Effect of some non-genetic factors on the growth of kids of the brown short-haired breed

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ABSTRACT: The evaluation of effects of some non-genetic factors (sex, litter size, age of dams and year of study) on the growth of 85 kids of the Brown Short-haired breed was carried out in a period of two successive years. The analysis of the growth of all kids revealed that in the time interval from birth to Day 90 of age daily gain and final body weight were 181.3 g and 19.52 kg, respectively. As far as the effect of sex was concerned, the intensity of growth was significantly higher in males than in females ($P \leq 0.01$) in all periods under study. From birth to Day 90, the respective daily gains of males and females were 200.6 g and 162.0 g. As far as the litter size was concerned, it was found out that daily gains of singles and triplets were higher than those of twins and that the differences between single kids and twins were significant ($P \leq 0.01$) in all periods under study. Specifically, daily gains of single kids, twins and triplets in the time interval from birth to Day 90 were 201.4 g; 167.1 g and 175.6 g, respectively. The analysis of the effect of age of dams on daily gains revealed significant effects of this factor on daily gains in the time intervals of Day 30 – Day 60; Day 60 – Day 90; Day 30 – Day 90 and from birth to Day 90 ($P \leq 0.05$). With the exception of the period from birth to Day 30, the highest daily gains were recorded in kids of four-years-old dams in all other periods under study. In both years of study, all kids were reared under nearly identical conditions but the effect of year of study on the growth was significant.

Keywords: goat; growth traits; kid; brown short-haired breed

Milk production has always been the main objective of rearing of goats and kids are still considered to be a by-product. On the other hand, it is necessary to mention that the interest of domestic consumers to consume kids is increasing and the highest demand is for animals of the body weight ranging from 12 to 18 kg. As far as the share of individual breeds in the market of kid meat is concerned, the customers can buy meat of kids of White Short-Haired (WSH) breed most frequently; the supply of kids of other breeds is very limited. This situation is influenced above all by small populations of other breeds, fractionation of individual herds and low numbers of animals on individual farms. Such a situation also exists in the second most frequent breed in the Czech Republic, viz. the Brown Short-Haired (BSH), which was created by the crossing-over of native spotted and brown goats with sires of the Harz breed imported from Germany (Pinďák *et al.*, 2003). As compared with the other breeds, numbers of goats of this breed have increased in recent years.

On the majority of Czech farms, reproduction of goats is organised in such a way that parturitions take place mainly in January so that newborn kids reach the required slaughter weight just before Easter, i.e. in the period when the demand is the highest. Such a system, however, requires that relatively high daily gains of kids will be achieved. The growth of kids is influenced by a number of differ-

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ent factors. Considering the fact that the coefficient of heritability of this trait is relatively low according to literary data, it can be said that it is influenced at most by such factors as nutrition and feeding, breed, sex, litter size and age of mother. Problems associated with effects of different milk replacers on the growth of kids of WSH breed under Czech conditions were studied by Skřivanová *et al.* (1995) and Kuchtík *et al.* (2002) while Ochodnický *et al.* (1991) evaluated the effect of intensive fattening on the growth of kids of this breed. Effects of different levels of nutrition on the growth of Alpine kids were studied by Genandoy *et al.* (2002) and Goetsch *et al.* (2001) evaluated effects of different forms of milk intake restriction on the growth of kids of this breed. Effects of breed and/or crossing of various breeds on the growth of kids were studied for example by Anous and Mourad (1993), Snell (1996), Mioc (1998). Mourad (1993), Mourad and Anous (1998). Portolano *et al.* (2002) analysed effects of not only particular genotypes but also other factors (e.g. sex, litter size and age of dams) on the growth of kids.

Although the BSH breed is the second most important Czech breed of goats, no detailed analyses and/or studies of growth intensity were carried out in this country in the past. Considering this fact the main objective of our study was to evaluate effects of some non-genetic factors (viz. sex, litter size, age of dams and year of study) on the growth of kids of this breed.

MATERIAL AND METHODS

The evaluation of effects of sex, litter size, age of dams and year of study on the growth of kids of BSH breed was performed in a period of two successive years on Zernov goat farm. The experiment involved altogether 85 kids (44 males and 41 females) originating from 49 goats. As far as the litter size was concerned, the experimental group consisted of 15 single kids, 64 twins and 6 triplets. A markedly higher percentage of twins was influenced above all by the relatively high fertility of mothers of experimental kids. As to the age of dams, 16 kids had two-years-old dams, 20 three-years-old, 13 four-years-old, 13 five-years-old and 23 six-years-old and/or older dams. In both experimental years all kids under study were born in January. All kids were reared in a standard manner till the end of the study period in both years, i.e. with their mothers in a stable with deep litter. Contacts with mothers were not limited so that the kids had an *ad libitum* intake of mother's milk. Their feeding ration further consisted of meadow hay (*ad libitum*), mineral lick (*ad libitum*) and concentrate supplement ČOT (concentrate supplement for early weaning of calves, PDI-E 105 g/kg, NEF 7.8 MJ/kg). The average daily consumption of ČOT per kid was 0.045 kg. In both years, feeding rations of mothers involved maize silage, meadow hay and concentrate supplement ČOT (0.8 kg/day). Health condition and nutritional status of mothers and their kids were good during the whole study period.

In both years, all experimental kids were weighed for the first time at birth and thereafter regularly in four-week intervals. All determinations of weight were carried out to the nearest 0.1 kg. On the basis of the results of weighing the body weight was adjusted to average age 30 (BW 30), 60 (BW 60) and 90 days (BW 90) by using a linear interpolation method. Daily gains (DG) were calculated in grams for the following intervals:

DG 1 = DG between (BW birth) and (BW 30)
DG 2 = DG between (BW 30) and (BW 60)
DG 3 = DG between (BW 60) and (BW 90)
DG 4 = DG between (BW birth) and (BW 60)
DG 5 = DG between (BW 30) and (BW 90)
DG 6 = DG between (BW birth) and (BW 90)

Recorded data were statistically analysed using the least-squares method (SAS; PROC GLM). The systematic effects were year of study, sex, litter size and age of dam.

The following model equation was used for statistical calculations:

$$Y_{ijkl} = \mu + Y_i + S_j + LS_k + A_l + e_{ijkl}$$

where: Y_{ijkl} = measured trait
μ = overall mean
Y_i = effect of the ith year (fixed effect – 2 classes)
Sj = effect of the jth sex (fixed effect – 2 classes)
LS_k = effect of the kth litter size (fixed effect – 3 classes)
A_l = effect of the lth age of dams (fixed effect – 5 classes)
e_{ijkl} = residual error

Statistical analysis was carried out using the mathematical–statistical programme SAS version 8.2.

RESULTS AND DISCUSSION

The analysis of the growth of the whole experimental group revealed that in the time interval from birth to the end of experiment (i.e. Day 90), daily gain (DG) was on a relatively high level and made 181.3 g (Table 2). This value was higher than the values mentioned by Genandoy *et al.* (2002) and Goetsch *et al.* (2002). On the other hand, Skřivanová *et al.* (1995) recorded higher DG in their experiments with kids of the WSH breed.

At the end of the study period the body weight (BW) of kids was 19.52 kg (Table 1); this BW was higher than that mentioned by Snell (1996) for all genotypes at the age of 100 days and comparable with data on kids at the age of 138 day published by Ochodnický *et al.* (1991). In the time interval from birth to Day 30, DG 1 of the whole group of kids was 175.7 g. As far as the individual time intervals were concerned, the highest intensity of growth was recorded in the subsequent period, i.e. between Days 30 and 60 (196.3 g). This tendency, however, differs from data published by Ndlovu and Simela (1996), Kuchtík *et al.* (2002) and Portolano *et al.* (2002), who observed that the intensity of growth slightly decreased with the increasing age. In our experiment, a certain decrease in growth intensity was observed in the subsequent time interval (i.e. from Day 60 to Day 90) in the whole set of experimental animals; however, the observed daily gain (172.0 g) was in fact the same as that observed in the whole set in the time interval from birth to Day 30.

The evaluation of the effect of sex on growth indicated that males showed the higher growth intensity than females in all time intervals under study. This corresponded with data published by Chavla *et al.* (1984), Mourad (1993), Ndlovu and Simela (1996), Mourand and Anous (1998) and Portolano *et al.* (2002). Contrary to the authors mentioned above, there were statistically highly significant differences ($P \leq 0.01$) between both sexes in our experiment in all time intervals. The evaluation of effect of sex on growth intensity in individual time intervals also revealed that the highest daily gains (males = 218.4 g and females = 174.1 g) were recorded in both sexes in the time interval of Day 30–Day 60; these results corresponded with data published by Mourad and Anous (1998). However, in the subsequent time interval (i.e. from Day 60 to Day 90), a decrease in the intensity of growth was observed in both sexes (to 183.9 g and 160.1 g in males and females, resp.) and BW 90 of males and females was 21.33 and 17.71 kg, respectively. It is of interest that, in contrast to males, females reached higher

Table 1. Least-squares means and standard errors (L.S.M. ± S.E.M.) of body weights (BW, in kg) according to sex, litter size, age of dams and year of study

		n	BW at birth	BW at 30 days	BW at 60 days	BW at 90 days
Total		85	3.19 ± 0.132	8.47 ± 0.277	14.36 ± 0.479	19.52 ± 0.656
Sex	Males (A)	44	3.27 ± 0.160	9.26 ± 0.335^{B}	15.81 ± 0.578^{B}	21.33 ± 0.792^{B}
	Females (B)	41	3.12 ± 0.139	7.68 ± 0.292^{A}	12.90 ± 0.503^{A}	17.71 ± 0.689^{A}
Litter size	Singles (A)	15	3.41 ± 0.161	9.24 ± 0.338^{b}	15.81 ± 0.583^{Bc}	21.53 ± 0.798^{Bc}
	Twins (B)	64	3.32 ± 0.083	8.27 ± 0.174^{a}	13.68 ± 0.301^{A}	18.36 ± 0.412^{A}
	Triplets (C)	6	2.86 ± 0.338	7.90 ± 0.708	13.59 ± 1.222^{a}	18.66 ± 1.673^{a}
Age of dams	2 years old (A)	16	3.05 ± 0.210	8.16 ± 0.441	13.57 ± 0.761	18.07 ± 1.042^{ce}
	3 years old (B)	20	3.06 ± 0.164	8.39 ± 0.345	14.15 ± 0.595	19.07 ± 0.815
	4 years old (C)	13	3.45 ± 0.208	8.77 ± 0.437	14.96 ± 0.753	20.64 ± 1.032^{a}
	5 years old (D)	13	3.14 ± 0.214	8.49 ± 0.448	14.45 ± 0.772	19.69 ± 1.057
	6 years old and more (E)	23	3.29 ± 0.173	8.54 ± 0.363	14.66 ± 0.627	20.12 ± 0.858^{a}
Year	1999 (A)	43	3.63 ± 0.163^{B}	8.33 ± 0.341	13.57 ± 0.589^{b}	18.66 ± 0.806^{b}
	2000 (B)	42	2.77 ± 0.138^{A}	8.61 ± 0.289	15.14 ± 0.499^{a}	20.38 ± 0.683^{a}

$^{A, B, C, D, E}P \leq 0.01$; $^{a, b, c, d, e}P \leq 0.05$

Table 2. Least-squares means and standard errors (L.S.M. ± S.E.M) of daily gains (DG, in g) according to sex, litter size, age of dams and year of study

		n	DG 1.	DG 2	DG 3.	DG 4	DG 5.	DG 6.
Total		85	175.7 ± 7.352	196.3 ± 7.485	172.0 ± 7.779	186.0 ± 7.075	184.1 ± 7.216	181.3 ± 6.584
Sex	Males (A)	44	199.6 ± 8.879^{B}	218.4 ± 9.038^{B}	183.9 ± 9.394^{B}	209.0 ± 8.543^{B}	201.2 ± 8.713^{B}	200.6 ± 7.951^{B}
	Females (B)	41	151.9 ± 7.728^{A}	174.1 ± 7.867^{A}	160.1 ± 8.176^{A}	163.0 ± 7.436^{A}	167.1 ± 7.584^{A}	162.0 ± 6.920^{A}
Litter size	Singles (A)	15	194.4 ± 8.950^{B}	218.9 ± 9.111^{B}	190.7 ± 9.469^{B}	206.7 ± 8.611^{B}	204.8 ± 8.783^{B}	201.4 ± 8.014^{B}
	Twins (B)	64	164.9 ± 4.622^{A}	180.2 ± 4.705^{A}	156.2 ± 4.890^{A}	172.5 ± 4.447^{A}	168.2 ± 4.536^{A}	167.1 ± 4.139^{A}
	Triplets (C)	6	167.9 ± 18.761	189.6 ± 19.099	169.2 ± 19.849	178.8 ± 18.053	179.4 ± 18.412	175.6 ± 16.801
Age of dams	2 years old (A)	16	170.5 ± 11.683	180.3 ± 11.894^{ce}	150.0 ± 12.361^{ce}	175.4 ± 11.242	165.2 ± 11.466^{ce}	166.9 ± 10.462^{c}
	3 years old (B)	20	177.4 ± 9.138	192.3 ± 9.303	163.9 ± 9.669^{c}	184.9 ± 8.793	178.1 ± 8.968	177.9 ± 8.183
	4 years old (C)	13	177.2 ± 11.568	206.3 ± 11.776^{a}	189.4 ± 12.239^{ab}	191.7 ± 11.131	197.9 ± 11.352^{a}	191.0 ± 10.359^{a}
	5 years old (D)	13	178.5 ± 11.856	198.7 ± 12.070	174.5 ± 12.545	188.6 ± 11.409	186.6 ± 11.636	183.9 ± 10.618
	6 years old and more (E)	23	175.1 ± 9.623	203.8 ± 9.796^{a}	182.2 ± 10.181^{a}	189.5 ± 9.260	193.0 ± 9.444^{a}	187.1 ± 8.617
Year	1999 (A)	43	156.8 ± 9.044^{B}	174.8 ± 9.207^{B}	169.5 ± 9.569	165.8 ± 8.702^{B}	172.1 ± 8.875^{B}	167.0 ± 8.099^{B}
	2000 (B)	42	194.7 ± 7.670^{A}	217.8 ± 7.808^{A}	174.6 ± 8.115	206.2 ± 7.380^{A}	196.2 ± 7.527^{A}	195.7 ± 6.868^{A}

$^{A, B, C, D, E}P \leq 0.01$; $^{a, b, c, d, e}P \leq 0.05$

DG in the time interval from Day 60 to Day 90 than in the time interval from birth to Day 30 (160.1 g and 151.9 g, resp.).

The analysis of the effect of litter size revealed that DG of single kids and triplets were always higher than those of twins. This observation corresponded with data published by Mourad and Anous (1998) while in our experiment the difference between DG of single kids and twins was significant ($P \leq 0.01$) in all time intervals under study. For example Portolano *et al.* (2002) mentioned significantly higher DG in single kids than in twins in the time interval from birth to Day 45 but in the case of twins and triplets they mentioned the slightly higher growth intensity of twins in time intervals of Day 15–Day 30 and Day 30–Day 45. The analysis of the effect of litter size on the intensity of growth further revealed that in the time interval from birth to Day 90, average DG of single kids, twins and triplets were 201.4 g; 167.1 g and 175.6 g, resp., and that they were always higher than those mentioned by other authors dealing with the problem of the growth intensity of kids.

The evaluation of the effect of age of dams on the growth of kids indicated that, in contrast to results published by Mourad and Anous (1998), Portolano *et al.* (2002) and Al-Shorepy *et al.* (2002), the effect of this factor on the level of DG was statistically significant in our experiment ($P \leq 0.05$), viz. in time intervals of Day 30–Day 60; Day 60–Day 90; Day 30–Day 90 and from birth to Day 90. The most uniform effect of mother's age on the intensity of kid growth was observed in the time interval from birth to Day 30 because DG 1 ranged from 170.5 g to 178.5 g. The highest daily gain in this time interval was recorded in kids originating from five-years-old dams. In the time intervals to follow, the highest daily gains were recorded in kids originating from four-years-old dams and the second highest level of DG was recorded for kids of six-years-old dams. Kids born to two-years-old dams showed the lowest DG in all time intervals under study.

As far as the effect of year of study on the growth of kids was concerned, it was found out that this factor showed a highly significant effect ($P \leq 0.01$) on the level of DG; the only exception was the interval of Days 60–90. In

our experiments the BW of kids on Day 90 in the first and the second year of study were 18.66 kg and 20.38 kg, resp.; the difference between these values was statistically significant ($P \leq 0.05$). However, it is also of interest that no significant effect of the year of study on DG of kids was recorded in the time interval of Day 60 to Day 90 while in both preceding periods (i.e. Day 0–Day 30 and Day 30–Day 60) the differences between these values were statistically highly significant ($P \leq 0.01$).

CONCLUSIONS

The evaluation of the effects of sex on the growth of kids revealed that the daily gains in males were always significantly ($P \leq 0.01$) higher than in females. As far as the litter size was concerned, it was found out that daily gains of single kids and triplets were always higher than those of twins and that the differences between single kids and twins were highly significant in all intervals under study ($P \leq 0.01$). The evaluation of the effect of age of dams on the growth of kids indicated that, with the exception of the time interval from birth to Day 30, the highest daily gains were recorded in kids originating from four-years-old dams while the lowest ones were recorded for kids originating from two-years-old dams. Although in both experimental years the kids were kept under nearly identical conditions, it was observed that, with the exception of the time interval between Day 60 and Day 90, the effect of the year of study on the level of daily gains of kids was highly significant ($P \leq 0.01$).

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