

## Rumen inert fat or starch as supplementary energy sources for reproducing ewes grazing wheat stubble

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### Abstract

A trial was conducted to determine the efficiency of utilization of rumen inert fat as a supplementary energy source for reproducing South African Mutton Merino ewes (n = 56) grazing wheat stubble. The ewes were randomly divided into four groups of 14 ewes each, with every group representing a treatment. The wheat stubble paddock was divided into four paddocks of equal sizes, and the ewes grazed these paddocks at a stocking density of 4.6 ewes/ha from the 1 November 1992 until May 1993 after the break of the season. The ewes were rotated between the paddocks on a weekly basis. Each group received 250 g of supplementary feed per head daily for the last six weeks of pregnancy, and this was increased to 360 g during the first four weeks of lactation. Supplementation was supplied on Mondays, Wednesdays and Fridays for a 70-day period. Supplementary feed contains either inert fat, starch (maize meal), a combination of inert fat and starch or wheat bran as an energy source. The crude protein concentration of the supplements varied between 167 and 196 g/kg feed. No significant difference occurred between the live weights of ewes during the last six weeks of pregnancy, the first four weeks of lactation, or the total feeding period. The ewes receiving the 50% fat plus 50% maize meal tended to lose less weight during lactation than the ewes that received maize meal as their main energy source. No significant difference occurred in the absolute live weight of ewes over the experimental period. A lack of response to inert fat as supplementary source in the live weight of the ewes was observed during the total experimental period, when compared to the control group which received wheat bran.

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**Keywords:** SA Mutton Merino ewes, rumen inert fat, supplementary energy source, wheat stubble

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### Introduction

Wheat stubble is the dominant forage available during summer in the Mediterranean sheep farming areas of South Africa, such as the Swartland region. Europe produces about 330 million tons of cereal straw annually (Cañeque *et al.*, 1998), and about 460 000 ha of wheat stubble are available in South Africa annually (Brand, 1996). During the early summer period, cereal stubble generally provides adequate nutrition for sheep, but serious deficiencies may occur during the late summer, autumn and early winter months (Brand *et al.*, 2000). Autumn and winter lambing seasons are followed in this region, which implies that ewes in the critical physiological stages of pregnancy and lactation are dependent on wheat stubble. However, wheat stubble contains low levels of carbohydrates and nitrogen, has a poor digestibility and high cell wall content (Dann & Coombe, 1987). This implies that wheat stubble is unable to meet the high nutrient requirements of the reproducing ewe (Aitchison, 1988; Brand *et al.*, 1997), and therefore supplementary feed is essential. The low digestibility of wheat stubble as well as the decrease in the physical capacity of the rumen of the pregnant ewe results in a reduced intake of available wheat stubble (Mulholland *et al.*, 1976). Therefore, the aim of supplementing the diet is to correct ruminal and animal deficiencies in the diet (Dann & Coombe, 1987). In a study by Gomes *et al.* (1994) it was indicated that by including a rapidly fermentable carbohydrate like maize meal in the diet of ewes grazing wheat stubble, the energy supply could be successfully supplemented. A higher live weight was also obtained with pregnant and lactating ewes that received cereal supplements while grazing wheat stubble compared to an unsupplemented group (Cloete & Brand, 1990).

Fats represent an excellent source of dietary energy for inclusion in ruminant diets. It contains an average of 37 MJ gross energy/kg feed, all of which is available as digestible energy, and about 0.80 of

which (30 MJ/kg) is available as net energy. The efficiency of utilization of dietary lipid for body fat synthesis is also more than double that of carbohydrates (Thornton & Tume, 1984). The energy density of a diet can be increased without reducing forage to concentrate ratio (Grummer *et al.*, 1990) by the inclusion of fats in the diet. On the other hand, fat has the disadvantage of reducing the digestibility of fibre in the rumen when it is fed in excess of 2-3% of the feed dry matter (Palmquist, 1988), because it protects fibre from being fermented (Harfoot *et al.*, 1974), as well as being toxic to cellulolytic bacteria (El Hag & Miller, 1972). Holter *et al.* (1993) found that when lactating dairy cows were supplemented with a bypass protein-fat supplement, forage and total dry matter intake (DMI) were reduced significantly, which negated the potential nutritional value of the supplement. Therefore, if more than 6% fat is to be included, it must either be protected from ruminal fermentation or be converted to soaps (Palmquist & Jenkins, 1982; Kotzè, 1992) if they are to be used as supplements in ruminant diets. Depending on the diet, fat may contribute 7-10% of the digestible energy in the rumen (Ruckebusch & Thivend, 1980). The high acidity in the duodenum combined with detergent action of bile acids, lysolecithin and fatty acids causes saturated fatty acids to be more digestible in ruminants than in non-ruminants (Palmquist & Jenkins, 1980).

A trial was conducted to quantify the effect of rumen inert fat, maize meal or a combination of these energy sources in combination with a low degradable protein source as supplementary feed for pregnant and lactating ewes when grazing wheat stubble.

### Materials and Methods

A trial was conducted at the experimental farm, Langgewens, in the Swartland area of the winter rainfall region of South Africa (33°17'S, 18°42'E, altitude 177 m). Fifty-six South African Mutton Merino (SAMM) ewes were synchronized with Repromap® (medroxyprogesterone acetate, 60 mg) sponges and then mated from 1 November 1992. The ewes grazed wheat stubble for five months at a stocking density of 4.6 ewes/ha. The ewes were randomly divided into four paddocks of equal sizes, and rotated between paddocks on a weekly basis. Each ewe received 250 g supplementary feed daily for the last six weeks of pregnancy and during the first four weeks of lactation this was increased to 360 g per ewe. The supplementary feed mixtures contained a standard amount of molasses and fish meal with either wheat bran (control group), maize meal, bypass fat or a combination of maize meal and bypass fat as an energy source. The rumen inert fat source was Morlac® (Marine Oil Refiners, Dido Valley, Simon's Town, RSA). The supplementary feed was provided as licks in troughs on Mondays, Wednesdays and Fridays, and the ewes were weighed every fortnight. The experiment ended in May after the break of the season.

An analysis of variance was used to detect differences in live weight changes in the different groups of ewes. The live weight of the ewes was used as a covariant at the onset of the experiment, to correct subsequent live weight data by analysis of covariance (Statgraphics 5.0, 1991). The physical composition of the four diets received by the ewes for 70 days are presented in Table 1.

**Table 1** Ingredient composition of four supplements presented as supplementary licks to SA Mutton Merino ewes during the last six weeks of pregnancy and the first four weeks of lactation while grazing wheat stubble for 150 days at a stocking density of 4.6 ewes/ha

| Raw materials           | Treatments |            |                      |                                    |
|-------------------------|------------|------------|----------------------|------------------------------------|
|                         | Control    | Maize meal | Bypass fat (Morlac®) | 50% bypass fat plus 50% maize meal |
| Molasses                | 50         | 50         | 50                   | 50                                 |
| Fishmeal                | 50         | 50         | 50                   | 50                                 |
| Wheat bran              | 100        | 0          | 50                   | 25                                 |
| Maize meal              | 0          | 100        | 0                    | 50                                 |
| Bypass lipids (Morlac®) | 0          | 0          | 50                   | 25                                 |
| Salt                    | 50         | 50         | 50                   | 50                                 |
| Total (kg)              | 250        | 250        | 250                  | 250                                |

## Results and Discussion

The chemical composition and total digestible nutrient (TDN) content of the supplements are presented in Table 2. The crude protein (CP) concentration of the diet varied between 167 and 196 g/kg feed, whereas the TDN concentration varied between 520 and 767 g/kg feed.

**Table 2** Calculated chemical composition on an air dry basis (g/kg) of supplementary feed sources provided to SA Mutton Merino ewes grazing wheat stubble

| Composition                | Control | Maize meal | Supplements                           |                      |
|----------------------------|---------|------------|---------------------------------------|----------------------|
|                            |         |            | 50% bypass fat plus<br>50% maize meal | Bypass fat (Morlac®) |
| Crude protein              | 196     | 172        | 169.6                                 | 167.0                |
| Crude fibre                | 56.0    | 23.6       | 28.8                                  | 34.0                 |
| Total digestible nutrients | 520.0   | 604.0      | 685.0                                 | 766.0                |
| Calcium                    | 11.2    | 10.7       | 10.9                                  | 11.0                 |
| Phosphorus                 | 9.5     | 6.8        | 7.3                                   | 7.7                  |

The live weight changes of the SAMM ewes over the 150-day trial period are presented in Table 3. It is evident from Table 3 that no significant differences ( $P > 0.05$ ) were observed between the live weight of ewes during the last six weeks of pregnancy, the first four weeks of lactation, or the total feeding period. The ewes in the group that received 50% fat plus 50% maize meal lost less weight than the ewes that received maize meal as their main energy source ( $P \leq 0.08$ ). There was also no significant difference in the live weight change (LWC) of ewes over the experimental period (Figure 1). Similar to our results, Horton *et al.* (1992) found that Ca soaps had no effect on apparent digestibility of organic matter (OM), CP or crude fibre (CF) when fed to lactating ewes.

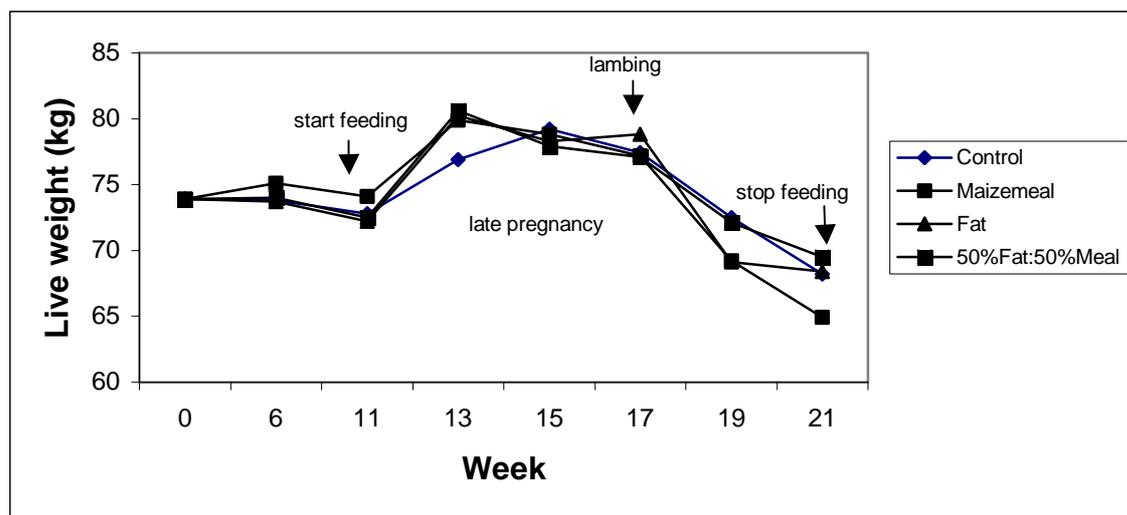
**Table 3** Live weight changes (kg) of SA Mutton Merino ewes during the feeding period (November 1992 until May 1993)

| Item                            | Live weight change |            |            |                                       | s.e.m. | P    |
|---------------------------------|--------------------|------------|------------|---------------------------------------|--------|------|
|                                 | Control            | Maize meal | Bypass fat | 50% bypass fat plus<br>50% maize meal |        |      |
| Initial bodyweight              | 73.9               | 73.9       | 73.9       | 73.9                                  | 1.0    | 0.71 |
| Final bodyweight                | 68.2               | 64.9       | 68.4       | 69.5                                  | 2.0    | 0.31 |
| Weight change:                  |                    |            |            |                                       |        |      |
| Last six weeks of pregnancy     | +4.5               | +4.2       | +5.8       | +4.3                                  | 0.5    | 0.70 |
| First four weeks of lactation   | -9.2               | -12.3      | -10.5      | -7.6                                  | 0.7    | 0.08 |
| Total feeding period (10 weeks) | -4.6               | -8.1       | -4.8       | -3.3                                  | 0.9    | 0.28 |

In the study by Horton *et al.* (1992) it was also found that with the inclusion of rumen inert fat at 7.5 to 29.6% of NRC (1985) energy requirements of lactating ewes no effect on bodyweight changes of lactating ewes or their lambs was noted. Failure of rumen inert dietary lipid to improve weight change in lactating ewes may be due to its effect on forage consumption and fat absorption.

When compared to the control group, which received wheat bran as supplement, the experiment indicated a lack of response in the live weight of the ewes due to supplementary maize meal and rumen inert fat. Wheat bran is a high-quality product (13.5-150 g CP/kg; Boucque & Fiems, 1988), probably matching responses achieved by either maize meal or rumen inert fat. In a study by Horton *et al.* (1992) it was also concluded that in spite of increasing the energy density of the diet, hay intake and fat absorption were

depressed by the inclusion of rumen inert fats, and therefore no beneficial effects of lactating ewes on milk production, milk composition, bodyweight change in ewes or nursing lambs were found. In contrast to these results Sklan (1992) found that live weight of ewes increased after lambing from 65.4 kg to 75.1 kg at 90 days in ewes given calcium soaps of fatty acids (CSFA). In a study by Perez-Hernandez *et al.* (1986) it was found that each of twin lambs reared by ewes receiving a basal diet containing 145 g CP and 10 MJ metabolisable energy (ME) per kg dry matter with a lipid source, supplemented with 200 g/day of the lipid source, were on average 1.0 kg heavier at 5 weeks of age than those from ewes receiving the basal diet alone.



**Figure 1** Live weight of SA Mutton Merino ewes grazing wheat stubble for 150 days at a stocking density of 4.6 ewes/ha and supplemented with different energy sources during late pregnancy and early lactation

## Conclusion

A lack of response in ewe live weight due to supplementary maize meal and bypass fat was indicated by this study, which shows that supplementary energy either in the form of starch or rumen fat was without advantages in this study. In a study done by Cronjè & Oberholzer (1990) it was also found that supplementation with as little as 100 g/d whole maize reduced roughage intake due to substitution. Animal response to supplementary feed is, however, to a great extent also dependent on the quality of the available pasture and production results due to supplementation may change according to pasture quality. The main reason for a lack of response on the starch containing a bypass fat as found in this study may probably be due to the fact that wheat bran provided in the control group probably matched responses achieved by the test sources.

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