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Brief communication

THE RELATIONSHIP BETWEEN THE DEGREE OF UDDER DEVELOPMENT AND MILK PRODUCTION IN COOPWORTH EWES

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While it has been shown that there is a high correlation of mammary weight with milk production between species (Linzell, 1972), there are few data correlating the same parameters within a species. As milk production per unit weight of udder tissue is relatively constant even for species differing widely in body size (Linzell, 1972), the contribution of udder weight to variation in milk production between individuals within a species is likely to be substantial, particularly when other variables such as nutritional status are held constant.

In many species the measurement of udder size usually requires surgical or post-slaughter removal of the udder for the appropriate determinations (DNA content, gross weight, etc.) to be made. However, the morphology of the udder in ruminants (and humans) enables udder size to be determined as a volume by water displacement, with the advantage that serial measurements may be made on the same animal. This water displacement technique has been applied to lactation studies in goats (Linzell, 1966) and Scottish women (Hytten, 1954), milk production of the former, but not the latter, being closely related to udder volume.

The present study reports the results of applying the water displacement technique to the study of udder development in Coopworth ewes and its relationship to milk production.

Measurements of udder volume were made in 1978 and 1979 on single- and twin-bearing ewes subjected to variable levels of pasture allowance during pregnancy (1.0 to 2.0 kg DM/ewe/day throughout pregnancy for single-bearing ewes; 1.0 to 2.0 kg DM/ewe/day in early pregnancy and 2.0 to 6.0 kg DM/ewe/day in late pregnancy for twin-bearing ewes). As these allowances did not affect udder volume or milk production at peak lactation (3 weeks *post partum*), the data for each year were pooled. The results for both seasons were essentially similar and only data for 1979 are presented (Table 1). During lactation, pasture allowance was the same for all ewes (8.0 kg DM/ewe/day) at

TABLE 1: UDDER SIZE AND MILK PRODUCTION IN COOPWORTH EWES

	No. of lambs reared	
	1	*2*
Peak milk yield[1] (ml)	2 240 ± 50[2]	2 850 ± 90
Peak udder volume[3] (ml)	1 210 ± 30	1 480 ± 50
Udder productivity (ml/ml tissue/day)	1.88 ± 0.04	1.94 ± 0.06
Udder volume/unit liveweight[3] (ml/kg)	21.9 ± 0.6	26.7 ± 0.8

[1] Measured by the oxytocin method (McCance, 1959), 2 to 3 weeks *post partum.*
[2] Mean ± standard error of the mean.
[3] Measured 3 weeks *post partum.*

a level shown to promote near maximal pasture intakes (Rattray and Jagusch, 1979).

Udder volume was measured weekly from about day 110 of pregnancy until the time of weaning (10-week lactation). During late pregnancy, udder volume increased exponentially until lambing. It then declined slightly in both groups, the rate of decline increasing to about 5% per week from the third to the tenth week of lactation.

The rate of udder growth was greater in twin- than single-bearing ewes, the volume of the former being approximately 25% greater at peak lactation (Table 1).

Peak milk production was about 25% greater in twin-bearing than single-bearing ewes, and this difference was a reflection of udder volume, udder productivity being similar in both groups (Table 1). There was a significant linear relationship between peak milk production (Y, ml) and udder volume post milking (X, ml) at peak lactation which was described by the equation $Y = 1.45X + 582$ ($r = 0.69$; $P < 0.001$; $n = 65$). This relationship was also statistically significant within both the single- and twin-bearing groups.

The udder volume technique appears to be a satisfactory measure of potential milk production, udder productivity (Table 1) being similar to that found by Linzell (1972) for a wide range of species. Udder volume (Y, ml) was also a precise indicator of udder weight (X, g), the relationship being described by the equation $Y = 0.901X + 28$ ($n = 40$; $r = 0.96$; $P < 0.001$) when udder weight was determined following the slaughter of ewes in late pregnancy (day 138).

The difference in udder volume between the single- and twin-bearing ewes at peak lactation was not due to body-weight differences between the groups (Table 1). More likely, udder volume is determined by the endocrine activity of the placenta during pregnancy (Davis *et al.,* 1979). However, udder growth was induced during early lactation in a group of 15 single-bearing ewes receiving an additional foster lamb at birth, and milk production and udder volume at peak lactation were similar to those of twin-bearing ewes. Furthermore, udder volume at peak lactation was not affected by removal of one-half of the udder of single-bearing ewes between day 90 and day 100 of pregnancy, milk production also being similar to that found in sham-operated and normal ewes.

Thus a substantial part of the variation in peak milk production between individual ewes receiving a similar plane of nutrition may be explained by differences in udder volume. Studies are in progress to evaluate the relationship of udder volume to secretory cell number (mammary DNA content).

It is intended to apply a similar approach to that used here to establish relationships between udder size and milk production in dairy cows, where the application of udder size in a breeding selection programme may be of profitable consequence.

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