

Resumen

Un grupo de 30 cabras Maradi de 7 meses de edad, constituido por 15 machos y 15 hembras, con un peso promedio de 11.8 kg, fue alimentado con raciones en las cuales la cáscara de caupí reemplazó al maíz w/w a niveles de 0, 15, 30, 45 y 60% de la ración, durante 6 meses.

Se evaluaron tanto el efecto del caupí en la digestibilidad de las raciones, como el comportamiento de las cabras, las características económicas y también las características de los animales en canal.

Ocurrió una depresión en la tasa de crecimiento, en la ingestión de alimentos y en la eficiencia de la utilización de la ración conforme se incrementó el nivel de cáscaras de caupí en la ración alimenticia. Además, se observaron decrementos similares en la longitud de las canales de los animales, del por ciento de pieles y de órganos internos al aumentar la cáscara de caupí en las raciones. Contrariamente, se observaron mayores beneficios económicos al reducir los costos de alimentación y también hubo incrementos de rendimiento por unidad alimenticia conforme se incrementó el nivel de cáscaras de caupí en las raciones. Sin embargo, se encontró que las cabras pueden ser convenientemente alimentadas con niveles del 30 al 45% de cáscaras de caupí, sin que ello afecte adversamente la tasa de crecimiento o la digestibilidad nutricional de las raciones.

Introduction

○wing to inadequate supply and astronomical increases in prices of cereal grains, there has been an increasing world-wide interest in finding cheaper alternate sources of energy and protein ingredients in the diets of livestock. Some of these alternate sources have been identified as agro-industrial by-products and farm wastes.

These sources must not only be cheap and readily available, but they must not form regular sources of dietary nutrients to man directly except through the channels of livestock and livestock products. Cowpea husk — a farm waste, falls into this category. Apart from the fact that they are available in great quantities in Nigeria (9), a lot of man-hours, energy and money are used in disposing them off. Recently, farmers from the Savanna ecological zone of Nigeria, devised a method of sun-drying them after harvesting and selling them in jute bags to live-

stock farmers at very cheap prices. Samples of these husks from different locations of the above-mentioned ecological zone have been collected, and analysed and compared with maize samples. Apart from the high crude fibre content of the husks, there has not been found much differences, from this research, between the crude protein and energy contents of maize and cowpea husks, locally available.

The objectives of this study, therefore, were to determine the effects of cowpea husks incorporated into rations for goats, on the intake, digestibility and efficiency of utilization of the rations, and growth, carcass, organs and economic value for goats.

Materials and Methods

Cowpea husks (*Vigna unguiculata* Walp.) used in this study were obtained from the Institute's experimental stations. They were sun-dried for about a week. Some of the feedmills, locally available, were unable to mill the husks hence the use of a Christy-Norris hammer mill. The ground husks were then incorporated in graded levels in rations for goats

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Feeding and management of experimental animals

Thirty 7-month old Maradi goats (fifteen bucks and fifteen does) with an average initial body weight of 11.8 kg were divided into five groups equalized for sex, mean weight and weight distribution among groups. The experimental rations (Table 1) were allotted randomly to the five groups of goats consisting of six goats per group and fed *ad libitum* for a period of 180 days during which they all had free access to water and salt-lick.

Spraying weekly with acaricide against tick infestation and deworming with thiabendazole every three months were part of the management procedures practised during the 6-month experimental period. Records of group feed intake and individual body weight were kept on weekly basis. During the last three weeks, two bucks were withdrawn from each treatment group and placed in metabolism cages for a digestibility study. They were each offered daily 90% of the average daily feed intake of their respective treatment groups in the week prior to the metabolism trial and given free access to water. Any refused feed was weighed daily before the day's ration was put in the feeder. After an initial adjustment of 14 days in the metabolism cages, faeces were collected daily from each animal for 7 days. The 7-day faecal samples were pooled into two 3- and 4-day composite samples for chemical analysis. Samples of the refused feed, experimental rations, and faeces drawn from composite samples were then analysed for chemical composition. At the end

of the study, one buck and one doe from each group were starved for 24 hours, but water was provided. They were then weighed individually to obtain the final body weights and slaughtered for carcass evaluation. Prevailing market prices of feed ingredients and of goats were used to calculate feed costs and estimate gross income.

Analytical procedure

The AOAC method (5) was used for the determination of the chemical composition of the experimental diets, faeces and carcass samples. All data were subjected to analysis of variance and significant mean differences were tested by the Duncan's New Multiple Range Test (11).

Results and Discussion

Digestibility of experimental diets

With increases in the level of cowpea husks in the diets, consistent decreases were observed in the digestibility coefficients of crude protein, crude fibre, ether extract, nitrogen free extract, energy and total digestible nutrients (Table 2). Rations containing over 45% cowpea husks were significantly ($P \leq 0.05$) inferior to others in digestibility components of the rations studied.

As pointed out earlier, cowpea husks contain high levels of crude fibre content (31%). Other workers

Table 1. Feed and chemical composition of the diets.

Ingredients (%)	Levels of cowpea husks %				
	0	15	30	45	60
Maize	60	45	30	15	0
Cowpea husks ¹	0	15	30	45	60
Groundnut cake	15	15	15	15	15
Brewers' dried grains	19	19	19	19	19
Dicalcium phosphate	3	3	3	3	3
Bone meal	2	2	2	2	2
Salt	0.5	0.5	0.5	0.5	0.5
Agricare ²	0.5	0.5	0.5	0.5	0.5
Chemical analysis					
Crude protein	17.3	17.7	18.1	18.5	19.0
Crude fibre	5.3	9.5	13.9	18.3	22.5
Ether extract	3.8	3.3	2.9	2.5	2.0
Gross Energy (MJ/kg)	17.6	18.0	18.3	18.8	19.1

1 Contained 14% crude protein, 31% crude fibre, and 0.73% ether extract

2 A trade mineral-vitamin mixture manufactured by Pfizer Livestock Feeds Company, Lagos (Nigeria).

Table 2. Digestibility coefficients (%).

Feed components	Levels of cowpea husks					S.E. Mean
	0	15	30	45	60	
Crude protein	81.4 ^{ab}	82.5 ^a	75.9 ^b	71.2 ^{bc}	63.5 ^c	± 3.6
Crude fibre	78.3 ^a	63.3 ^{ab}	54.1 ^{bc}	49.3 ^{bc}	37.2 ^c	± 5.8
Ether extract	81.3 ^a	80.2 ^{ab}	76.2 ^{bc}	77.5 ^{abc}	73.3 ^c	± 2.2
NFE	92.5 ^a	87.5 ^{ab}	83.5 ^b	79.2 ^{bc}	76.0 ^c	± 3.2
IDN	85.5 ^a	79.4 ^b	65.9 ^c	66.3 ^c	59.2 ^c	± 2.2
Energy	90.3 ^a	83.5 ^{ab}	82.5 ^{ab}	76.8 ^b	75.6 ^b	± 2.6

a, b, c = different letters within the same row are significantly ($P \leq 0.05$) different.

(1, 2, 4, 6) working with waste products (dried brewers' grains, cocoa husks, maize cobs), fairly high in crude fibre, have obtained similar reduced digestibility coefficients. The factors these workers associated with these inferior digestibility coefficients were unpalatability, low DM intake, breakdown of feed components and chaffiness of rations. It has also been observed (1) that goats and sheep fed rations supplemented with brewers' dried grains (crude fibre 18%) gained less weight compared with those fed maize supplemented rations. Similar observations were also made with sheep and goats fed cocoa husks (4).

Growth response

Growth rate was significantly ($P \leq 0.05$) affected by the inclusion of cowpea husks in the goats' diets (Table 3). Increasing levels of cowpea husks beyond 45% resulted in a significant reduction in growth

rate ($P \leq 0.05$). The highest feed intake was recorded for animals fed 15% level, although it was not significantly different from the control treatment. Appreciable decreases were observed in the feed intake of goats fed diets containing 45-60% cowpea husks. Although the efficiency of feed utilization decreased as cowpea husks inclusion in rations increased, only the 60% level was markedly affected and there was in fact no difference between the control and 15% level. The reducing growth rate as cowpea husks levels in rations increase, could be attributed to decreasing feed intake and efficiency of feed utilization, digestibility and total digestible nutrients obtained in this study. These deductions have been confirmed by several workers (2, 7, 10) who have found that diets high in crude fibre result in reduced growth rate.

Economic performance

Table 3 also presents the economic performance of goats fed cowpea husks-based diets. It is observed

Table 3. Performance of goats fed cowpea husks diets.

Performance characteristics	Levels of cowpea husks %					S.E. Mean
	0	15	30	45	60	
Initial bwt (kg)	11.3	11.6	12.4	11.8	12.0	± 0.3
Final bwt (kg)	17.8 ^a	17.9 ^a	17.5 ^{ab}	16.0 ^b	15.3 ^c	± 0.5
Body wt gain (kg)	6.6 ^a	6.3 ^a	5.1 ^b	4.2 ^{bc}	3.3 ^c	± 1.7
Feed intake (kg)	93.5 ^a	99.8 ^a	91.4 ^{ab}	81.4 ^c	78.5 ^c	± 3.9
Feed/kg body wt gain (kg)	14.2 ^c	15.9 ^{bc}	17.8 ^b	19.3 ^b	23.5 ^a	± 2.5
Feed cost (₦ ¹)	14.0 ^a	12.1 ^a	10.1 ^b	7.4 ^c	5.6 ^d	± 1.5
Gross Revenue goat (₦)	26.8 ^a	26.9 ^a	26.3 ^a	24.0 ^b	24.1 ^b	± 0.6
Revenue less feed cost, ₦	12.8 ^d	14.8 ^c	16.2 ^b	16.6 ^b	18.5 ^a	± 1.0
Returns index ²	100	116	127	130	145	

a, b, c = different letters within the same row are significantly ($P \leq 0.05$) different.

¹₦ = Naira, the Nigerian currency ₦1.00 = US\$ 1.7.

²Based on the revenue less feed cost of the control diet as 100%.

that both feed cost and estimated gross income decreased significantly ($P \leq 0.05$) while the revenue (less feed cost) and the returns index increased with increases in the husks. Although there was a decline in the estimated gross revenue, which might be due to depression in growth rate as cowpea husks in diets increase, increases in returns index indicate greater profitability or economic benefit with increases in the maize replacement level of cowpea husks. The results of this study have confirmed that the modest biological production performance by animals fed rations made from farm wastes or agro-industrial by-products is usually accompanied by corresponding increases in economic benefits in the reduced feed costs and the gross revenue, which can be regarded as an index of profitability (3).

Carcass and organs characteristics

The carcass data (Table 4) indicate non-significant ($P \leq 0.05$) decreases in slaughter weight, carcass length, hides, head and trotters for animals on rations with 30% cowpea husks or less. Significant decreases ($P \leq 0.05$) were recorded in carcass quality after this level. Visceral fat increased significantly ($P \leq 0.05$) as cowpea husks increased in ration and this was more marked at the 60% level. This accumulation of fat especially at the 60% level indicates that cowpea husks have a fattening effect on goats at high levels. It has been found (1, 8) that farm wasted and agro-industrial by-products high in crude fibre content, when fed at high level, result in the deposition of fat.

In conclusion, this study has shown that the inclusion of cowpea husks at a level as high as 45% will not significantly depress growth rate and nutrient digestibility of goats relative to the control diet although the carcass quality may be affected. It is

therefore concluded that the expensive maize fraction of the diet can be replaced by between 30-45% of the cheap, fibrous but readily available cowpea husks to reduce feed cost and increase profitability.

Summary

Thirty 7-month old Maradi goats comprising fifteen bucks and fifteen does with an average body weight of 11.8 kg were fed diets in which cowpea husks replaced maize w/w at 0, 15, 30, 45 and 60% levels respectively for 6 months. The effect on digestibility of rations, live performance, carcass and economic characteristics of the goats were evaluated.

A depression in growth rate, feed intake and efficiency of feed utilization occurred as the level of cowpea husks increased. Similar decreases in carcass length, dressing-out percentage and organs with increases in cowpea husks in the rations were observed. Conversely, greater economic benefits in reduced feed cost and increased returns per feed cost as the level of cowpea husks in rations increased were recorded. However, levels of between 30-45% could conveniently be fed to goats without adversely depressing growth rate and nutrient digestibility.

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Table 4. Carcass and organ characteristics of goats fed cowpea husks diets.

Carcass characteristics	Levels of cowpea husks %					S.E. Mean
	0	15	30	45	60	
Slaughter wt, kg	17.7 ^a	17.8 ^a	17.4 ^a	15.9 ^b	16 ^b	± 0.4
Carcass length, cm	60.2 ^a	58.6 ^a	55.7 ^{ab}	50.2 ^b	51.4 ^b	± 2.2
Dressing-out %	47.1 ^{bc}	49.3 ^a	48.4 ^b	46.7 ^{cd}	45.0 ^d	± 0.7
Hides, kg	1.6 ^a	1.7 ^a	1.6 ^a	1.3 ^b	1.3 ^b	± 0.09
Head, kg	1.6 ^a	1.5 ^b	1.5 ^b	1.3 ^{bc}	1.25 ^c	± 0.07
Visceral fat, kg	0.85 ^b	0.73 ^c	0.87 ^b	0.92 ^b	1.22 ^a	± 0.13
Liver, kg	0.52 ^a	0.45 ^b	0.42 ^b	0.49 ^{ab}	0.38 ^c	± 0.12
Heart, kg	0.11 ^{ab}	0.13 ^a	0.10 ^b	0.09 ^b	0.8 ^c	± 2.6
Kidney, kg	0.10 ^b	0.11 ^a	0.08 ^c	0.07 ^c	0.07 ^c	± 0.72

a, b, c = different letters within the same row are significantly ($P \leq 0.05$) different

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