

Study of growth curve variations for kids 0- 6 months old of Alpine goat breed in Albania

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SUMMARY

Study of growth curve for kids at the age 0-6 months old and influence of non genetic factors on its variation, in order to evaluate the level of acclimatization of Alpine goat breed in Albania, was carried out by analyze of data for 728 kids managed in two different production systems- (a) semi intensive production system in farms with over 50 goats and (b) small family farms that manage 2-3 goats as “Goat of family”. Gompertz model was used for modeling growth dynamics of kids. For each kid, Gompertz’s model parameters were estimated. Analyze of variance was carried out according to procedure of General Fixed Factor Linear Model (GLM). Results showed that linear model accounts for 58-62% of total variance of growth curve parameters. Non genetic factors affect the variances of these parameters. Production system ($P<0.01$) is the most important factor that affect on phenotypic variance of growth curve parameters. Sex and mode of birth ($P<0.05$) are factors that must be taken into account during growth of kids 0-6 months old. Values and variations of growth parameters of Alpine kids farmed under conditions of Albanian production systems show that this breed has positively responded to these conditions.

Keywords: Alpine goat breed, acclimatization, Gompertz's curve of growth, non genetic factors, kids 0-6 months old

INTRODUCTION

Growth dynamics of young generation may be used as one of indicators to evaluate the level of adaptation of a gene fund under conditions of a production system which is different from its origin place. Growth period of young generation until the puberty age can be divided into three phases: (i) maternal phase- from birth to weaning, (ii) phase of development of bio physiological mechanisms of growth and individual response to environmental conditions- from weaning to 6 months old and (iii) growth phase from the age of 6 months to puberty one.

Susceptibility of organism to environmental conditions in these three phases is different. At the first phase, it can be considered that kid is “protected”

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by maternal effect. During the second phase the kid should cope with environment conditions and therefore, necessary bio physiological mechanisms should function well in order to have a normal growth dynamics. As a consequence, this phase can be considered as one of phases that bring more information in relation to the adaptation rate and/or response of breed under conditions of environment, different from its origin place.

Already, in spite of bio physiological mechanisms are more developed in order that the animal to be adapted better to environment, study of growth dynamics during the third phase, is important because it can serve to more accurately and completely judge for the rate of response of young organisms to the changed conditions of environment. It can in particular be accomplished by comparing values of growth indicators until puberty age: (i) age at first heat appearance (ii) live weight at the first matching; (iii) conception rate of first matching achieved by individuals placed in environment, different from its origin place, with average values, which are characteristic to breed. The objective of the present paper is to give the information about the level of acclimatization of Alpine goat breed in Albania, based to the study of growth performances of kids during the period age 0- 6 months.

MATERIAL AND METHODS

Live weight data for 728 kids of Alpine breed, of which, 432 kids born in small family farms, which manage no more than 5 goats and 296 kids belonging to private farms that manage flocks of over 50 goats were analyzed. Using the data of weighing, carried out every 15 days for the period from birth to 6 months old, growth curve was build up, for each kid, according to Gompertz's model:

$$y = A \exp(-\exp(-b(t-c)))$$

Ku y - live weight of kid

t - age of kid

k - growth curve asymptote

b, c -adjusted both slop and inflexion point

The individual growth curve parameters were analyzed as quantitative traits. A General Linear Model analysis was applied to decompose the total variance and to apply the F statistical significance test. The statistical GML model used with independent variables was as follows:

$$Y_{ijkln} = \mu + a_i + b_j + c_k + k_l + e_{ijkln} \quad (1)$$

Ku :

Y_{ijkln} - the performance analyzed: curve parameters (A, b and c)

μ - mean of population

a_i - the sex effect (i=1,2, male or female)

- b_j - the mode of birth effect ($j=1,2$, single or twin)
 c_k - the "row of kidding" effect ($k=1,2$ - first and second)
 k_l - the "system of management" effect ($l=1,2$ - farm with over 50 goats, farm with not more than 5 goats)
 e_{ijkln} - the model residuals

RESULTS AND DISCUSSIONS

For each kid, the Gompertz growth curve parameters were estimated by an iterative procedure with zero as the starting value for all parameters. The number of the iteration is fixed less than 1000 and the convergence criterion was set at 10^{-8} (Najari et al. 2007)

For each of production systems, which are applied in Albania, Gompertz's models, that describe the dynamics of growth rate of kids for the age 0-6 months old, were estimated as follows:

Farm with over 50 goats

$$Y(\text{weight}) = 29.8 \text{Exp}(-\text{Exp}(0, 6825 - 0,017 \text{ age}))$$

Family farms up to 5 goats

$$Y(\text{weight}) = 31.98 \text{Exp}(-\text{Exp}(0, 7307 - 0,019 \text{ age}))$$

Referring to the parameters of curves it can be said that asymptotic weight, which is at the same time also as statistical estimation of adult animal weight, is higher to kids that are managed under conditions of small family farms. Age (in days) at which, the curve of growth dynamics of body weight pass through the point of inflexion, for kids reared under the conditions of small family farms is estimated about 38 days and the body weight corresponding to this point is 10.51 kg.

Meanwhile, these two indicators for kids raised under conditions of semi-intensive production system in farms with over 50 goats, are respectively: age at inflexion point 9 days higher and body weight at the day of inflexion point 14 % lower. Supported upon indicators, referring to the interpretations of authors given in literature (Ben Hamonde, 1985; Nguyen Thi Mai et al. 2000, Najari, Sg. etc. 2005, 2007) it can be stated that kids raised under conditions of small family farms perform a growth process that make possible for entering in reproduction of them at optimal age and body weight

Table 1 shows averages of some indices of growth dynamics to kids from birth to 6 months old raised in different production system.

Referring the information of table 1, that could interpret as the kids' response in different production systems, it must be formulated the following:

► In general, kids of Alpine breed differently respond to different conditions of environment. Nevertheless, based upon the average indicators of live weight during the different growth phases, it can be said that during the

growth phase (birth to 6 months) responses of kids do not reach to compromise the behavior of this breed in these production system. This is because of the rule according to which animal growth process is carried out during this period, for each of production systems, is complied with that described by Gompertz's Function. Statistical weight of Gompertz's Model for each of production system is estimated ($R^2 \geq 0.92$.)

Table 1 Averages of growth indicators of kids estimated by Gompertz's model in the different production systems.

Indicators	Unit	Production system	
		Farm with over 50 goats	Family farm with no more 5 goats
Live weight at birth	kg	3.11	3,15
Live weight at 6 months old	kg	25.72	28,12
Age at inflexion point	day	47.0	38,0
Weight at inflection point	kg	9.04	10,51
Live weight :			
age at 1 month	kg	6.708	7,561
age at weaning	kg	13.904	17,64
age of 4 months	kg	20.414	24,571
Average daily gain:			
From birth to one month	g	128	155
From birth to weaning	g	154	208
From weaning to 6 months	g	120	112
From birth to 6 months old	g	134	152

► To have better results in the growth rate of female kids, which will be maintained for reproduction, especially, under conditions of rearing in private farms with more 50 goats, it is advisable that mothering period be lasted by about 8-12 days

The results of multivariate analyze, carried out according to model (1) given in table 2.

Table 2 Results of analyze of variance for Gompertz's model parameters: GML (1)

Source of variance	d.f.	Parameters of Gompertz's curve		
		A	b	c
Sex of kid	1	11.4***	4.13*	4.02*
Mode of birth	1	5.21*	3.46*	3.81*
Row of kidding	2	4.13*	2.02 ^{NS}	1.83 ^{NS}
Production system	1	12.3***	5.97**	6.09**
Residuals	723	Variance 8.152	Variance 0.023	Variance 0.015

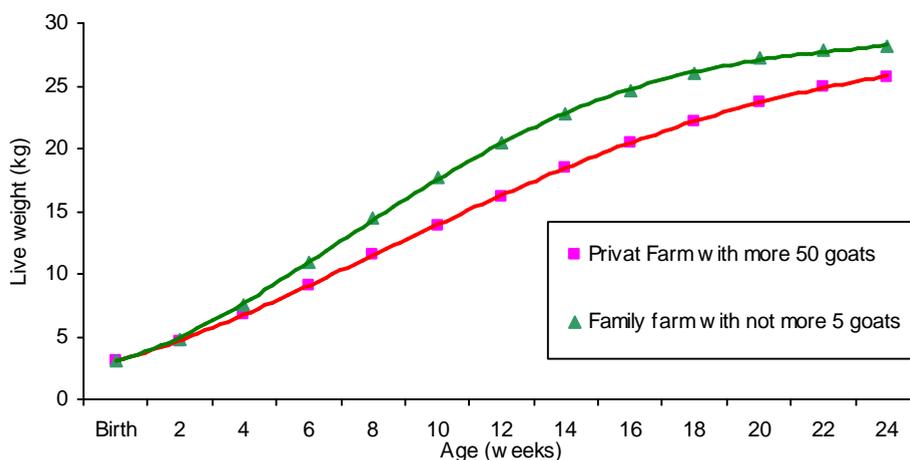
^{NS} Non significant; Significant ($p < 0.05$); **Significant ($p < 0.01$); ***Highly significant ($p < 0.001$)

It seems that the factors analyzed, affect in the variations of Gompertz's model parameters. The production system (type of management) manifests a

high significant effect upon all analyzed traits ($p < 0.01$). Regarding kid's sex, birth mode and row of kidding which were known with classic impacts upon the early kid growth; it seems that they have moderate effects under the Albanian farming conditions. Kid's sex is one of the most important factors ($p < 0.01$; $p < 0.05$), which influence in the variation of all three parameters. Mode of birth influence ($p < 0.05$) in total variance of three parameters and the row of kidding affect only the total variance of parameter "A" ($p < 0.05$), whereas, regarding other two parameters, her effects could be considered as a tendency not statistically proved ($p > 0.05$).

The effect of production system on growth curve of kids from birth to 6 months old, is graphically given in Fig. 1.

Fig.No. 1 Kids' growth curve adjusted by Gompertz model and by production system

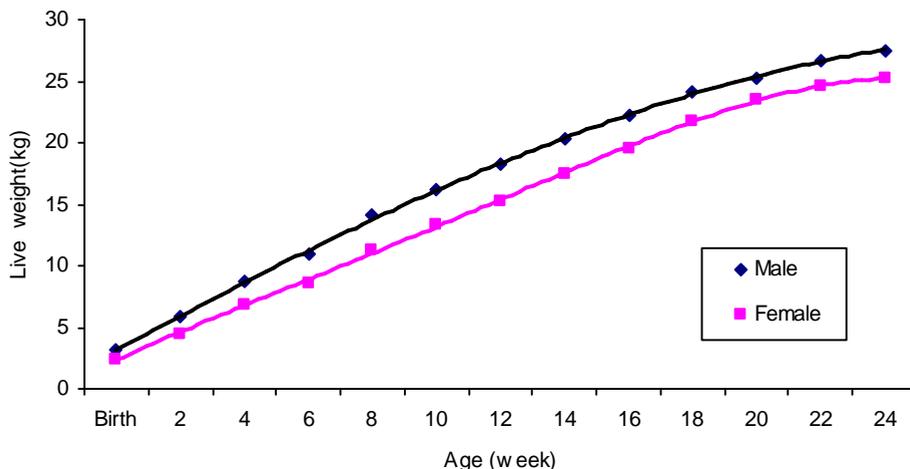


Growth curves show the predicted theoretical character for two production systems. In general, they are similar to curves given in literature in the case of studying growth curves of kids that are managed in different production systems. (Gaddor, A., Najari, Sg., 2007, Barbato, G.F. etj. 1991, Simondon, K.B. etj. 1991, Das M.S. etj. 1996). In the case of kids raised in small farms, the curve expresses better the theoretical character of physiological growth process. Under the condition of semi-intensive production system applied in farms with more 50 goats, the quantitative indicators of growth dynamics are negatively influenced. Nevertheless this system of production has not brought the essential disorders in physiological growth process. As a consequence, it can be said that factors related to production system, applied in Albanian farms, are administrated in such a way that not to create serious problems in the physiological growth process of kids.

Fig. 2 illustrates the growth curve for male and female kids. Since the birth, differences of kids' weights are remarkable for the two sexes. The birth weight, estimated at 3.2 kg (m) and 2.4 kg (f), respectively explain the superiority of

earlier male weights. This male superiority continues during the growth period. According to Gompertz's curves, the male and female asymptotic weights are respectively estimated 31.9 kg (m) dhe 27.8 kg (f). Similar effects of sex on growth performance are published by different authors (Babato et al. 1991, Anthony et al. 1991, Banda et al. 1993, Barthaee, Leroy, 1996, Alexandre et al. 1997, Oltenacu, et al. 1999, Ounni, M. 2006, Najari et al. 2007, Amour Gaddou ret al.2007).

Fig. No. 2 Kids' growth curve adjusted by Gompertz model and by kids' sex

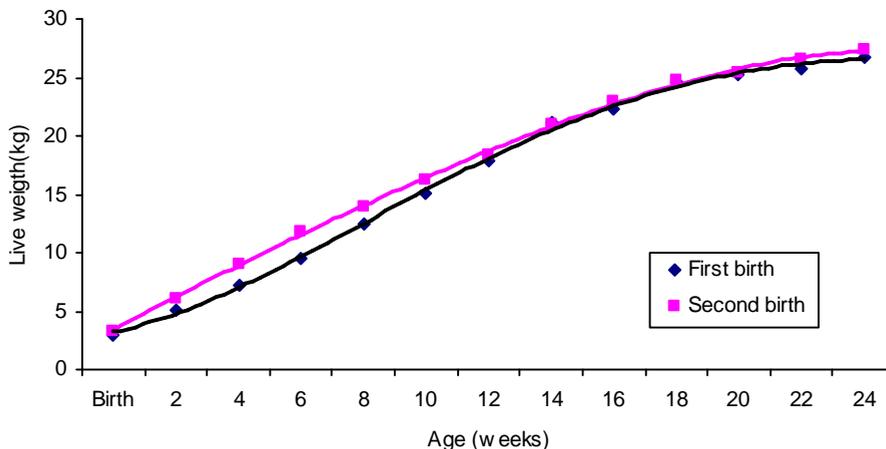


However, the lower asymptotic weights permit to female to reach more rapidly the same physiologic state with respect to the male. In fact the female kids reach the inflexion point since 39 days of ages, so 6 days before the male kids, the same physiologic state can be represented by the inflexion weight with was, respectively 11.24 and 9.12 kg for male and female kids. According to these results, we can deduct that the female kids of Alpine breed farming in the Albanian system productions, can reach the maturity state rapidly and its can began reproductive process since the first year of age. This can be considered as an argument in favor of their good adaptation in the new Albanian environment.

Row of kidding is a factor, whose effect is only statistically proved in the case of parameter "A" of Gompertz's model. The effect of other two parameters is only shown as a trend. Such a result is met in literature. Nevertheless, it needs to be stressed that, most authors, in their studies, confirm effects of this factor. Perhaps, this situation, which is met in this case, it can also be as a consequence of fact that the data are only for kids obtained for two first kidding.

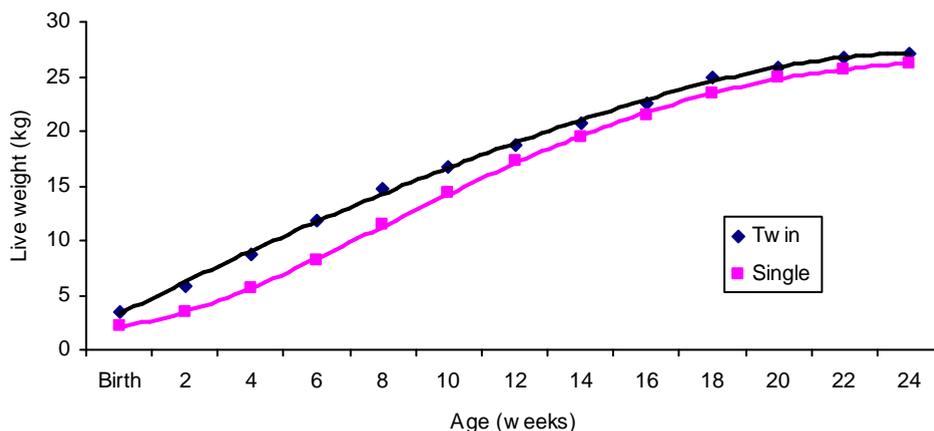
Gompertz's curves corresponding to row of kidding are given Fig. 3

Fig. No. 3 Kids` growth curve adjusted by Gompertz model and by row od kidding



As seen, the differences in these curves are only evidenced in the first growth phase, from birth to 3 months old. After that period, this difference is not evidenced anymore. Such a fact can be explained by the effect “mother” due to differences that can be in milk quality and intake produced during the period of mothering in first and second lactations.

Fig.No. 4 Kids` growth curve adjusted by Gompertz model and by mode of birth



Mode of birth is a factor, whose effect on Gompertz’s curve parameters is statistically proved. In literature, the effect of this factor is considered as a classic one (Lyatuu etj. 1992, Okello etj. 1993, Gromela etj. 1998, Gaddour etj. 2007). Effects of this factor are in particular visible during the first growth phase, from birth to 12 weeks (Fig. 4).

Kids, which were born single, can be more quickly grown (Alexandre etj. 1997), especially during the period of mothering. This situation is also seen in our case analyzed. Live weight gain obtained by kids born single is about 25-30 % higher compared to twin born ones.

After that period, differences of live weight gain between single born kids and twin born ones are reduced until at age of 6 months; afterwards, according to Gompertz's curves these differences are estimated by about 0.9 kg.

CONCLUSIONS

1. Two systems of management: small farm family with not more 5 goats and semi-intensive production system-farm with more 50 goats, influence in different ways on the dynamics of kids' growth for the period from birth to 6 months. Production system of small family farms creates better conditions for a normal growth process and in accordance with standards of breed.

2. Independently on differences evidenced between two systems of management, growth dynamics of kids until at the age of 6 months, shows that the responses of Alpine goats breed evidenced a normal acclimatization process under Albanian farming conditions.

3. The results of study of variations of the main growth indicators carried out by the Alpine kids breed, live weight at the different age, from birth to 6 months old on the one hand, and modeling of their growth curves through Gompertz's model, on the other hand, can served as an argument for their normal adaptation in Albanian farming conditions.

4. Variations of Gompertz 's curve parameters brought about by the effect of non genetic factors such as: sex, mode and row of kidding and system of management underline the normal development of physiological process of kids' growth during the first 6 months of life farming under the Albanian condition system.

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