Estimation parameters of the kid's growth curve in Tunisia goat by using Gompertz model

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Abstract

Data issued from 16 years periodical weighing was used to adjust growth curve before 5 months age of 1687 suckled kids. Among tested models, the iterative procedure allowed to identify the Gompertz model as the best to adjust kid's growth evolution. Curve parameters of male and female were fitted by Gompertz model after about 22 and 18 iterations with a CD value of 71% and 72% respectively. The growth curve adjustment helps to a better herd management and kid's fattening according to each genotype potentialities.

Key words: Goat, Gompertz model, Sex mode, Birth mode, Tunisia.

Introduction

In Tunisia, goat herd counts about 1 500 000 females and more than 60% of goats are raised in the semi arid and arid zones (Gaddour *et.al.*, 2012d ; Najari *et.al.*, 2010). Local goat is genetically considered as a population having a wide phenotypic variability and it's essentially raised in pastoral and agropastoral modes (Najari, 2005). The lactated kid's meat is the main product for this breeding mode and it contributes with about 75% in the regional meat production under very low input systems (Gaddour *et.al.*, 2012c ; Najari *et.al.*, 2010). Under oasian conditions, the goat husbandry plays a key role by its significant various contributions in the farmer's incomes (Gaddour *et.al.*, 2012a; Gaddour *et.al.*, 2010). Goat benefits from an intensified breeding mode under low climatic risks which characterize the arid area (Gaddour *et.al.*, 2009). In order to increase the oasian goat herds' production, some high yielding exotic breeds were introduced, since 1980, in the arid region (Gaddour *et.al.*, 2011). The objective of this program has been either to produce meat where goats were not milked or to increase dairy yields where milk contributes to the farmer incomes (Gaddour *et.al.*, 2008).

Like other animal phenotypes, growth curve parameters change by all factors affecting the weight, especially the genetic potentialities of the breed (Gaddour *et.al.*, 2009).
The present study aims at adjusting the kid's growth curve of local population, introduced breeds and crosses as a step to evaluate the meat production kinetic and potentialities for each sex and birth mode.

Materials and Methods

Animal's materials:

Data used is relative of local goat, Alpine, Damascus and crosses raised under experimental conditions since 1980 (Gaddour *et.al.*, 2012d; Gaddour, *et.al.*, 2010). The crossing plan aims to substitute local goat by more productive crossed genotypes (Gaddour *et.al.*, 2012b; Gaddour, 2005). The indigenous goat population shows a large variability both in morphology and performances (Najari *et.al.*, 2010). The indigenous goat is characterised by its small size, it's walking ability and it's water and forage shortage resistance. Such adaptative qualities allow the survival of the local goat on sparse rangelands under harsh and irregular natural conditions.

Native goat is hairy and basically black coat colored with spots on the head horned and has bread and dewlap on the neck (Gaddour *et.al.*, 2012c; Gaddour *et.al.*, 2009).

To perform the crossbreeding scheme, Alpine and Damascus goats were introduced from France and Cyprus respectively since 1980 (Gaddour *et.al.*, 2012a; Gaddour, 2005).

Curve parameters estimation:

Due to the identical basic aspects of the physiologic growth process, some developed functions are largely used to describe the general growth curves (Wahi *et.al.*, 2004). The residual values are assumed to be independent with a constant variance (Mignon-Grasteau and Beaumont, 2000; Trangerud *et.al.*, 2007).

Evaluation criteria used to compare studied models accuracy were computing difficulty and fitting goodness. Computing difficulty was defined as the number of iterations needed to converge (Mignon-Grasteau and Beaumont, 2000). Except for Richards' model, the starting values of parameters are null to allow the same convergence conditions (Wahi *et.al.*, 2004; Yang *et.al.*, 2006). Goodness of fit was defined as the magnitude of the residual mean squares at convergence (RMS), which provides a measure of the estimation precision (Mignon-Grasteau and Beaumont, 2000). The accuracy is also evaluated by the nonlinear coefficient of determination (CD). Statistical analysis was done by SPSS program.

Results and Discussion

Gompertz growth curve adjustment per sex and birth mode:

The converging behaviour of the growth curve adjustment is largely dependent on the data corresponding to kids' weights which varies with the sex and birth mode (Trangerud et al., 2007). Thus, the adjustment models behaviour can potentially changes with sex and birth mode. Table (1) presents the Gompertz convergence performances for each sex and birth mode. The lowest iteration number corresponds to the male and female is respectively 22 and 18. The adjustment accuracy (CD and RMS values) seems the best for simple and double mode goat having respectively 5.6 and 6.58 as RMS.

Table (1): Convergence parameters of growth tested models by sex and birth mode.

parameters	NbIt	CD	RMS
Male	22	071	6.68
Female	18	0.72	5.31
Simple mode	20	0.74	5.6
Multiple mode	22	0.68	6.58

NbIt: Iteration number to convergence; CD: coefficient of determination; RMS: residual means squares.

Kids growth curve of caprine per sex and birth mode

The growth curve parameters, adjusted by Gompertz model, were estimated for each genotype (Table 2). The corresponding parameters were used to draw the kids' growth curves for sex and birth mode.

Table (2): Growth curve parameters estimated by the Gompertz model.

parameters	A	b	c	Age at Inflexion (days)	Weight at Inflexion (kg)
Male	16.81	0.03	-0.33	11	6.18
Female	14.69	0.03	-0.3	10	5.4
Simple mode	16.11	0.03	-0.33	11	5.92
Multiple mode	15.54	0.03	-0.33	10	5.71

A: Asymptotic weight; b and c: Gompertz curve parameter.

The asymptotic value (A) seems to be the highest for male and simple mode. These kids reach more than 16.81 kg as body weight before 5 months age. Rather than the asymptotic weight, the inflexion point coordinates change with sex and birth mode (Table 2). Among sex, the male showed the heaviest inflexion weight with 11 kg. Barbato (1996) related the age of the curve inflexion with the value of the corresponding weight which can affect the maturity age of animals.

The most important period of growth seems to be the first two months of age for sex and birth mode; in fact the kid's weight seems to tend rapidly to the asymptotic value. Hence, keeping kids after four or five months of age in the herd do not provide any additional meat production; however, it can induce major production costs per kg of kid's meat.

Conclusions

The growth curve parameters and shape illustrate a specific growing behaviour for the studied genotypes. It seems that some groups are able to produce an additive weight with age when others stopped the weight gaining since early age. This aspect has to be considered to optimize the genotypes management to ensure better meat production and farmers incomes.

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