).

Table 4. Influence of birth weight on the age at weaning, body weight at weaning and average daily weight gain of kids (LSM ± SE)

	Birth weight				
Parameter	<1.50 kg (n = 67)	1.50 - 2.49 (n = 262)	2.50 - 3.49 (n = 186)	≥3.50 (n = 15)	SL
Age at weaning, days	195.97 ± 4.40[a]	192.04 ± 2.23[a]	183.37 ± 2.64[a]	145.87 ± 9.31[b]	P<0.01
Weight at weaning, kg	21.17 ± 0.34[a]	22.57 ± 0.17[b]	24.06 ± 0.20[c]	25.60 ± 0.72[c]	P<0.01
Daily weight gain, g	103.92 ± 3.52[a]	110.40 ± 1.79[a]	121.01 ± 2.12[b]	163.04 ± 7.45[c]	P<0.001

SL = significance level; [a,b,c] Values marked with different letters in the same row of the table differ significantly

The significant influence of the kidding season on birth weight was determined, as well as on the age of kids at weaning and the average daily weight gain of kids until weaning (Table 5). The kids born in spring had significantly higher (P>0.001) average birth weight (2.3 kg) than kids born in winter (1.77 kg) and significantly higher (P<0.05) average daily weight gain (116.27 : 107.22 g). Therefore, the period until weaning of kids born in spring was significantly (P<0.01) shorter than of those born in winter (185 : 205 days).

Table 5. Influence of kidding season on birth weight, age at weaning, and body weight at weaning and average daily weight gain of kids (LSM ± SE)

	Season of kidding		
Parameter	Winter (n = 85)	Spring (n = 445)	SL
Birth weight, kg	1.77 ± 0.07	2.30 ± 0.03	P<0.001
Age at weaning, days	205.34 ± 3.93	184.91 ± 1.72	P<0.001
Body weight at weaning, kg	23.10 ± 0.32	22.98 ± 0.14	NS
Daily weight gain, g	107.22 ± 3.30	116.27 ± 1.44	P<0.001

SL = significance level; NS = not significant.

Discussion

The birth weight of kids is highly variable, and is mostly under the influence of breed. In most cases it is 1/15 of the body weight of an adult goat (MORAND-FEHR, 1981). Within the breed, variations of birth weight are conditioned by the type of birth, sex, parity, the development and age of dam, length of pregnancy, feeding, season of kidding and health condition (LAES-FETTBACK and PETERS, 1995). The average birth weight of Croatian multicolored breed kids (Table 1) is significantly lower than that determined for different breeds used in intensive systems of production of meat and milk. PAVIĆ et al. (1988) determined a significantly higher birth weight of Alpine breed (4.11 kg) and Saanen kids (3.56 kg) bred in Croatia in intensive goat milk production. ĐURIČIĆ et al. (2009) list the average birth weight of Boer goat kids as 3.6 kg, whereas MAJID et al. (1993) determined the average birth weights for five goat breeds in the south of the USA (Alpine 3.8 kg, LaMancha 3.3 kg, Anglo- Nubian 3.3 kg, Saanen 3.8 kg and Toggenburg 3.5 kg). Apart from the genotype, the lower birth weight of Croatian multicolored goat kids may be ascribed to the breeding system used, but mostly to poor feeding conditions.

In comparison to the average daily weight gain of Croatian multicolored goat kids determined (115.43 g), Boer goat kids gain 200 g daily on average in better feeding conditions during the first twelve months (MIOČ, 2009). PAVIĆ et al. (1988) determined an average daily weight gain of 149.7 g for Alpine kids and somewhat higher weight gains (164.92 g) by Saanen kids (in the period from kidding to the 102nd day of life). Feral kids achieve an average daily weight gain of 126 g up to the age of 180 days, whereas crossbreds of Boer and Feral goats had an average daily weight gain of 148 g (DHANDA et al., 2003). Consistent with the results of this research (Table 2), MOURAD and ANOUS (1998) point out that the sex of kids has no significant influence on kids' birth weight. In contrast, most authors point out the significant influence of sex on the birth weight and growth of kids (MAVROGENIS et al., 1984; RUVUNA et al., 1988; KUCHTIK and SEDLACKOVA, 2005). KEZIĆ et al. (2005) determined a significantly higher average daily weight gain in male kids in comparison to female Alpine kids (174.01 : 129.17 g) and female kids of the Croatian white goat (161.64 : 139.13 g). Male Boer goat kids achieve average daily weight gains of 250 g in the first nine months of life, while female kids gain on average 186 g daily in the same period (MIOČ, 2009).

Consistent with the results of our research (Table 3), MORAND-FEHR (1981) specifies the higher birth weight of single kids (3.10 kg) in comparison to twin kids (2.80 kg) of the Anglo- Nubian breed. TODARO et al. (2004) also determined higher birth weight of single kids (4.14 kg) in comparison to Nebrodi twin kids (3.82 kg) in Sicily. Many authors (HUSAIN et al., 1996; MOHAMMED and AMIN, 1997; LEHLOENYA et al., 2005) claim that birth weight significantly decreases with an increasing number of kids in a litter.

The research determined the significant influence of birth weight on age and body weight of kids at weaning, as well as on the average daily weight gain of kids until weaning (Table 4). Kids of birth weight higher than 2.50 kg had a significantly ($P<0.001$) higher average daily weight gain until weaning, and consequently were weaned earlier ($P<0.01$) than kids of lower birth weight. Also, kids of higher birth weight (>3.50 kg) had the highest average body weight at weaning (25.60 kg). The listed results are in accordance with the results of other authors' researches (HUSAIN et al., 1996; ZELEKE, 2007).

The season of kidding also influenced the birth weight and growth of Croatian multicolored kids until weaning (Table 5). Consistent with the results of this research, MARAI et al. (2002) list higher birth weight of kids born in spring in comparison to those born in winter, while ZELEKE (2007) concludes that the kidding season has no significant influence on kids' birth weight. Considering the fact that a significantly higher number of kids in this research were born in spring than in winter (445 : 85), the obtained results of higher birth weight and growth of kids born in spring cannot be taken with a hundred percent certainty regarding the influence of the season.

Conclusions

Kids of the Croatian multicolored goat bred in extremely extensive conditions have relatively modest production characteristics. The average birth weight of kids is 2.28 kg and at weaning (on the 186th day) kids weigh 23.0 kg on average. In the period from birth until weaning, kids grow daily on average 115.43 g. The significant influence of sex on the average daily weight gain and body weight of kids at weaning was determined, as well as the significant influence of type of birth on body weight at birth and growth of kids until weaning. Also, the significant influence was determined of birth weight on daily gain and body weight of kids at weaning. The kidding season had a significant influence on the birth weight of kids, age of kids at weaning and average daily weight gain.

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SAŽETAK

Cilj ovog istraživanja bio je utvrditi neke proizvodne karakteristike jaradi hrvatske šarene koze (porođajna masa, dob i tjelesna masa pri odbiću te prosječni dnevni prirast) u ekstenzivnim uvjetima uzgoja. Istraživanje je uključilo 530 jaradi s četiri obiteljska gospodarstva iz Šibensko-kninske i Zadarske županije. Porođajna masa i tjelesna masa jaradi pri odbiću određivani su pojedinačnim vaganjem, uz pomoć elektroničke vage s preciznošću od ±0,05 kg. Jarad je držana s kozama od jarenja do odbića pri čemu je uz sisanje mlijeka bila na paši i brstu. Rezultati istraživanja pokazuju da su porođajna masa jaradi, njihova tjelesna masa pri odbiću i prosječni dnevni prirast prilično varijabilni i pod utjecajem spola, tipa porođaja i sezone jarenja. Nakon jarenja jarad je prosječno težila 2,28 kg, a pri odbiću (dob od 186 dana) prosječno 23,0 kg. Jarad je u razdoblju od jarenja do odbića prirastala prosječno 115,43 g dnevno, a u usporedbi sa ženskom jaradi, muška jarad imala je značajno (P<0,001) veći prosječni dnevni prirast (125,15 : 106,96 g) i značajno (P<0,05) veću tjelesnu masu pri odbiću (23,46 : 22,58 kg). Najmanji prosječni dnevni prirast (103,92 g) utvrđen je kod jaradi s malom porođajnom masom (<1,50 kg), dok je najveći prosječni dnevni prirast (163,04 g) ustanovljen kod jaradi s najvećom porođajnom masom (≥3,50 kg). Također je utvrđen i značajan (P<0,001) utjecaj sezone jarenja na porođajnu masu i rast jaradi od jarenja do odbića.

Ključne riječi: jarad, hrvatska šarena koza, porođajna masa, dnevni prirast, odbiće