Genetic components of individual economically important traits related to productivity in Creole meat goats of Guadeloupe

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GENETIC COMPONENTS OF INDIVIDUAL ECONOMICALLY IMPORTANT TRAITS RELATED TO PRODUCTIVITY IN CREOLE MEAT GOATS OF GUADELOUPE

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INTRODUCTION

In Guadeloupe, the local Creole goat is used for meat production. Different results have shown their high level of adaptation and productivity in intensive grazing systems (Alexandre *et al.,* 1999 ; Mandonnet *et al.,* 2001). The good management conditions and the intensive reproductive system are partly responsible for the remarkable performances of this type of animal. However, a complete genetic analysis on different individual growth and reproductive traits and their relationships to partial and lifetime production level in Creole meat goat, will be necessary if a selection scheme is developed. The results of such analysis will be presented in this paper.

MATERIALS AND METHODS

The data set used in this study was obtained from Gardel Experimental Station, a research unit of INRA, Antilles – Guyane. This station is located in a dry region of Guadeloupe a humid island located in the Caribbean. A brief description related to management and characters analysed will be presented, more details can be found in Alexandre *et al.* (1999).

Animal management and characters. Goats were reared on irrigated and fertilised pastures in a rotational system. Does were supplemented during their reproductive cycle. Regular drenching against ticks and helminths were carried out. The reproduction was managed in order to obtain three kiddings within two years. Three mating seasons were determined by the systematic use of buck effect. The kids were weighted every two weeks and weaned at a fixed date, with a mean age of 81 days. The individual growth traits of 7424 animals born between 1980 to 1997 in a total of 52 year-season was the principal data set available. These animals were the progenies of 178 sires, 125 grandsires and 916 dams which produced 3560 litter during the period. The pedigree of each animal (sire and dams) till foundation generation was available and used in this study.

Different characters were recorded on each animal, and grouped according to their biological and economical importance. The first group was for animal growth traits (AGT), including the live weight (LW_i) at fixed age i, 10, 30 or 70 days of age. LW_{10}, LW_{30} and LW_{70} were estimated according to Naves *et al.* (2001). The litter size at birth (LS), loss of kids (LK) within the first two weeks of age together with individual birth weight (BW) were considered as a complex related to animal fitness traits (AFT). The traits belonging to AGT and AFT were combined in order to estimate the animal productivity traits (APT). The partial productivity (PP) was the first subgroup of APT. PP_{ij} was the sum of offsprings' LW at each fixed age i within each kidding number j. For offsprings dead or those sent to artificial rearing system, LW

was put to zero. Each record was adjusted for sex effects. The lifetime productivity (LP) was the second subgroup and was estimated as the sum of PP_j for each female within the lifetime time period going from the first rank of kidding to rank of kidding j.

Statistical analysis. The variability of all characters related to AGT and AFT -as a trait measured for each animal born in the litter and its mother - were studied by different individual multiple trait animal models (IMAM) by the use of ASREML program developed by Gilmour *et al* (2001). The same software was used to analyze the subgroups of APT characters but in that case, the mother of the litter was considered as animal**.** The mixed models considered the additive genetic direct, additive genetic maternal effects and the covariance between direct and maternal genetic effects, the maternal environmental effects (permanent and temporal) and residual effects as random variables. The year-season of mating, number of kidding and a combination (sex of the kids with size of the litter at birth) were included as fixed effect. The genetic and non genetic correlations between individual characters from AGT, AFT and APT were estimated by various bivariate animal models, following the same statistical strategy, but where the individual to whom the traits was recorded was considered as animal for AGT and AFT, while the mother of the litter was the animal in APT.

RESULTS AND DISCUSSION

The quantity of parameters obtained in this study exceeds what it is possible to show within the context of this contribution, so only a general description will be presented. All genetic parameters were estimated with high level of accuracy due to an exceptional quality and structure of the data set available in which 74% of the does were represented as animal and mother and 95% of the animals were represented in the vector of records.

Animal fitness traits. The results from the best IMAM for the characters belonging to AFT are presented in table 1.

Table 1. Genetic parameters[A] for animal fitness traits in Creole meat goats

Traits	mean	h^2_a	h^2_m	r_{am}	c^2	Я	DCVg	MCVg
Litter size	2.34	0.23	0.20	-0.61	0.18	0.38	14.1	13.0
Birth weight	1.70	0.22	0.24	-0.13	0.09	0.34	31.9	33.6
Loss of kids	0.58	0.16	0.09	-0.72	0.13	0.22	69.1	51.5
Standard error		0.03 to 0.04	0.03 to 0.04	0.09 to 0.12	0.02 to 0.03	0.02 to 0.04		

[A] Meaning of the symbols in the text. DCVg and MCVg are the genetic coefficient of variation (%) for genetic direct and genetic maternal effects respectively.

Heritabilities for LS, BW and LK for the direct genetic effects (h^2_a) and maternal genetic effects (h^2_m) were medium. There was a high level of antagonism between direct and maternal genetic effects (r_{am}) for LS and LK but not for BW. The environmental maternal effects (c^2) and repeatability (Я) explained a very important part of the total phenotypic variation for these three characters (table 1). The genetic coefficients of variation for genetic direct (DCVg) and

genetic maternal (MCVg) effects for each trait were high. This would mean that there are plenty of space for breeding in Creole goat of Guadeloupe. However, such a selection objective, based on AFT parameters, will not be profitable because all the relationships among these characters, at genetic and non genetic levels, were in a clear and non useful sense. Any improvement in LS will be negatively correlated to BW and this in turn will increase LK. Accordingly, an intermediate performance level would be the best strategy for traits belonging to AFT in correspondence with the theoretical and practical results (see an excellent discussion in Rauw *et al*., 1998).

Animal growth and productivity traits. The first two kiddings were completed by 88.2% of the Creole does, which were able to produce an $LP_{70,2}$ equal to 26.4 kg of kids at 70 days of age. This latter value was equivalent to 105.6% of the adult LW of the mother. LP_i, increased regularly to reach 80.3 kg at kidding number 5 (with a range of 36.4 kg to 129.3 kg of weaned kids). This large variability in a group of characters belonging to APT will be very useful from an economical point of view. Nevertheless, the direct selection for lifetime performances must be considered with caution, because is a time consumption procedure which increases the generation interval. A high significant correlation ($R > 0.715$) was obtained between the breeding value of females for lifetime performances at different kidding number. This means that it will be possible to improve APT by considering the results of a single PP_i . This possibility was examined by the use of various bivariate animal models with different AGT and PP_{70} (table 2).

Table 2. Genetic parameters[A] in animal growth traits (AGT, kg) and partial productivity at 70 days of age (PP_{70}, kg) in Creole meat goats

	mean	h^2_a	h^2_m	DCVg	MCVg	$RDPP_{70}$	$RMPP_{70}$
LW at 10 days	2.70	0.29	0.15	28.5	20.7	0.54	0.79
LW at 30 days	4.43	0.24	0.16	28.1	23.5	0.38	0.89
LW at 70 days	7.35	0.19	0.16	28.8	27.2	0.38	0.87
Standard error		0.03 to 0.04	0.03 to 0.04			0.05 to 0.10	0.06 to 0.08

[A]The genetic meaning of AGT are defined in the text. DCVg and MCVg are the genetic coefficient of variation (%) for genetic direct and maternal effects respectively for AGT. $RDPP_{70}$ and $RMPP_{70}$ are the genetic direct correlation and genetic maternal correlation between AGT and PP_{70}.

The design matrix was not the same in these bivariate animal model. For AGT, the covariance between genetic direct and maternal effects was not significant. The h^2_a was higher than h^2_m for LW_{10} and LW_{30} , but very similar for LW_{70}. The genetic correlation between growth traits (direct and maternal effects) and partial productivity of the does (maternal effects) at 70 days of their kids were medium to high but in the positive direction. The genetic coefficient of variation was higher than 20% for direct and maternal effects for AGT components, while it was 32% higher for PP_{70}. The same trend was found when the partial productivity of the does was measured at 10 or 30 days of age. According to this pattern, there are possibilities to improve the productivity of the does by selection based on the own live weight of the animals at a very young age.

CONCLUSION

This study shows the existence of a great level of genetic variability for different economical traits in this population of Creole meat goats, which can be improved by selection methods. On the other hand, a clear and significant antagonism between components of AFT was observed. The best strategy will be to use the components of the complex of AGT as selection criterions and to keep at a medium level the animal fitness traits. A good recording system will be necessary to reach this goal. More studies are needed in order to incorporate the economical cost in the breeding scheme.

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