Short communications

A preliminary assessment of predictive measures for the expression of weaning efficiency in sheep

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Weights and individual feed intake data of 30 Dorper crossbred ewes and their single-born lambs were collected from conception to weaning. The data were used to calculate actual weaning efficiency of the individual ewe-lamb units [AEFF = lamb weaning weight/DDMI (digestible dry matter intake) of both ewe and lamb × 100]. The accuracy of ewe weight (EW^b) as a predictor of lamb weight (LW) and of predictive weaning efficiency (PEFF = LW/EW^b) as a predictor of AEFF were investigated. Best predictions were obtained when EW was raised to the power of 0.72 and 0.67, respectively.

Gewigte en individuele voerinnamedata van 30 Dorper kruisings en hulle enkellinggebore lammers is vanaf konsepsie tot speen aangeteken. Die data is gebruik om ware doeltreffendheid van die individuele ooi–lam eenhede te bereken (WDOEL = Lamspeengewig/VDMI (verteerbare droëmateriaalinname) van beide ooi en lam × 100]. Die akkuraatheid van ooigewig (OG^b) as 'n voorspeller van lamgewig (LG) en van speendoeltreffendheid (VDOEL = LG/OG^b) as voorspeller van WDOEL is ondersoek. Die beste voorspellings is verkry toe OG tot die mag van 0.72 en 0.67 onderskeidelik verhef is.

Keywords: efficiency, ewe size, prediction, sheep, $W^{0.75}$

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Meat production is relatively inefficient in sheep and cattle. The high maintenance requirements of the breeding female contribute largely to this low efficiency (Dickerson, 1978). An improvement of both biological and economical efficiency therefore becomes increasingly important.

The assessment of efficiency requires measurement of individual feed intake, which is unpractical under normal circumstances. An accurate predictor of the efficiency of the dam–offspring unit that does not require individual feed consumption data, would therefore be useful for estimating biological efficiency (Davis *et al.*, 1987).

The metabolic weight of an animal is commonly calculated by applying the exponent 0.75 to its weight (i.e. $W^{0.75}$). Since fasting heat production and metabolic rate are closely related to it, it was assumed that $W^{0.75}$ represents the metabolic weight of the animal (Brody, 1945; Kleiber, 1961). Many researchers subsequently advocated the adjustment of a variety of other response variables (e.g. growth rate) for variation in weight by dividing them by $W^{0.75}$. Roux & Scholtz (1984) also recommended the use of $W^{0.75}$ as a means to obtain relative growth rate of growth efficiency. Consequently, these ratios (e.g. ADG/$W^{0.75}$ or weaning weight/$W^{0.75}$) are commonly used as a means of calculating relative growth or weaning efficiency (Turner, 1959; Dinkel & Brown, 1978; Davis *et al.*, 1983; 1987).

$W^{0.75}$ was developed from data of species which varied widely in W. The application of the exponent 0.75 within species is therefore questionable. As a means of expressing weaning efficiency (weaning weight/$W^{0.75}$) it does not take into account the additional intake by the dam during pregnancy and lactation for the sake of her progeny. Metabolic weight may therefore not be the appropriate way of expressing efficiency. The objective of this preliminary study therefore was to evaluate different values as exponents to dam weight in order to obtain a more appropriate scaling of EW for the prediction of weaning efficiency in ewes.

Ewe lambs from unrelated Dorper crossbred ewes of the same age were raised together from 90 days of age. At the age of 10 months they were mated for the first time, followed by two successive mating periods every eight months. The same three Dorper rams were used in all three mating periods of 30 days each. The ewes were weighed before each mating period and weights were recorded.

A pelleted balanced commercial diet (10.5 MJ ME/kg DM; 130 g CP/kg DM) was fed at approximately 1% of ewe body weight on an individual basis. This was, however, adapted to maintain an approximate constant condition score of 3 (Russel *et al.,* 1969). Additionally, a poor quality hay was provided *ad lib.* Individual pellet and hay intake were both recorded weekly. The lambs were also provided with a pelleted commercial creep diet (12.7 MJ ME/kg DM; 150 g CP/kg DM) *ad lib* from the first week after birth. Digestibility of each diet was also determined and digestible dry matter intake (DDMI) obtained.

The lambs were weaned and weaning weights recorded at an average age of 63 days. Individual ewe intake was recorded from the estimated day of conception (150 days prior to lambing) until weaning of her lamb. Individual lamb creep feed intake was recorded from the first week after birth until weaning. Thirty ewes with single-born lambs were used for this experiment. Ewes with twins were excluded.

Weaning weights (LW) and pooled intakes of the ewe and lamb were adjusted for sex, age of weaning as a covariable, and age of ewe (3 levels) by multiple regression. Ewe weights (EW) were adjusted for differences in age only.

Predictive measures of efficiency of the ewe-lamb until [PEFF = adjusted lamb weaning weight (LW)/adjusted weight of the ewe (EW^b)], with varying values of b and the actual efficiency (AEFF = LW/DDMI of ewe and lamb × 100), values were calculated and compared. The PEFF values were then regressed on AEFF values to obtain the best fit. The b values were obtained through simple linear regression procedures.

It is well-known that heavier dams produce heavier offspring. This was also the case in this study. The relationship between adjusted lamb weaning weight (LW) and ewe weight (EW) and mating is presented in Figure 1. The best fit was obtained by the regression:

$$\ln LW = 1.70 + \underset{(\pm 0.113)}{0.29} \ln EW \quad (p = 0.015;\ r^2 = 19.4\ \%)$$

However, when the constant (1.70) was forced to zero, the

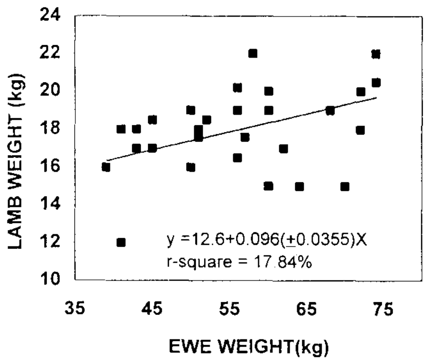

Figure 1 The relationship between adjusted lamb weight (LW) and adjusted ewe weight (EW).

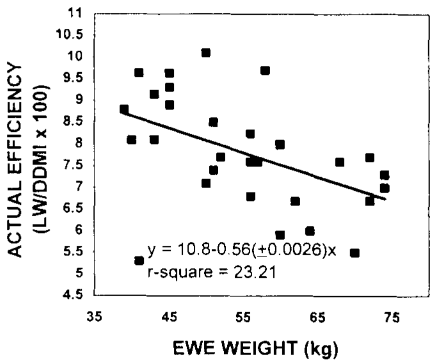

Figure 3 The linear regression of actual efficiency (LW/DDMI × 100) on ewe weight.

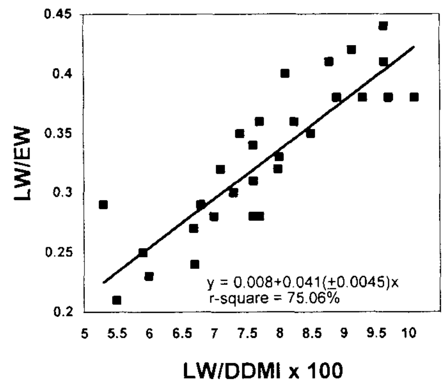

Figure 2 The relationship between LW/EW and actual efficiency (LW/DDMI × 100).

slope became 0.72, which corresponds closely to 0.75.

The relationship between AEFF and LW/EW is presented in Figure 2. It clearly demonstrated a strong relationship. The best fit was obtained by the allometric regression:

$$\ln \text{AEFF} - \ln \text{LW} = 1.84 - \underset{(\pm 0.065)}{0.67} \ln \text{EW} \quad (p = 0.000;\ r^2 = 79.3\ \%)$$

The best fit was therefore obtained with b = 0.67. Although it does not differ significantly from 0.75 (t_{28} = 1.26), it corresponds to the intraspecies value for metabolic rate of 0.67 obtained by Heusner (1982) and the generally below 0.75 values for sheep reviewed by Thonney *et al.* (1976).

Simple correlation coefficients between efficiency (AEFF and PEFF) and the components thereof, are presented in Table 1.

Both LW and EW were poor indicators of AEFF and PEFF. LW accounts for only 19.7% and 26.0% of the variation in AEFF and PEFF of the ewe–lamb unit, respectively. Similarly, values for EW as predictor of AEFF and PEFF were 23.2% and 27.7%, respectively. Dinkel & Brown (1978) and Wagner *et al.*, (1984) found in beef cattle that calf weight was a more suitable predictor than cow weight was. The regression of AEFF on EW is presented in Figure 3, which indicates that the smaller ewes were slightly more efficient than the larger ewes. This corresponds to results obtained in beef cattle (Kress *et al.*, 1969; Carpenter *et al.*, 1972). Since the productive cycle was defined as the period from conception to weaning (approximately 213 days), the difference between larger and smaller ewes would be more accentuated if the non-productive period (approximately 27) of the eight month cycle had been included.

Table 1 Pearson correlation coefficients between efficiency (AEFF and PEFF) and LW, EW and DDMI

	Efficiency			
	AEFF	*p* value	PEFF	*p* value
LW	0.444	0.014	0.510	0.004
EW	–0.482	0.007	–0.526	0.003
DDMI	–0.685	0.000	–0.571	0.001

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was, wat aansienlike hittebeskadiging voorstel. Ruminale-stikstofverteerbaarheid het ook verlaag (p <0.05) met hittebehandeling. Verteerbaarheid van nie-degra-deerbare proteïen is voorspel met 'n $r^2 = 0.72$ en beramingsfout (Sy.x) van 4.78%. Die voorspellingsvergelyk-ing (p <0.001) van UDP-V (%) = 91.9 – 0.025 (ADIN, % in DM)^2, behoort 'n nuttige riglyn te wees om UDP-V en hitte-beskadiging van hitte-geprosesseerde en ongeprosesseerde plantproteïenbronne te voorspel.

Keywords: roasting, plant protein, undegradable protein, ADIN, dairy cows

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