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Effects of Dietary Levels of Palm Kernel Meal and Cobalt Supplement in Sheep Fed Cassava Peeling Wastes Based Diet

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Abstract: A 56-day feeding trial was carried out to study the influence of palm kernel cake and cobalt mineral supplemenS on the feeding value of cassava peeling waste-based diet in young sheep. Sixteen weanlings. West African Dwarf sheep of average initial live weight of 2.59 + 012kg were divided into four roups. Each group was randomly assigned to one of four treatment diets in a 2 × 2 factorial experiment. The animals were fed at 3% of their body weights. They were fed ad-libitum with clean drinking water and mineralized salt lick throughout the 56 daDietary treatments consisted of two inclusion levels (7.74 and 37.53%) of palm kernel cake; and two inclusion levels (0, and 1.0 ppm) of cobalt supplement. The diets were;

A – Low dietary level of palm kernel cake and low cobalt mineral supplement

B – Low dietary level of palm kernel cake and high cobalt mineral supplement

C – High dietary level of palm kernel cake and low cobalt mineral supplement

D – High dietary level of palm kernel cake and high cobalt mineral supplement

The experiment lasted for 56 days involving sixteen (16) lambs in a factorial design used to evaluate the, average dry matter, nutrient intake, nutrients digestibility, body weight gain, nitrogen retention, urinary and serum thiocyanate levels, serum total protein and urea-nitrogen concentrations. All measurements are taken 56 days after the feeding trial. Body weight gains (g/day) in the sheep were measured as, 7.55, 5.09, 23.72, and 26.09 at the 56th day measurement for dietary treatments A, B, C, and D respectively. The body weight gain values obtained in sheep on dies C and D were higher ($P<0.05$) than for those on diets A and B at the 56th days measurements. However, the crude protein intake and crude Fibre intake values obtained in sheep on diet C and D were higher ($P<0.05$) than for those on diets A and B at the 56th days measurements. Similar trends were obtained for nitrogen retention in sheep. The sheep receiving dietary treatments C and D had higher ($P< 0.5$) serum thiocyanate level at the 56th day measurement when compared to those on dietary treatment A or B. Similar trends were obtained for urea- nitrogen. The effect of the treatments on serum total protein and urinary thiocyanate levels were not significant ($P>0.05$) among the four treatment groups. It was concluded that sheep consuming high levels of palm kernel cake in a cassava peeling waste-based diet, benefited from dietary cobalt supplements in terms of body weight gain and nitrogen retention.

Key words: Sheep, palm kernel cake, cassava peeling waste, and cobalt mineral supplement

I. Introduction

Palm kernel cake is agro- industrial by –product that is obtained from palm oil extraction in cultivated tropical rain countries laying between 12^{o} N and 12^{o}N, such as Indonesia, Malaysia, and Nigeria. Indonesia and Malaysia are the largest producer and exporter of palm oil and palm oil by- products. While Nigeria, Colombia and Thailand have recorded less than 10% of the world's production. When the palm fruit is processed it produces palm oil, palm kernel cake, and meal according to the method of extraction.

Palm kernel cake has been used as a feed for various livestock production. Palm kernel cake is relatively high in minerals content calcium 0.276%, phosphorus 0.645%, Magnesium 0.158%, zinc 0.214%, sodium 0.187%, potassium 0.365%, copper 0.25%, manganese 1.3ppm and iron 0.75ppm

Cassava (*Manihot esculenta crantz*) is an annual tuber crop that is grown in the equatorial regions of the world. Cassava tuber of either sweet or bitter cultivar can be processed into a variety of staple food commonly found among the low income rural dwellers in Africa and Asia continents. The sweet cassava cultivar contains less than fifty milligrams of potential hydrogen cyanide per kilogram of the fresh root while the bitter cultivar contains two hundred and fifty milligrams or more of potential hydrogen cyanide per kilogram of fresh root. Consequently roots of sweet cassava cultivars are more favoured as food for man and his domestic animals over the roots of bitter cultivars which are used mainly for industrial purposes. However, the cyanide contents of sweet and bitter cultivars can be considerably reduced through processing

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The availability of grains and oil-rich seeds for ruminant livestock production will continue to decline with an increase in feed consumption levels by men and monogastric animals. Alternative sources of fermentable energy and protein must be sought, in such high-yielding, low-input crops as cassava and cassava waste products. Cassava peeling and cassava leaves are waste products of cassava farming that are readily available in major parts of the tropics. Cassava peelings which consist of the epidermal layer together with some parts of the dermis can be rich in fermentable energy depending on the thickness of the dermis layer but it is frequently low in crude protein. Cassava leaves with a relatively high crude protein content of 24-30% could therefore complement cassava peelings in providing nutrients-balanced rations for ruminants

Cobalt mineral is required for the biosynthesis of vitamin B_{12} which is essential for optimum production and reproduction in animals. The mineral element is a structural component of vitamin $B_{12,}$ representing about four percent of its chemical structure. Animals cannot store cobalt minerals in appreciable quantity and have to depend on regular supply through dietary intake. Since there is no other physiological role for cobalt in animals than for the synthesis of vitamin B_{12}, any sign of cobalt deficiency is a direct expression of vitamin B_{12} deficiency.

1.1 Statement of the Problem

A major problem of sheep production in developing countries today is that of high cost of feeds and feedstuffs. This is caused by an acute shortage of energy and protein rich feedstuffs of the right nutritive value that can support production in the animals. This problem emanates from the increased competition between man and his livestock for the little energy and protein concentrates available. Research had predicted a continuous decline in the supply and availability of grains in the world market. The problem of inadequate feed supply for ruminant livestock production is aggravated during the dry season when forage grasses become dried, devoid of chlorophyll, highly lignified and contain little nutrients which cannot sustain production.

1.2 Justification and Importance

The major problem of the high cost of feedstuffs can be ameliorated when cassava waste is used and supplemented with cereal grains in providing energy for increased productivity in sheep. Also, palm kernel meal can be used as a substitute for conventional protein feedstuffs in meeting the sheep protein requirement for increased productivity. Both cassava waste and palm kernel meal are cheap to feed ingredients

A justifiable way of utilizing the cassava wastes is to use them in feeding the ruminants livestock. Cassava peeling wastes can be used as a source of readily fermentable energy in ruminants. Reports have shown that cassava leaf and peels have a high but variable protein content of 17 to 40% C.P and 3.45 to 6.50% on a dry matter basis, with almost 85% of the crude protein fraction in the form of true protein (Fasae et al..2022)

1.3 Objectives

The objectives of this study were;

1. To examine the feeding values of palm kernel cake in a cassava waste based diet that was fed to the sheep
2. To examine the influence of dietary cobalt intake in a cassava waste- based diet fed to the sheep

II. Materials and Methods

2.1 Housing and pre-experimental treatments

Metabolism cages shall be constructed with wood to house the experimental animals. Each sheep is to be housed in a 1 x $0.6m^2$ compartment. Feeders and drinkers shall be thoroughly washed and disinfected using the disinfectant. The animals shall be treated against endo-parasites with Albendazole and oxytetracycline L.A before the commencement of the experiment.

2.2 Diet Ingredients.

The palm kernel cake shall be obtained from agro- industries that process palm oil.

Cassava waste consisting of cassava peels with thin layers of cassava pulp shall be collected from the gari processing industry and sun-dried for 4 to 5 days. The sun drying process reduced moisture content and prevented fungal growth during storage. The cassava waste shall be milled in a hammer mill to pass through a 0.2mm sieve. The processed cassava waste shall be put in jute sacks and stored. Rice waste used is a combination of rice husk and rice bran, as obtained from rice milling mills. The rice waste shall be put in sacks and stored properly. Bone meal and table salt were bought from a feed mill, while cobalt chloride salt was bought from a chemical shop

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2.3 Animals and Dietary Treatments

Sixteen (16) weanling lambs of 5-8 months old with an average initial body weight of 9.27 ± 2.94kg shall be divided into four groups, balanced for weights, and assigned randomly to four treatments. Each animal shall represent a replicate. Dietary treatment shall consist of palm kernel cake at two inclusion levels, in a cassava waste based concentrate diet that was fed with or without 1ppm cobalt supplement. The resulting treatment diets are;

A= Low inclusion level of palm kernel cake (7.74%) without cobalt supplement.

B= Low inclusion level of palm kernel cake (7.74%) with 1ppm cobalt supplement.

C= High inclusion level of palm kernel cake (37.53%) without cobalt supplement

D= High inclusion level of palm kernel cake (37.53%) with cobalt supplement

Animals shall be fed at 3% of their body weights which allowed for feed refusals in all the treatment groups. Feeds shall be offered at 0800 and 1400 hours daily after being mixed with 5 drops of water to reduce dustiness. Clean drinking water shall be made available to each lamb free –choice throughout the 56-day growth and digestibility trial.

2.4 Data Collection

Animals shall be weighed before feeding on the first day and subsequently at two- week intervals during the 56 day period. An Accurate record of daily feed intake shall be prepared for each lamb from the amounts of daily feed offered and feed refusals during two separate collection periods of days 23-28 and 51-56.

Total feces and urine produced by the individual lambs during each of the collection periods shall be measured and recorded. Urine shall be collected into plastic buckets wetted with 98% (v/v) H_2S0_4. Representative samples (10%) of the feeds, feaces, and urine shall be kept on each animal. Feed and feacal samples shall be oven dried at 60 ^{0}C for 48 hours, sub- sampled, and stored separately for each animal in air-tight plastic bottles. Urine samples shall be kept under refrigeration in air-tight plastic jars containing 5ml, 98% (v/v) H_2S0_4.

2.5 Chemical and Statistical Analyses

Feeds and feaces shall be analyzed for dry matter, crude protein, and crude fiber using the AOAC (1990) procedures. Urine nitrogen shall be determined by the micro khjedah (AOAC 1990) method. Serum total protein, urea nitrogen shall be measured using the Biuret and Urease methods respectively. The thiocyanate concentration of the serum and urine samples shall be estimated by spectrophotometric method. Data shall be analyzed as in a 2x2 factorial designed experiment using ANOVA. Treatment means shall be appropriately subjected to the Duncan's multiple range tests.

III. Results and Discussion

The proximate analyses of feed ingredients were showed in Table 4.1. Also, there was the crude protein of the palm kernel cake, Rice milling waste, and cassava peelings were 17.4%, 6.9%, and 4.1% respectively on a dry matter basis. In Table 4.1 Treatments were as follows;

Treatment Group A has a low inclusion level of palm kernel cake **without** cobalt mineral supplements. Treatment Group B has a low inclusion level of palm kernel cake **with** cobalt mineral supplement. Treatment Group C has a high inclusion level of palm kernel cake **without** cobalt mineral supplements. And Treatment Group D has a high inclusion level of palm kernel cake **with** cobalt mineral supplement.

Table 3.1 THE PROXIMATE ANALYSIS OF THE TREATMENTS

	Palm kernel cake	Rice milling waste	Cassava peelings
Dry Matter	93.5	95.0	94.0
Crude Protein	17.4	6.9	4.1
Crude Fibre	10.9	30.5	7.4
Ash	6.8	16.2	4.3
NFE	58.0	57.0	76.2

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Table 3.2 THE PROXIMATE ANALYSIS OF THE TREATMENTS

ITEMS	A	B	C	D
Dry Matter	94	94.5	92	93
Crude Protein	9.5	8.5	15 5	15.4
Crude Fibre	12	12.2	17	17.5
Crude Fat	2.5	2.9	6.1	5.4
Ash	5.5	5.3	9.5	9.8
NFE	61.22	63.10	44.6	45.3

Table 3.3 DIET COMPOSITION (%)

ITEMS	A	B	C	D
Cassava peeling waste	75	75	59	59
Palm kernel cake	9	9	25	25
Rice milling waste	15	15	15	15
Salt	0.5	0.5	0.5	0.5
Bone Meal	0.5	0.5	0.5	0.5

Table 3.4 Effect of treatment on some performance characteristics in sheep

ITEMS	A	B	C	D	SEM
Mean initial live to weigh (Kg)	11.27	11.80	14.3	13	6.47
Mean final live weight (Kg)	18.82	16.89	38.02	39.09	2.14
Mean live weight gain (Kg)	7.55^{a}	5.09^{a}	23.72^{b}	26.09^{b}	1.99
Feed efficiency ratio gain/ feed	0.85	0.090	0.082	0.16	0.014
Total dry matter intake (g/day)	315^{a}	321^{a}	329^{a}	347^{a}	18.85
Total crude protein intake DM (g/day)	24^{a}	22.25^{a}	48.75^{b}	40.25^{b}	3.33
Total crude fibre intake DM (g/day)	42.45^{ab}	38.3^{a}	52.6^{b}	51.92^{b}	3.99

During the 56 days trial the dry matter intake for the sheep was not significantly different (P> 0.05) The dry matter intake for the 56 day trial for sheep on diet A,B,C,D were 315,321,329,347 g/day respectively. For the Total crude protein, there was no significant difference between diet A and B (P < 0.05). Also, there was no significant difference between diets C and D (P < 0.05)..For the mean live weight gain there was no significant difference between diet A and B (P < 0.05). Also, there was no significant difference between diet C and D (P < 0.05)... The sheep also show similar responses for the crude fibre intake (g/day) These responses were in agreement with the reported research done by O.Abanta 2015, M.Anaeta 2013, A.A. David 2020, V.O Asaolu 2006, and R. Niayale 2020.

Table 3.5 Effects of treatments on Apparent dry matter and nutrient digestibility (%)

ITEMS	A	B	C	D	SEM	significance
Dry matter	66^{a}	67^{a}	69^{a}	69^{a}	2.96	NS
Crude Protein	71^{a}	66^{a}	72^{a}	72^{a}	3.58	NS
Crude Fibre	38^{a}	47^{a}	56^{b}	54^{b}	2.79	S

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In Table 3.5 for the dry matter and crude protein digestibility, there was no significant difference between all the treatments ($P < 0.05$). But for crude fibre there was no significant difference between diet A and B ($P < 0.05$). Also, there was no significant difference between diets bn C and D ($P < 0.05$).

Table 3.6 Effects of treatments on Nitrogen Metabolism in sheep

ITEMS	A	B	C	D	SEM
Average Nitrogen intake (g/day)	7.05^{a}	6.2^{a}	13.82^{b}	12.95^{b}	0.15
Average feacal Nitrogen (g/day)	4^{a}	3.5^{a}	8.7^{a}	7.4^{a}	3.0
Average urinary Nitrogen (g/day)	0.55^{ac}	0.30^{a}	1.12^{b}	0.85^{bc}	0.12
Average Nitrogen Retention (g/day)	2.5^{a}	2.4^{a}	4.0^{b}	4.7^{b}	0.42

For the average nitrogen Retention (g/day), there was no significant difference between diet A and B ($P < 0.05$). Also, there was no significant difference between diets C and D ($P < 0.05$).

Table 3.7 Effects of treatments on serum compositions and urinary thiocyanate level

Parameter	**A**	**B**	**C**	**D**	**SEM**
Mean Serum urea nitrogen (mg/100ml)	1.85^{a}	2.2^{a}	3.9^{a}	5.05^{a}	3.57
Mean Serum total protein (mg/100ml)	52.1^{a}	62.5^{a}	61.59^{a}	63.2^{a}	5.63
Mean Serum thiocyanate (mg/litre)	2.77^{ab}	2.9^{a}	4.4^{b}	3.7^{b}	0.43
Mean urinary thiocyanate (mg/litre)	4.1^{a}	4.1^{a}	4.4^{a}	4.2^{a}	0.44

In Table 4.5 For the Serum Thiocyanate (mg/litre) there was no significant difference between diet A and B ($P < 0.05$). Also there was no significant difference between diet C and D ($P < 0.05$).. Also for mean Serum urea nitrogen (mg/100ml), Mean serum total (mg/100ml) and Mean Urinary Thiocyanate (mg/litre) there was no significant difference between the diets ($P < 0.05$).

IV. Conclusion and Recommendation

The result of this research showed that giving the sheep palm kernel meal at a high inclusion level with cobalt mineral supplement cause the following;

1. An increase in live weight gain and feed efficiency ratio in the sheep.
2. An increase in dry matter crude protein and crude fibre intake.
3. An increase in the digestibility of crude protein and crude fibre

The present research work showed that dietary cobalt mineral supplement has caused a significant improvement in the sheep fed cassava peeling waste based diets at a high level of inclusion of palm kernel meal and cobalt mineral supplement. Farmers are advised in using cassava peeling waste to feed lamb it is better to supplements it with palm kernel cake and cobalt mineral supplement for the optimal growth of the lamb, especially during the dry season when the fresh forages are scarce.

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