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Effects of different dietary inclusion levels of sunflower oil cake on the growth performance of South African mutton Merino lambs

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Abstract

A lamb feedlot study was conducted to evaluate the effects of different dietary inclusion levels of sunflower oil cake (SFOC) on the intake and growth performance of lambs. Diets containing 0, 7, 14 and 21% SFOC were formulated and fed *ad libitum* to 24 South African Mutton Merino lambs (24.0±0.32 kg live weight). The lambs were randomly distributed into 4 dietary treatments with 6 replicates based on completely randomized design. Average daily feed intake, average daily gains (ADG) and feed conversion ratio (FCR) was recorded during the experimental period, and the experiment lasted for 63 days. Higher ($P<0.05$) feed intake and growth rate were obtained in lambs fed on diets containing 0, 7 and 14 % SFOC compared to those fed on 21 % SFOC. It was concluded that SFOC should not be included at > 14 % in diets for growing lambs. Further work is needed to determine the effects of the diets on nutrient utilization and carcass quality of lambs.

Keywords: Daily Gain, Intake, Lambs, Oil Cake, Sunflower

Introduction

There is a growing trend in South Africa to improve smallholder ruminant fattening schemes to ensure household food security, alleviate rural poverty and to supply better quality animals for meat consumption (Stroebel, 2004). However, feed shortage and costs are the most important obstacles in achieving these goals (Nkosi et al., 2010). Protein supplements such as oil cakes (e.g. soybean oilcake) and urea, are mainly used in animal diets but are considered to be a limiting factor under smallholder farming conditions in South Africa. This is due to the high cost of these resources and their supply is diminishing. In addition, the use of protein sources of animal origin has been banned for animal diets (ACT 36, 1947) and interest in finding alternative protein sources for feeding livestock has been raised. South Africa is a major importer of soybean oil cake (SBOC), and imports of close to 1 million tons of SBOC will be required by 2019 to supplement the shortfall in local production (BFAP, 2010). Alternatively, there is a consistent production of sunflower, which is ranked as the third largest grain crop produced in South Africa after maize and wheat, and almost 70% of sunflower seed is destined for oil production (ITAC, 2010). The production of oil from sunflower seeds leads to the availability of sunflower oil cake (SFOC) which can be used for animal nutrition. Utilization of SFOC by itself or as a replacer of other cakes has been studied by many researchers worldwide (Economides, 1998, Irshaid et al., 2003, Titi, 2003). However, there is large variation in the nutritional quality of SFOC, which is caused by different processing methods for oil production (Mandarino, 1997). It has been reported that SFOC is deficient in lysine, but rich in methionine (Villamide and San Juan, 1998). As methionine is the first limiting amino acid in microbial protein for lambs (Visagie, 2010), it is expected that an increase in SFOC in the diet should improve lamb performance. The objective of this study was therefore to study the effects of different dietary inclusion levels of SFOC on the growth performance of South African Mutton Merino (SAMM) lambs.

Materials and Methods

Batches of sunflower oil cake (SFOC) were collected from Ilanga Oils, Meyerton, South Africa and brought to the ARC-Irene Institute, South Africa (longitude 28^0 13`S : latitude $25^0$ 55`E, altitude 1524 m) for chemical composition analyses, feed formulation and animal feeding trials. Diets containing 0 (control), 7, 14 and 21% SFOC were formulated (Table 2). The control diet contained 5% soybean oil cake (SBOC) that contained 473.9 g crude protein (CP)/kg dry matter (DM), 58.4 g crude fibre (CF)/kg DM, 57 g ash/kg DM, 53.9 g ether extract (EE)/kg DM and 15.7 MJ metabolizable energy (ME)/kg DM. Feed samples were collected weekly and analysed for DM, organic matter (OM), CP, gross energy (GE), EE, metabolizable energy (ME), neutral detergent fibre (NDF) and acid detergent fibre (ADF). The diets were fed *ad libitum* to 24 South African Mutton Merino (SAMM) lambs (18 – 24 months old with a live weight of 24.1±0.32 kg) that were housed in individual metabolic crates (2.2 m^2) in an insulated well-ventilated barn. The quantities of these diets were offered to lambs so as to meet their nutrient requirements (ARC, 1984). The lambs were randomly allocated to four treatments resulting in 6 lambs per diet and had *ad libitum* access to fresh water. The growth study consisted of 14 day adaptation period followed by 63 days data collection. Lambs were weighed before the start of the study and with weekly intervals thereafter until the end of the trial. Daily feed refusals per animal were collected, weighed, thoroughly mixed and composited before the morning feeding. Feed intake, average daily gain (ADG) and feed conversion rate (FCR) were determined.

The DM of diets was determined by drying the samples at 90^0C until a constant mass was achieved, following the procedure of AOAC (ID 934.01, 1990). After drying, the samples were ground through a 1-mm screen (Wiley mill, Standard Model 3, Arthur H. Thomas Co., Philadelphia, PA) for chemical analyses. The ADF and NDF were determined according to Van Soest *et al* (1991). Crude protein (ID 968.06), OM (ID 942.05) and EE (ID 963.15) were determined according to the procedure of AOAC (1990). The GE of diets was determined with a bomb MC-1000 modular calorimeter, and the ME was determined by using the gas production technique of Pienaar (1994).

Statistical analysis

Data of the means for the chemical composition and growth performance in lambs were analysed in a completely randomized design for ANOVA using Genstat (2000). The differences among treatment means were compared with least significant difference (LSD) and significance was declared at 5 % probability level. The data was fitted with the Snedecor and Cochran (1980) statistical model: $Y_{ij} = \mu + t_i + ß_j + \varepsilon_{ij}$ where Y_{ij} is the individual observations of the i-th treatment and the j-th block, μ is the general effect, t_i is the effect of the i-th treatment, β_j is the effect of the j-th block, ε_{ij} is the random variation or experimental error.

Results and Discussion

The chemical composition of SFOC is shown in Table 1. The CP of SFOC in the present study was 266 g CP/kg DM, lower than those reported by Moran (2005) and Economides (1998). However, the CF and EE of SFOC in the present study were higher than that reported by other researchers (Economides, 1998; Moran, 2005). These differences in the chemical composition of SFOC may be due to different processing methods or different varieties of sunflower since new varieties have higher CP and oil content and lower hull percentage (25-30%) compared with the traditional varieties with 35-40% hulls (Van Waalwijk and Van Doorn, 1982). Increasing the level of SFOC in the diet resulted in increased fibre content of the diet (Table 2). This is consistent with Irshaid et al. (2003) who reported increased dietary fibre when sunflower meal was increased to 346 g/kg in the diet of growing lambs.

Table 1: Chemical composition of sunflower oil cake

Parameter	g/kg DM
Crude protein	266.3
Crude fibre	308.3
Ash	48
Ether extract	308.4
Metabolizable energy MJ/kg DM	15.7

The increase of SOFC to 21 % reduced (P<0.05) the growth performance of lambs compared to those fed on the other treatments (Table 3). It has been reported that SFOC is slightly unpalatable to ruminants (Stake et al., 1973) and its high fibre content restricts its utilization by young ruminants (Villamide and San Jaun, 1998), which might be the reason for reduced growth performance in lambs fed the 21% SFOC diet. Jordan et al. (2006) reported a depressed animal performance when a diet containing higher dietary fat was fed to beef cattle. The SFOC diet had higher EE content than the other diets (Table 2), which might have a negative effect on the growth performance of lambs fed the diet. Improved (P<0.05) lamb growth performance was obtained with diets containing < 14%. In contrast, Irshaid et al. (2003) did not report significant differences in the growth rates of lambs that were fed on diets containing 0, 50 and 100% replacement of soybean meal with SFOC. In addition, Erickson et al. (1980) could not report differences in the growth performance of lambs that were fed either on soybean cake meal or SBOC.

Kandylis et al. (1999) recorded 223 g/d when lambs were fed diet containing 200g sunflower meal/kg, and Price et al. (2009) recorded 298 to 329 g/d with FCR < 5 in SAMM lambs that were fed on diets containing ionophores. In addition, a 56 d growth study recorded 203 g/d in SAMM lambs fed on a diet containing 140 g CP/kg DM and 9.9 ME MJ/kg DM (Sheridan et al., 2003). These values were better than those recorded in the present study. Nevertheless, all the lambs of the present study had more than 150 g/d (Table 3), an indication that they had good acceptable

Table 2: Formulation (g/kg as is basis) and chemical composition of experimental diets (g/kg DM, unless stated otherwise)

Ingredient, g/kg	0	7	14	21
Maize	560	325	320.4	250
Wheat bran	106	100	100	100
Dried potato hash	0	200	161.4	183
Molasses meal	100	100	100	100
Soybean oilcake	50	0	0	0
Sunflower oilcake	0	70	140	210
Ammonium sulphate	6	5	0	0
Limestone	11	11	12	11
Salt	5	5	5	5
E. curvula (hay)	60	80	70	50
Lucerne	100	100	90	90
*Premix finisher	2	4	1.2	1
Chemical composition (g/kg DM unless stated otherwise)				
DM	878	889	874	886
OM	933	940	945	940
CP	141	135	134	146
EE	35.9	37.8	38.9	47.6
GE MJ/kg DM	16.5	15.5	15.2	15.1
ADF	116.3	201.3	207.8	213.1
NDF	289.7	348.3	349.9	353.5

*DM basis: selenium 10 mg/kg, potassium 215 mg/kg, iron 50 mg/kg, cobalt 20 mg/kg, zinc 50 mg/kg, manganese 1600 mg/kg, copper 300 mg/kg, iodine 70 mg/kg, calcium 220 mg/kg, phosphorus 280 mg/kg, sulphur 30 g/kg, salt 950 g/kg. DM, dry matter; OM, organic matter; CP, crude protein; EE, ether extract; GE, gross energy; ADF, acid detergent fibre; NDF, neutral detergent fibre.

Table 3: Growth performance and dietary intake (g/kg DM, unless stated otherwise) in lambs fed experimental diets (n=6)

	Treatments					
	0	7	14	21	SEM	P-value
IBW kg	22.93	24.53	24.43	24.68	0.453	0.055
FBW kg	36.85^{b}	38.90^{a}	39.43^{a}	35.23^{b}	0.514	0.016
ADG g/d	176^{b}	185^{a}	190^{a}	157^{b}	14.2	0.029
FCR kg/kg	6.9	6.6	6.8	6.1	0.778	0.089
DMI	1226^{a}	1225^{a}	1285^{a}	960^{b}	81.8	0.035
OMI	1103.4^{a}	1102.5^{a}	1156.5^{a}	895^{b}	77.0	0.033
CPI	148^{a}	136.5^{b}	138.8^{a}	120.7^{c}	10.36	0.045
GEI MJ/kg DM	16.92^{b}	15.63^{b}	18^{a}	16.02^{b}	1.242	0.041
NDFI	278^{c}	356^{b}	414^{a}	369^{b}	28.5	0.051

$^{a-c}$ Means in the same row with different superscripts differ significantly (P<0.05); IBW, initial body weight; FBW, final body weight; ADG, average daily gain; FCR, feed conversion rate; DMI, dry matter intake; OMI, organic matter intake; CPI, crude protein intake; GEI, gross energy intake; NDFI, neutral detergent fibre intake

growth rates (Marley et al., 2007). However, the feed conversion rates (FCR) obtained in the study was higher than 6 and did not differ (P>0.05) between treatments.

Conclusions

The results of the present study showed that increasing SFOC to 21% in the diet of growing lambs negatively affect dietary intake and growth performance. Further work is needed to determine the effects of the diets on nutrient utilization and carcass quality of lambs

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