

PERFORMANCE OF SHEEP IN FEEDLOT FED WITH PALM KERNEL CAKE AND OTHER ENERGY SOURCES

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SUMMARY A trial was conducted using 40 Commercial Merino x Border Leicester male intact sheep fed in feedlot, with 30% Palm kernel cake (PKC) in all rations, plus either ground maize, maize with cassava, maize with palm sago or sago alone in four treatment groups. The trial was to determine the effects of maize, cassava and sago on the growth performance of sheep, fed on the isonitrogenous and isocaloric diets. It was also to determine the effects of the sodium molybdate as a chelating agent to bind excess copper, when used with the high copper PKC feed in a feedlot. Sheep on maize-based ration had the highest average daily gain (ADG), feed conversion ratio (FCR) and cost per kg gain. The ADG were 192, 178, 159 and 138 g, respectively. The highest and lowest FCR values were in sheep fed maize based diet and sago based diet, respectively. Despite the high cost of maize and the low cost of palm sago the cost per kg gain was the lowest for the maize diet, followed by sago and cassava. The serum copper content of the animals were within the normal physiological levels thus indicating that the sodium molybdate had bound the copper in the feeds rendering it unavailable and prevented copper toxicosis, despite the high levels of copper in the feeds offered.

Keywords: sheep, feedlot, palm kernel cake, maize cassava, palm sago

INTRODUCTION

Palm kernel cake (PKC) is probably the cheapest single feed ingredient of ruminants in Malaysia. Its use as cattle feed is widely documented (Mustaffa *et al.*, 1986; Sukri and Dahlan, 1986 and Yusoff *et al.*, 1987, 1989). However, a high proportion of PKC in the diet of sheep is known to cause copper toxicosis. Recently, several preventive measures had been reported to be effective against copper toxicosis in sheep as a result of feeding PKC (Rahman *et al.*, 1989 and Hair-Bejo and Alimon, 1992). With these preventive options, sheep could be fed with PKC, even in feedlots, to produce prime lambs at lower cost. The incorporation of another energy source and minerals would render PKC a balanced diet since the energy and mineral levels of PKC are low.

The objectives of this trial are to determine the effects of PKC in a sheep feedlot diet and the merit of other energy feed ingredients used with it to enhance the energy levels of the rations for optimum growth and profitability.

MATERIALS AND METHODS

Forty male sheep of the Commercial Merino x Border Leicester (CMBL) breed, of four to five months of age were selected and randomly allotted to four treatment groups of 10 animals each. Each group of animals was placed in a slatted flooring pen measuring 4 m x 5 m and each was randomly assigned to one or the other of the four feed rations as in Table 1. The rations were computed to produce feeds containing 12.0% crude protein and 11.1 MJ/kg Metabolisable Energy (ME). Sodium molybdate was used to act as a chelating agent to tie up excessive copper mainly from PKC in the feeds, to render it unavailable, to prevent sheep copper toxicosis.

Table 1. The composition of the rations for the feedlot sheep (percent as-fed basis)

Ingredients	Ration Number			
	1	2	3	4
Palm kernel cake, solvent	30	30	30	30
Ground maize	66.5	36.5	36.5	-
Cassava chips	-	30	-	-
Dried palm sago	-	-	30	60
Soya bean meal	-	-	-	6.0
Urea	1.0	1.0	1.0	1.5
Minerals (Salt, Tricalcium phosphate & limestone)	2.5	2.5	2.5	2.5
Sodium molybdate	(12.5g/tonne feed, thoroughly mixed with the minerals)			

The respective rations were fed to the animal for two weeks during the adjustment period. The animals were then individually weighed before the actual experiment. The feeds offered and refused were recorded daily to determine the feed intake. Samples of the feeds, offered and refused were analysed fortnightly, using the AOAC (1975) methods. ME was determined by the Gas Test technique as described by Menke *et al.* (1979). Blood samples were taken from the animals every month and their serum copper levels were determined using the Boehringer Commercial Reagent kits. The animals were reweighed every 30 days for the three months feeding duration.

Analysis of Variance Procedure was used to evaluate results and Duncan's Multiple Range Test was used to compare treatment means as outlined by Steel and Torrie (1960).

RESULTS AND DISCUSSION

The chemical composition of the rations used is given in Table 2. The protein contents were close to 12.0% and the ME values were approximately 11.0 MJ/kg for all the rations.

Table 2. The chemical composition of the four rations (percent dry matter basis)

Parameter	Ration Number			
	1	2	3	4
Dry matter	90.1	89.2	88.2	88.3
Protein (N x 6.25)	12.2	11.5	11.6	12.2
Crude fibre	10.2	8.0	9.4	7.0
Ether extract	4.2	2.7	2.4	2.0
Total ash	7.7	6.3	7.1	6.5
N-free extract	65.7	71.2	68.8	72.3
Metabolisable energy (MJ/kg)	11.1	11.0	10.9	10.9
Copper (ppm)	11.0	11.0	12.3	15.7

The overall performances of the animals are shown in Table 3. The average daily gain (ADG) was the highest ($P>0.05$) in sheep on Ration 1 (with maize as the major variable feed ingredient) at 192 g, followed by Ration 2 (a feed with lower proportion of maize plus cassava chips) at 178 g. The third highest ADG was observed in animals on Ration 3, with maize and palm sago as the variable ingredient, instead of cassava, at 159 g, although the differences in ADG between Rations 2 and 3 were not significant. The lowest ($P>0.05$) ADG was recorded in animals on Ration 4, with high sago and no maize, at 138 g.

Jaafar and Khusahry (1983) noted that supplementary feeding of sheep proved beneficial and economical. Feeding Dorset Horn a concentrate or supplements at 1% of their body weights gave ADG of between 46.82 to 75.14 g compared to only 23.95 g for unsupplemented sheep grazing under rubber plantations. Dwi Yulistiani *et al.* (1990) reported ADG of between 146-163 g with *ad libitum* feeding of Javanese Long Tail Sheep with concentrates and roughage and Davis and Rajion (1990) obtained an ADG of 149 g for Australian imported sheep fed *ad libitum* concentrates and grass. In the present trials, similar results were obtained.

Table 3. The performance of feedlot sheep fed palm kernel cake and other energy sources

Parameters	Ration Number			
	1	2	3	4
Avg. Initial wt. (kg)	20.1	22.1	21.0	21.2
Avg. Final wt. (kg)	37.4	38.3	35.3	33.6
Avg. daily gain (g)	192 ^a (±6.3)	178 ^{ab} (±4.4)	159 ^b (±8.8)	138 ^c (±5.8)
Avg. daily DM intake (kg)	0.88 ^a (±0.42)	0.88 ^a (±0.47)	0.86 ^a (±0.49)	0.93 ^a (±0.46)
*Cost of feed day ⁻¹	\$0.48 ^a (±0.20)	\$0.52 ^a (±0.23)	\$0.41 ^{ab} (±0.19)	\$0.38 ^b (±0.14)
Feed conversion ratio	4.59	4.97	5.43	6.75
Cost of feed kg ⁻¹ gain	\$2.47	\$2.92	\$2.58	\$2.76

a,b,c, means with same superscript in the same row show non-significant difference as tested by Duncan's Multiple Range test at $p=0.05$.

Standard deviations are shown in parenthesis

* Cost of feed rations per kg.: Ration 1 = \$0.45; Ration 2 = \$0.47; Ration 3 = \$0.46; and Ration 4 = \$0.33.

Despite the similarity in protein and energy contents in all the feed rations, the type of ingredients in the ration appear to influence growth performance. Ground maize outperformed other ingredients like cassava and palm sago in the present trial. Comparing ground maize, flaked and rolled barley and soya bean meal (among other things), Armstrong and Beever (1969) noted that ground maize retained the most by-pass energy through the rumen to be absorbed in the small intestine. The quantity of glucose that escapes rumen degradation and is available to the animals is highest by ground maize compared to the other feedstuffs. In the present trial, the same trend was shown to take effect by ground maize compared to the other feedstuffs.

The average daily dry matter (DM) intakes were similar for all rations. The cost of feed eaten per day was the lowest by animals on Ration 4, because palm sago was the cheapest ingredient. Rations 1 and 2, that is the maize and cassava based diets were more expensive. Due to the low ADG by the animals on Ration 4, its feed conversion ratio (FCR) was the highest while animals fed Ration 1, with maize, had the lowest FCR. Although the cost of feed for Ration 4 was the lowest, the cost of feed per kg weight gain could not make up for its low ADG to equal the other feed rations and thus, it was the most expensive. Animals on Ration 1, with maize (though the most expensive feed ration) had the lowest cost per kg gain. Thus, maize appears to be the best energy feed ingredient to be incorporated for energy enhancement in a feed ration, compared to feeds like cassava or sago.

Serum Copper Levels

Table 4 shows serum copper levels in sheep fed the various diets with a constant proportion of PKC in all the rations. All feeds had high levels of copper, as is seen in Table 2, as a result of the PKC. However, the animals could still maintain normal physiological levels of copper in their serum, even after taking the feed ingredient for three months. The inclusion of sodium molybdate in all the feeds, perhaps, had helped to reduce copper availability in the blood, as the molybdenum had bound most of the copper, rendering it unavailable for metabolism. Excess unwanted copper from PKC is detoxified in feeds for sheep as reported earlier by Rahman *et al.*, (1980), using sodium molybdate; Hair-Bejo and Alimon (1992), using zinc and molybdate and chelating of molybdate by Underwood (1980)

Palm kernel cake, used at 30% level in feedlot rations of sheep when incorporated with sodium molybdate is safe since no sign of copper toxicity was observed during the three months period.

Table 4. Average copper levels in blood serum of sheep fattened with PKC based feeds ($\mu\text{g}/\text{dl}$)

Months After Feeding	Ration Number			
	1	2	3	4
Initial	79	75.7	77.5	75.2
1 month	78.9	73.6	77.5	76.1
2 months	82.1	72.5	72.9	76.4
3 months	96.0	97.6	96.3	94.0
Range of Normal levels	88 - 197			

ACKNOWLEDGEMENTS

The authors wish to thank the Director General of the Veterinary Services Department, for his permission to publish this paper; the staff of the Nutrition Unit, Institut Haiwan for all the assistance rendered during the trial and Puan Habipah for typing the manuscript.

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RINGKASAN

PRESTASI BEBIRI DI DALAM FIDLOT DIBERI MAKAN KEK ISIRONG SAWIT DAN SUMBER TENAGA LAIN

Suatu percubaan telah dijalankan mengguna 40 ekor bebiri jantan kacukan *Commercial Merino x Border Leicester* sempurna dalam fidlot dengan diberi 30% kek isirong sawit (PKC) dalam semua ransum, dan dicampur dengan sama ada jagung kisar, jagung bersama ubi kayu, jagung bersama sagu rumbia, atau sagu sahaja mengikut empat kumpulan perlakuan. Percubaan ini bertujuan menentukan kesan jagung, ubi kayu dan sagu terhadap prestasi pertumbuhan bebiri yang diberi diet isonitrogen dan isokalori. Percubaan ini juga bertujuan menentukan kesan natrium molibdat sebagai agen pengkelat yang mengikat kuprum berlebihan, apabila diberi bersama makanan PKC tinggi kuprum, dalam suatu fidlot. Bebiri yang diberi ransum berasaskan jagung telah memberi purata tambahan berat badan harian (ADG), nisbah penukaran makanan ternakan (FCR), dan kos per kg tambahan paling tinggi. ADG mengikut mengikut kumpulan perlakuan tersebut masing-masing adalah 192, 178, 159 dan 138 g. Nilai FCR paling tinggi dan paling rendah masing-masing pada bebiri diberi diet berasaskan jagung dan diet berasaskan sagu. Walaupun kos jagung itu tinggi dan kos sagu rumbia rendah, kos per kg tambahan paling rendah adalah pada diet jagung, diikuti oleh sagu dan ubi kayu. Kandungan kuprum serum haiwan ini berada pada aras fisiologi normal dan ini menunjukkan yang natrium molibdat telah mengikat kuprum dalam makanan ternakan membuatnya tidak bebas dan mencegah berlakunya toksikosis kuprum, walaupun aras kuprum dalam makanan ternakan yang diberi itu tinggi.