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Feeding saponified sunflower oilcake meal to sheep

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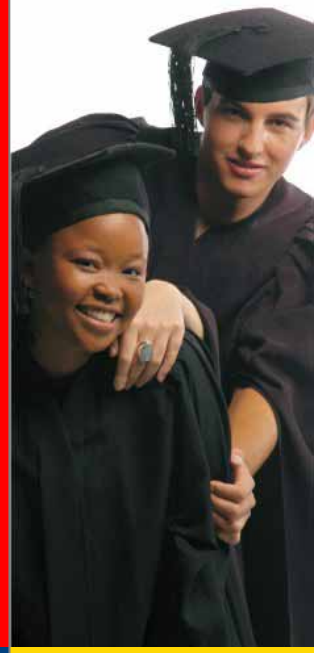

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INTRODUCTION

- Global search for alternative energy sources lead to biodiesel production.
- Sunflower seed contains about 50% oil and is well adapted to subtropical environment with short growth season.
- Suitable crop for small scale farmers.
- Biodiesel still more expensive than mineral diesel.
- Add value to oilcake.
- Small scale oil presses envisaged without extraction.
- High levels of residual oil : 12-16%
- Saponification to add value ensuring higher levels of polyunsaturated fatty acids at abomasum in the case of Ca soaps.
- *In situ* saponification investigated:
  - Protein protection
  - Modification of fatty acid profile in sheep.

MATERIALS AND METHODS

- Mechanically extracted sunflower oilcake with 14% residual oil.
- Saponified by using NaOH followed by $CaCl_2$
- Three groups (n=10) of SA Mutton Merino weaner lambs (ca. 24 kg)
- Kept in single pens with slatted floors.
- Fed *ad libitum* on one of three diets containing either low fat hexane extracted oilcake (control), high fat mechanically extracted oilcake (HFSFOC) or saponified (SSFOC) as protein source (Table 1) for 63 days.
- Animals were weighed weekly
- Orts were collected daily
- All the animals were slaughtered after 9 weeks


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MATERIALS AND METHODS

- Back fat samples were taken at the last rib
- Samples were kept at -20 ºC until analysis
- A gas chromatographic method was used for the determination of long chain fatty acids after trans-methylation with methanol-potassium hydroxide.
- Fatty acid methyl esters were extracted with n-hexane and analysed by capillary gas liquid chromatography with flame ionisation detection. Nonadecanoic acid (C19:0) was used as internal standard.
- Results were subjected to the GLM procedure of SAS using Duncan's multiple range test

Table 1 Experimental diets

	Extracted SFOC	Expeller SFOC	Saponified SFOC
Yellow maize	50	40	40
Wheaten bran	9.77	12.4	12.4
Molasses meal	10	10	10
Sunflower oilcake, extracted	15	0	0
Sunflower oilcake, expeller	0	15	0
Sunflower oilcake, saponified	0	0	15
Ammonium sulphate	0.4	0.4	0.4
Limestone	1.3	1.5	1.5
Salt	0.5	0.5	0.5
E. curvula hay	12.83	20	20
Premix, finisher	0.2	0.2	0.2

Table 1 Experimental diets (cont.)

	Extracted SFOC	Expeller SFOC	Saponified SFOC
Protein, %	12.3	10.7	10.3
Fat, %	2.9	4.3	3.1
DM, %	90.4	91.0	91.0
NDF, %	30.0	33.9	36.2
ADF, %	14.2	17.3	17.7
Calcium, %	0.39	0.47	0.38
Phosphorus, %	0.32	0.3	0.27
ME (calculated) (MJ/kg)	10.15	10.18	10.18

Table 1 Experimental diets (cont.)

	Extracted SFOC	Expeller SFOC	Saponified SFOC
Saturated fatty acids	19.50	24.29	21.96
Mono unsaturated	36.40	40.07	37.45
Poly unsaturated	44.10	35.64	40.59
Trans fatty acids	0.00	4.37	4.80
Cis fatty acids	77.71	69.16	70.63
Omega 3 fatty acids	2.28	1.60	2.12
Omega 6 fatty acids	0.00	0.08	0.00

- Three cannulated Bonsmara oxen were used to incubate HFSFOC and SSFOC to determine rumen protein degradability according to Ørskov (1982).
  - Samples milled through a 2mm sieve, approximately 5g (air dry) sample sealed in nylon bag.
  - One bag incubated in the rumen of each of the three steers per period using the complete exchange method.
  - This procedure was repeated with incubation periods of 0, 4, 7, 10, 24, 34, 48, and 72h.
  - Bags were rinsed under running tap water (15 seconds) and washed in a washing machine (cold water) for 10 minutes.
  - The washed bags were dried in a forced draught oven at 65° C for 48h and contents analysed for N
  - The percentage N disappearance at each incubation period was calculated from the proportion remaining after rumen incubation.

RESULTS

Table 2 Experimental oilcakes

Analysis	Extracted SFOC	Expeller SFOC	Saponified SFOC
DM	92.6	93.1	92.1
Protein	31.3	21.9	23.5
Fat (ether extract)	2.4	14.1	6.2
NDF	38.0	47.3	49.2
ADF	29.6	39.1	32.4
Calcium	0.28	0.24	0.95
Phosphorus	1.0	0.63	0.65

RESULTS

Table 3: Growth performance and slaughter data (mean ±s.e.)

	Extracted SFOC	Expeller SFOC	Saponified SFOC
ADG (g/day)	211±12 [a]	164±15 [b]	209±15 [a]
FCR (kg/kg)	5.21±0.11 [a]	4.76±0.12 [b]	5.54±0.18 [a]
Feed intake (g/day)	1229±27 [a]	1123±29 [b]	1307±43 [a]
Initial weight (kg)	23.4±1.1 [a]	24.0±1.0 [a]	24.1±0.9 [a]
Final weight (kg)	36.7±0.9 [a]	34.3±0.8 [b]	37.3±0.9 [a]
Dressing %	45.6±0.67 [a]	43.4±1.13 [a]	44.8±0.48 [a]
% drip loss	2.34±0.08 [a]	2.69±0.24 [a]	3.03±0.54 [a]

RESULTS

Rumen protein degradability

- Expeller SFOC : 91.3% effective degradability
- Saponified SFOC : 67.5% effective degradability

	Extracted SFOC	Expeller SFOC	Saponified SFOC
ADG (g/day)	211	164	209
Feed intake (g/day)	1229	1123	1307
Protein, %	12.3	10.7	10.3
Average protein intake (g/d)	151	120	135
Protein efficiency (g gain/g protein intake)	1.40	1.36	1.55

RESULTS:

Table 4: Fatty acid composition of backfat.

	Extracted SFOC	Expeller SFOC	Saponified SFOC
Saturated fatty acids	54.86±0.72 [a]	54.36±0.91 [a]	58.89±1.15 [b]
Mono-unsaturated fatty acids	40.57±0.64 [a]	40.90±0.74 [a]	37.75±1.22 [b]
Poly-unsaturated fatty acids	4.51±0.65 [ab]	4.74±0.32 [a]	3.36±0.25 [b]
Trans fatty acids	2.74±0.17 [a]	3.01±0.24 [a]	2.64±0.36 [a]
Cis fatty acids	37.30±0. 56 [a]	37.60±0.70 [a]	35.71±1.06 [a]

RESULTS:

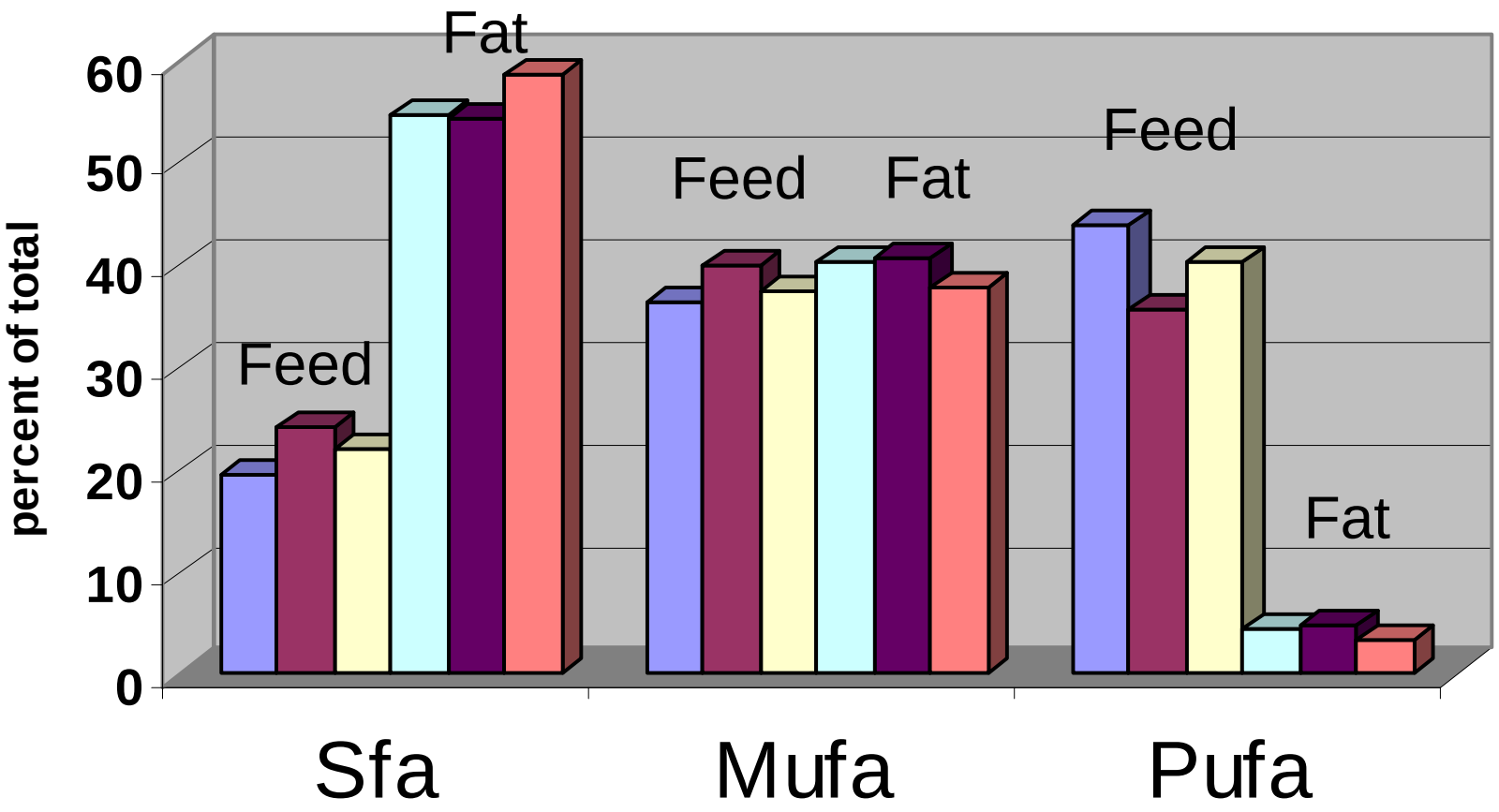
Table 4: Fatty acid composition of backfat (cont.)

	Extracted SFOC	Expeller SFOC	Saponified SFOC
C18:2/C18:3	9.94±1.15 [a]	11.81±1.62 [a]	16.86±1.95 [b]
Mufa/Sfa	0.74±0.02 [a]	0.76±0.03 [a]	0.65±0.03 [b]
Ufa/total fa	0.45±0.01 [a]	0.46±0.01 [a]	0.41±0. 01 [b]
Ufa/Sfa	0.83±0.02 [a]	0.84±0.03 [a]	0.70±0.03 [b]

Mufa = monounsaturated fatty acids

Ufa = unsaturated fatty acids

Sfa = saturated fatty acids


percent of total
60
50
40
30
20
10
0
Fat
Feed
Feed
Fat
Feed
Fat
Sfa
Mufa
Pufa

RESULTS:

Table 4: Fatty acid composition of backfat (cont.)

	Extracted SFOC	Expeller SFOC	Saponified SFOC
C:18	28.41±0.90 [a]	31.06±1.28 [ab]	34.75±1.78 [b]
C:16	26.28±0.66 [a]	24.25±0.57 [b]	24.67±0.59 [b]
C:14	2.81±0.10 [a]	2.66±0.09 [a]	2.72±0.13 [a]
n-6:n-3	4.18±1.05 [b]	2.93±0.60 [a]	4.94±0.68 [b]

CONCLUSIONS:

- Saponification protected protein from rumen degradation
- Higher voluntary intakes by saponification – similar to low fat
- Despite lower protein content, similar growth to extracted SFOC
- Probably due to bypass protein effect and intake
- Sheep on saponified SFOC diet had more saturated fatty acids
- Less mono unsaturated fatty acids
- Less poly unsaturated fatty acids
- Thus lower ratios of unsaturated : total and saturated fatty acids
- Substantially higher C18:2/C18:3 ratio
- Significantly higher n-6:n-3 ratio
- Biohydrogenation must have taken place in the rumen
- Value of the process rather in the bypass protein than the modification of fatty acid composition

ACNOWLEDGEMENTS:

Thanks for the technical support of Mr KJ Leeuw and Mr LS Maesela of the ARC Irene.

The funding (GUN2069289) of the National Research Foundation is gratefully acknowledged.