# Evaluation of maize gluten feed in complete diets for growing sheep

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## SUMMARY

In two concurrently run experiments involving 40 growing sheep weigh- ing 29 - 30 kg and fed to 40 kg weight, maize Gluten Feed (GF) was evaluat- ed compared with Cotton Seed Meal (CSM). Dry matter intake, growth rate, feed conversion ratio, feed digestion and rumen ammonia-N were measured. Eight complete diets were fomiulated to comprise various ratios of GF : CSM with or without sorghum grain. DM intake was significantly ($p < 0.05$) in- creased by increasing CSM proportion in the rations in experiment 1, while increasing GF proportion significantly ($p < 0.05$) reduced DMI, in experi- ment 2. Best performance was obtained when GF : CSM ratio was 1 : 2, and a proportion of grain (15%) was included in the diet. Rumen ammonia-N concentration for the diets fed in experiment 2, was always above 50 mg N/L at all times during 4 h - postfeeding period. In general, growth rate and feed conversion ratio values obtained were comparable to available data for grow- ing Sudan desert sheep.

## INTRODUCTION

Under intensive livestock production system in many of the developing countries large proportion of agro-industrial by-products are used in feeding milking cows and fattening stocks. Yet in Sudan research in use of agro- indusnial by-products in ruminant nutrition is very limited. The present work was initiated to evaluate maize gluten feed (GF) a by-product of starch glu- cose industry as nitrogen source compared with ootton seed meal (CSM).

## MATERIALS AND METHODS

Two separate experiments were simultaneously conducted in order to study the growth performance of lambs fed complete diets varying in the pro~ portions of the GF relative to CSM; as the main protein source in the ration. The digestibility of each ration was determined, while the effect of these rations on rumen ammonia nitrogen concentration was monitored, in the second experiment only.

Experimental diets:

The experiment involved eight experimental diets. Ingredients and nutritive value of each diet are shown in table 1. The ingredients were mixed and hammer milled, and fed as one complete diet.

*Table 1: Ingredients of the experimental diets; and the nutritive value of the diets.*

| | Diet | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Experiment 1 | | | experiment 2 | | | | |
| | D1 | D2 | D3 | D4 | R1 | R2 | R3 | R4 |
| Component: (kg) | | | | | | | | |
| Mazie gluten feed | 600 | - | 300 | - | - | 150 | 300 | 450 |
| Cotton seed meal | - | 600 | - | 300 | 450 | 300 | 150 | - |
| Sorghum grain | - | - | 300 | 300 | 150 | 150 | 150 | 150 |
| Sorghum stover | 390 | 390 | 390 | 390 | 390 | 390 | 390 | 390 |
| Salt, common | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 |
| | 1000 | 1000 | 1000 | 1000 | 1000 | 1000 | 1000 | 1000 |
| Chemical composition, and nutritive value (g/ kg): | | | | | | | | |
| Organic matter | 962.0 | 936.2 | 951.8 | 938.8 | 944.0 | 950.4 | 937.5 | 956.9 |
| Crude protein (N X 6.25) | 183.7 | 185.5 | 154.2 | 155.3 | 170.0 | 169.5 | 170.5 | 169.0 |
| Crude fibre | 178.0 | 251.8 | 164.9 | 202.2 | 208.7 | 190.1 | 227.1 | 171.5 |
| Metabolisable energy of diet (MJ/ kg DM)* | 9.43 | 7.73 | 8.18 | 8.73 | 8.12 | 8.62 | 8.18 | 8.80 |

Experimental animals and their management:

5 - 8 month old Ashgar (Sudan Desert type) lambs (40 animals) were pur- chased from village markets in Managil Area, south of Gezira Province. When delivered at Kuku the lambs were tagged, sprayed for external parasites, dewormed and given a prophylactic injection (El

Khidir et. al., 1988). A pre-experimental period of about 3 weeks was allowed to the lambs in order to stablise and adapt to the new environment during which they were fed sorghum straw. Adequate water supply and overhead shade were provided.

During the experimental period, 14 and ll weeks in experiment 1 and 2 respectively, the lambs were randomly allocated to the experimental diets in completely randomised design. They were individually fed, gradually introduced to the diet until maximum intake was reached. Then the daily allowance was adjusted to a constant refusal weight, (10% weigh back).

The rations in experiment 1, were fed in 2 meals at 08.00 h and 16.00 h, on the other hand those of experiment 2, were given each in one single moming meal at 08.00 h.

In the meantime drinking water, mineralised salt licks were freely provided to the animals all through the experiments. About l kg of fresh Barseem (Medicago sativa) was given to each lamb once weekly in order to avoid any likely development of vitamin A deficiency.

The lambs bodyweight was recorded weekly in the morning before any meal was given.

Digestibility trials:

In both experiments, the experimental rations were fed each to 3 - 4 cas- trate rams, for 7 days preliminary period followed by a digestibility trial of 7 days collection period.

Rumen ammonia study:

Rumen liquor samples were collected through the rumen cannula of a permanently fistulated sheep fed each of the diets of experiment 2. The samples were collected just before the moming meal, then after 2, 3 and 4 h postfeedmg.

Laboratory techniques: ,

Samples of feeds and faeces were analysed for proximate constituents us- ing standard chemical procedures (A.O.A.C., 1980).

Rumen ammonia-N was determined by steam distillation over boric acid and estimated by direct ti- tration with standard hydrochloric acid.

Stattlstical analysis.

Data were subjected to analysis of variance, and difference among treat- ments were examined by Duncan's new multiple range test (Steel and Torrie, 1960).

## RESULTS AND DISCUSSION

In experiment 1, both complete rations containing the higher proportion (D1, D2) or lower proportion (D3, D4) of GP or CSM were iso-nitrogenous (CP = 180 or 150 g/ kg DM respectively); as were also all the rations fed in experiment 2 (CP = 170 gl kg DM, table 1) evern though the GF : CSM ratio in the rations varied because of their comparable crude protein content, (table 2).

It can also be noticed in table 1 that increasing the proportion of CSM in the diets also increased the fibre content whereas it's reduction could be ef- fected by the increase in GF : CSM ratio due to higher fibre content in CSM relative to GP. Nevertheless all experimental diets were nearly of similar ener- gy concentration.

*Table 2: The chemical composition of mazie gluten feed and cotton seed meal (g/ kg).*

| Feed | component g/ kg DM | | | | | |
|---|---|---|---|---|---|---|
| Feed: | Dry matter | Ash | Protein (N X 6.25) | E. E. | Crude fibre | Nitrogen free ex- tract |
| Maize gluten feed | 981.8 | 16.3 | 246.9 | 54.7 | 88.0 | 594.1 |
| Cotton seed meal | 958.3 | 59.3 | 248.5 | 93.5 | 212.1 | 386.6 |

Voluntary dry matter intake (DMI) of the sheep fed the rations comprising CSM (D2 and D4) in experiment 1, was significantly higher ($p < 0.05$) than the intake of those fed the rations comprising GF (D1 and D3) irrespective of the proportion of_ the protein ingredient

whether 0.6 or 0.3 in the ration (table 3). Subsequently the increasing incroporation rate of GF in the complete ra- tions of experiment 2 significantly (D < 0.05) reduced DMI. However, this reciprocal interaction of GF : CSM inclusion ratio in the diet is also clearly apparent in the trend of feed digestion and growth performance of the lambs in both experiments, as can be seen in table 4. It is also obvious that a low proportion of sorghum grain in the diet, was necessary in order to improve the efficiency of the diet utilization, (Blaxter and Wainman, 1964; El Khidir et. al., 1988).

*Table 3: Intake of dry matter and metabolizable energy and performance of the experimental animals.*

| | Diet | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Experiment 1 | | | | | experiment 2 | | | | |
| | D1 | D2 | D3 | D4 | SE | R1 | R2 | R3 | R4 | SE |
| DM intake (kg/ d) | 1.10$^{Y}$ | 1.40$^{X}$ | 1.17$^{Y}$ | 1.43$^{X}$ | 0.074* | 1.38$^{a}$ | 1.35$^{ab}$ | 1.19$^{c}$ | 1.22$^{bc}$ | 0.041* |
| ME intake (MJ/ d) | 10.33 | 10.85 | 9.60 | 12.48 | - | 11.12 | 11.65 | 10.94 | 10.71 | - |
| Initial body weight (kg) | 28.25 | 28.83 | 28.70 | 31.25 | 1.583 | 33.10 | 29.90 | 30.25 | 29.40 | 1.200 |
| Final body weight (kg) | 37.42 | 43.83 | 38.00 | 42.83 | - | 45.60 | 44.00 | 41.10 | 41.40 | 1.451 |
| Total gain (kg) | 9.17 | 15.00 | 9.30 | 11.38 | - | 12.50 | 14.10 | 10.85 | 12.00 | 0.014 |
| Days in feed (day) | 78 | 84 | 84 | 84 | - | 70 | 70 | 70 | 70 | - |
| Average daily gain (kg/ d) | 0.123 | 0.179 | 0.113 | 0.138 | 0.017 | 0.179 | 0.201 | 0.155 | 0.171 | 0.014 |
| Feed conversion ratio (Kg DMI/ kg gain) | 10.55 | 8.97 | 11.19 | 11.16 | - | 7.70 | 6.72 | 7.69 | 7.11 | - |

*In this and the following tables means within the same line and followed by the same superscript are not significantly different.*
** = $p < 0.05$.*

The growth rate (ADG) and feed conversion ratio (FCR) obtained in this study (table 3) are reasonably comparable to the range of values for sheep growing to 40 kg slaughter weight and fed roughage-based or molasses- based diets, supplementaed with CSM or balanites kemel meal and urea (El Khidir et. al., 1983 and 1984) or complete rations of variable energy to con- centrate ratio (El Tayeb ct. al., 1988); as well as those fed conventional mixed diet in which cotton gin trash constituted 0 - 55% of the ration (Khalafalla and Mohamed, 1988).

*Table 4: Apparent digestibility of the dry matter, organic matter of crude protein of the experimental diets.*

| | Diet | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Experiment 1 | | | | | Experiment 2 | | | | |
| | D1 | D2 | D3 | D4 | SE | R1 | R2 | R3 | R4 | SE |
| Apparent digestibility (g/ kg) | | | | | | | | | | |
| Dry matter | 0.656 | 0.534 | 0.623 | 0.616 | - | 0.603 $^{a}$ | 0.647 $^{ab}$ | 0.676 $^{b}$ | 0.671 $^{b}$ | 0.013 $^{*}$ |
| Organic matter | 0.644 | 0.518 | 0.605 | 0.589 | 0.031 | 0.541 $^{a}$ | 0.575 $^{ab}$ | 0.613 $^{b}$ | 0.587 $^{b}$ | 0.012 $^{*}$ |
| Crude protein | 0.653 | 0.619 | 0.592 | 0.664 | - | 0.788 | 0.770 | 0.770 | 0.792 | |

The rumen ammonia-N concentration in the sheep fed the diets of experiment 2 (table 5), was always and at all times during 4 hours post feeding period above 50 mg NI L the minimal concentration suggested by Setter and Slyer (1974) to be optimal for maximal microbial fermentation in the rumen. It can also be seen in table 5, that the diets incorporating the higher proportion of CSM (R1 and R2) had the higher ammonia-N concentration than those in- corporated the higher proportion of GF (R3 and R4). Although rumen ammonia-N was not measured in experiment 1, it can reasonably be assumed that ammonia-N concentration produced in the rumen by these diets (D1 and D4) may not be below 50 mg N/ L (equivalent to 13% CP concentration in the diet, Satter and Slyter, 1974); because the CSM incorporation rate 0.6 and 0.3, and crude protein' concentration 15 - 18% particularly in these diets (D1 and D4) is more than adequate for production of sufficient rumen ammonia-N concentration required for efficeint feed digestion in the rumen.

It can be concluded that GF may favourably be used to substitute up to one third of CSM in complete rations for growing sheep.

*Table 5: Mean rumen ammonia-N concentration (mg/ L) in the rumen liquor of sheep collected at 0, 2, 3 and 4 hours in relation to time in experiment 2.*

| | Diets | | | | |
|---|---|---|---|---|---|
| | R1 | R2 | R3 | R4 | SE |
| Hour | Ammonia - N concentration | | | | |
| 0 | 198.05 | 220.80 | 161.10 | 209.74 | - |
| 2 | 342.20 | 244.12 | 166.87 | 217.74 | - |
| 3 | 321.87 | 255.96 | 153.87 | 134.70 | - |
| 4 | 292.69 | 254.65 | 122.87 | 138.29 | - |
| Mean | 288.72 [a] | 253.88 [b] | 151.18 [c] | 180.10 [c] | 10.223 ** |

** = $P < 0.01$


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