Study of the Relationship amongst Puberty Traits of Ewe Lambs of the Romney Breed of Kent in the United Kingdom

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ABSTRACT

Data on the growth performance from birth to 12 weeks old of 138 Romney ewe lambs were collected over two years at Wye Sheep Research Unit of the Imperial College (University of London). The pubertal behaviour of these young females was studied with the introduction of rams into their flocks and the relationship between pubertal traits was evaluated. The results showed that date of first (pubertal) oestrus was significantly ($p < 0.01$) affected by age at puberty and live weight at joining. Analysis of pooled data from ewe lambs of groups 1 and 2 resulted in significant effects of date of birth, weaning weight, growth rate from birth to weaning and from weaning to joining period, and dam age on live weight at joining puberty. Age at puberty was also significantly ($p < 0.05$) affected by growth rate from birth to joining. About 77% to 84% of Romney ewe lambs born in spring (April) reached puberty in autumn (October) of the same year.

Keywords: Puberty-Oestrus-Ewe lambs-Age-Live weight-Growth rate-United Kingdom

RESUME

Les données sur la croissance de 138 agnelles Romney de la naissance jusqu'à l'âge de 12 semaines ont été collectées pendant 2 années consécutives à Wye à l'Unité de Recherche sur les Ovins de Imperial College (Université de Londres). Le comportement pubertal de ces jeunes femelles a été étudié grâce à l'introduction des béliers et la relation entre différents parmètres à la puberté a été évaluée. Les résultats ont montré que la date de l'oestrus pubertal est significativement ($p < 0,01$) influencée par l'âge et le poids vif à la puberté, respectivement. Il ressort de l'analyse des données des agnelles des groupes 1 et 2 que la date de naissance, le poids au sevrage, le taux de croissance des agnelles de la naissance au sevrage et à la monte, l'âge de la mère ont un effet significatif sur le poids vif à la puberté. L'âge à la puberté est aussi influencé ($p < 0,05$) par le taux de croissance de la naissance à la monte. 77 à 84% des agnelles Romney nées pendant le printemps (avril) ont atteint la puberté en automne (octobre) de la même année.

Mots clés: Puberté-Oestrus-Agnelles-Age-Poids vif-Croissance-Royaume Uni.

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INTRODUCTION

Many events happen before the occurrence of puberty and this makes it difficult to have a single definition of puberty. For example, Dyrmundsson (1972) refers to it as the time of appearance of first indicators of reproduction, whereas Hafez and Hafez (2000) define it as the result of a gradual adjustment between increasing gonadotropic activity and the ability of the gonads to simultaneously assume steroidogenesis and gametogenesis. There are several hereditary and environmental factors affecting the onset of puberty (Laskey, 1962; Cahill, 1981; Inyangala et al., 1991; Bologum et al., 1993) especially in the temperate zones where sheep are seasonal breeders. Several authors have indicated that it is difficult to dissociate the effects of age, season, live weight and body condition on the attainment of puberty (Mallampati *et al.*, 1971; Quirke *et al.* 1983; Burnett et al., 1988). The objective of this study was to determine the relationship between various traits of Romney ewe lambs born in spring over two consecutive years at Wye Sheep Research Unit of the Imperial College (University of London) in the U.K.

MATERIALS AND METHODS

This study was carried out at Wye Sheep Research Unit of the Imperial College (University of London) in Kent region (south east of London). The population consisted of 138 Romney ewe lambs of which 57 born in spring of year I constituted group 1 and 81 born in spring of year II were in group 2.

The group 1 ewe lambs were weaned in July and grazed on permanent pastures during summer and autumn. Two Romney teaser rams fitted with raddle harnesses and "Sire Sine" cold weather crayons were introduced into the flock of the young females in September. The ewe lambs were checked every day for raddle marks which were indications of apparent first oestrous behaviour considered as the attainment of puberty. The teaser rams were replaced with a fresh intact ram for mating in a covered barn in November. Daily marking observations were continued on the 57 female lambs. In December, the ram was then replaced by another. The mating period ended in January to avoid a prolonged subsequent lambing period. Raddle crayon colour was changed every 2 weeks with the purpose of differentiating returns to oestrus from the new pubertal marks. All the lambs were weighed and body condition scored in September and weighed fortnightly, thereafter throughout the observation period until January the following year.

The group 2 ewe lambs were divided into 2 subgroups. Thirty-one animals of sub-group A were designated for pubertal studies during the breeding season and were introduced to teaser rams. The other 50 ewe lambs of sub-group B were introduced first to teaser rams on 8th October and then to entire rams from 2nd November to 30th November. All the ewe lambs were weighed and body condition was scored on 3rd September and every subsequent 2 weeks until 2nd March.

The data on date of birth, dam identification, litter size, sex, birth weight and identification number of newborn lambs pedigreed with the ewe lambs were recorded in the daily lambing book. Data on weight at four weeks, eight weeks and twelve weeks of age (weaning weight) were also recorded. The database constituted of all the information collected over two years from the two groups of ewe lambs was used in this study.

The SAS (1991) general linear model program was used for the study of the relationship between some traits. The mathematical model used for a set of dependent and independent variables was:

$Y_n = a + b_1X_1 + b_2X_2 + \ldots\ldots\ldots + bnXn + e$

and the variables for each case are specified in the results section.

RESULTS

The means and standard errors of the traits in consideration at the attainment of puberty are shown in Table 1. For the ewe lambs of group 1, a simple linear regression undertaken to determine the relation between the date of first oestrus (dependent variable) and live-weight, body condition score and age at puberty as independent variables revealed that age at puberty contributed 87.7% of the total variation. Neither live weight nor body condition had any significant ($p > 0.05$) contribution to the total variation. When live weight and body condition score were held constant, date of first oestrus advanced by 0.8 days for each day increase in age.

For the ewe lambs of group 2, the same analyses

Table 1: Comparison of pubertal and non-pubertal ewe lambs of group 1 and group 2

	Group 1		Group 2	
Parameters	Pubertal	Non-pubertal	Pubertal	Non-pubertal
No. of animals	43	8	50	31
Date of birth	6.4± 0.9	4.4± 2.3	8.4± 1.2	13.4± 1.4*
Dam age (years)	3.32± 0.2	3.87± 0.6	3.91± 0.2	3.29± 0.2
Birth type	1.93± 0.0	2.12± 0.3	2.09± 0.0	1.87± 0.0
Birth weight	4.85± 0.1	4.85± 0.4	4.52± 0.1	5.09± 0.1*
Adjusted 4 week weight (kg)	13.36± 0.5	11.87± 1.5	12.62± 0.3	13.00± 0.5
Adjusted 8 week weight (Kg)	22.20± 0.7	21.68± 2.1	20.17± 0.3	19.61± 0.6
Weaning weight (Kg)	27.24± 0.6	26.43± 2	23.77± 05	23.29± 0.8
Growth rate (g/day) - from birth to weaning	256.5± 6.4	265.4± 20.0	228.8± 5.1	217.2± 8.7
- from weaning to joining	214.9± 4.8	210.0± 22.5	205.4± 4.9	107.7± 7.5***
- from birth to joining	230.2± 3.6	219.1± 13.3	193.5± 3.7	176.0± 4.5**
Joining live weight (Kg)	44.49± 0.0	44.49± 2.7	41.59± 0.6	38.04± 1.0**
Body condition score	3.00± 0.0	2.62± 0.2*	3.21± 0.0	3.03± 0.1

Level of significant difference between pubertal and non-pubertal ewe lambs:
* $P < 0.05$ ** $P < 0.01$ *** $P < 0.001$

were carried out and the prediction equation that explained any significant variability was given by the multiple regression equation as:

$Y_2 = 0.8X_1 - 0.8X_2 - 72$ where
Y_2 is date of first oestrus (puberty)
X_1 is age at puberty ($p < 0.001$)
and X_2 body weight at joining ($p < 0.01$).

Body condition score was not significant ($p > 0.05$) and was therefore dropped from the model. Age at puberty and body weight at joining had significant contribution ($p < 0.001$) to the date of first oestrus. Other variables remaining constant, date of first oestrus advanced by 0.8 days for each day increase in age.

A forward selection method of linear multiple regression with pooled data from all the ewe lambs of group 1 and group 2 was used in an attempt to predict body weight at joining and age at exhibition of pubertal oestrus and the results obtained are shown below.

a) ***Body weight at joining***

The regression equation was given by:

$Y_1 = a + b_1X_1 + b_2X_2 + b_3X_3 + b_5X_5 + b_6X_6 + b_7X_7 + b_8X_8 + b_9X_9 + b_{10}X_{10} + b_{11}X_{11} + e$; where

Y_1 is body weight (kg) at joining;
X_1 is date of birth of ewe lambs,
$X_{2\,IS}$ age of dam at birth of ewe lambs (year),
X_3 is birth type of ewe lambs (single, twin, triple

etc...),
X_4 is birth weight of ewe lambs (Kg),
X_5 is adjusted 4 week weight (Kg),
X_6 is adjusted 8 week weight (Kg),
X_7 is adjusted 12 week weight or weaning weight (Kg),
X8 is growth rate from birth to weaning (g/day),
X_9 is growth rate from weaning to joining (g/day),
X_{10} is overall growth rate from birth to joining (g/day),
X_{11} is body condition score at joining and
e is error term.
The independent variables with significant statistics ($p < 0.05$) were retained in the model in order of importance by which they decreased the residual mean sum.

The best prediction model that explained variability was as follows:
$Y_1 = -3.06 + 0.07X_1 + 0.96X_7 + 0.11X_9 - 0.06X_{10} + 0.03X_8 + 0.06X_2$
($r_2 = 99\%$)

Date of birth, weaning weight, growth rate from birth to weaning and from weaning to joining and dam age had significant contributions ($p < 0.01$) to the weight at joining whereas birth type, birth weight, adjusted 4 week weight and adjusted 8 week weight had no significant contributions ($p > 0.05$). For each unit increase in one of these, considering the others constant, live weight at joining increased by 0.07, 0.96, 0.03, 0.11 and 0.06 Kg, respectively, for date of birth, weaning weight, growth rate from birth to weaning, growth rate from weaning to joining and dam age. Contrarily, body weight at joining reduced by 0.06 Kg for each g/day increase in overall growth rate, other variables being constant.

b) *Age at puberty*
The preceding model was repeated for the prediction of age at puberty and the prediction equation that best explained variability was given by:
$Y_2 = 264.8 + 0.012X_1 - 0.56X_2 + 3.11X_3 - 0.88X_4 + 1.52X_5$ where
Y_2 is age at puberty,
X_1 is growth rate from birth to weaning,
X_2 is overall growth rate from birth to joining,
X_3 is weaning weight,
X_4 is date of birth and
X_5 is dam age.
Birth type, birth weight, adjusted 4 week weight, adjusted 8 week weight, growth rate from birth to weaning, live weight at joining and body condition score at joining which had no significant impact ($p > 0.05$), were discarded from the model following the first run. Growth rate from weaning to joining and dam age were not significant either, but were retained in the model as they helped decrease Residual Mean Sum. Weaning weight and date of birth were nearly significant at 5% level; they were therefore considered in explaining variation in age at puberty. However, only overall growth rate from birth to joining was statistically significant ($p < 0.05$). Hence, all other factors remaining constant, for each g/day increase in growth rate, age at puberty reduced by 2.61 days, an indication that high overall growth rate permitted ewe lambs to reach puberty at lower age.

DISCUSSION

The first analysis of the variations with the ewe lambs of group 2 showed that joining live weight and age at puberty significantly ($p < 0.01$) affected the date of first behavioural oestrus. The analysis of pooled data of all pubertal lambs of the two groups showed that date of birth, weaning weight, growth rate from weaning to joining and age of dams of ewe lambs had significant effects on body weight at puberty. The results of Dickerson and Laster (1975) in respect to growth rate agree with the present findings. The fact that late seasonal lambings improved weight at puberty could imply that the rearing conditions were so adequate that younger female lambs grew fast enough to reach the necessary body weight for attainment of puberty. This supports the idea that steady growth throughout the rearing period (pre- and post-weaning) should be maintained. This observation was noticed in heifers by several authors (Wittbank et al., 1994; D'Hour et al., 1998). Similar observations have been reported by other authors (Bathaes and Leroy, 1994; Ebangi et al., 1996) in their study on sheep in Iran and Cameroon. Also, ewe lambs born to older ewes had higher weight at puberty. The importance of age of dam of the ewe lambs was also reported by Chirstenson *et al.* (1976). They showed that ewe lambs born to older dams had higher body weight at lambing at one year old. The limited effect of dam age showing that the weaning weight of New Zealand Romney ewe lambs was higher in those born to older dams has been studied elsewhere (McCall and Hight, 1981). The overall growth rate from birth to joining significantly

affected age at puberty. Therefore, high overall growth rate led to higher body weight in younger ewe lambs which were consequently able to reach puberty (Lees, 1979). This result is supported by Keane (1976) who demonstrated that the rate of growth during the rearing phase has an influence on weight at puberty. The absence of any significant correlation between body weight and body condition score is not in agreement with the findings of several researchers (Stephenson *et al.*, 1980; Burnett et al., 1988). The assessment of conformation through body condition seems to be more appropriate with adult ewes than with growing lambs in which the level of fatness is not important.

CONCLUSION

About 77 to 84% of Romney ewe lambs born in spring (April) reached puberty in the following autumn (October). The date of first oestrus was significantly affected by age and joining live weight. Female lambs born in later part of the season could reach puberty the same breeding season provided they were raised under a good nutritional regime. Ewe Lambs born to older dams were at advantage, therefore, if a plan of breeding from ewe lambs during their first year of age is to implement, those born to mature ewes should be considered.

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