Ife Journal of Agriculture Vol. 10 Nos 1 & 2 1988

Evaluation of the nutritive value of winged beqn pod for growing sheep

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Abstract

The nutritive value of winged bean pod (WBP) was evaluated by means of chemical analyses (proximate components) and *in vivo* digestion study. The digestion trial involved 12 ewe-lambs and 12 ram-lambs randomly alloted by weight into four treatments of three ewe-lambs and three ram-lambs per treatment. All experimental animals received certain amounts of a concentrate which contained 45% ground maize, 32% groundnut cake, 6% blood meal, 14.3% cane molasses, 1.7% oyster shell and 1% vitamin/trace mineral supplement. Animals on treatment 1 received a diet containing 50% of maize cob and 50% of the concentrate (MC:C; 50:50) while those on treatment 2 received a diet containing 50% WBP and 50% of the concentrate (WBP:C; 50:50). Animals on treatment 3 received a diet containing 60% WBP and 40% of the concentrate (WBP:C; 60:40) while those on treatment 4 received a diet containing 40% WBP and 60% of the concentrate (WBP:C; 40:60).

WBP contained higher crude protein (CP), crude fiber (CF), ash, ether extract (EE) and lower nitrogen free extract (NFE) than maize cob. Dry matter (DM) and organic matter (OM) digestibilities were higher for the MC:C (50:50) and WBP:C (40:60) diets than for the other diets. The inclusion of as much as 60% WBP in the diet still resulted in good digestibility of the various components. Digestibility of CP was highest for the WBP:C (40:60) diet and lowest for the WBP:C (60:40) diet. CP digestibility was similar for the MC:C (50:50) and WBP:C (50:50) diets, indicating that MC and WBP would enhance similar levels of digestible CP when fed at similar levels in the diet. WBP was a better source of digestible CF, ash, EE and NFE than MC. Among the WBP diets, digestibility of CF and ash increased with increasing level of WBP in the diet and digestibility of NFE was highest for the WBP:C (40:60) diet. The results showed that WBP can be incorporated into the diets of growing sheep at levels of up to 60% with reasonably good level of utilization.

Introduction

Winged bean *Psophocarpus tetragenelobus* originated in tropical Asia where it is cultivated (especially in Indonesia and Burma) for its tubers and young pods which are delicious vegetables. It is one of the few grain legumes which is well adapted to the humid lowland tropics. Although recently introduced into Nigeria, winged bean is rapidly becoming accepted by local farmers. As the cultivation of winged bean increases in Nigeria, there will be an increased need to get rid of the by-products (pods, stems and leaves). In India, winged bean pod and rice husk are mostly used as fuel or beddings for poultry animals. Castillo (1983) observed that the total digestible nutrients of matured winged bean pod in cattle, carabaos and goats were 63.5, 62.9 and 49.0 percent, respectively, indicating a reasonably good utilization by ruminants. Successful incorporation of winged been pod into livestock diets will help to control environmental pollution and to provide edible animal products from non-edible waste.

The objectives of this study are to evaluate winged bean pod as roughage source in the diets of sheep and to establish the level at which it can be included in the diet without any adverse effects on the animals.

Materials and Methods

Chemical analyses for the proximate components and *in vivo* digestion trial were conducted to evaluate the nutritive value of winged bean pod as roughage source for growing lambs.

Chemical Analyses:

Winged bean pod and maize cob (which served as the control because it is widely used as feed ingredient in ruminants' diets) were analyzed for dry matter (DM), organic matter (OM), crude protein (CP), crude fiber (CF), ash, ether extract (EE) and nitrogen free extract (NFE) as described in AOAC (1975).

In Vivo **Digestion:**

Twelve ewe-lambs and twelve ram-lambs (West African Dwart, average weight, 16 kg) were randomly alloted by weight into four treatments of three ewe-lambs and three ram-lambs per treatment for the digestion trial. The trial involved a 10-day adaptation period, a 7-day adjustment period and a 7-day collection period. During the adaptation period all animals were group-fed *ad libitum* with a ration containing 25% maize cob, 25% winged bean pod and 50% of a concentrate mixture (containing 45% ground maize, 32% groundnut cake, 6% blood meal, 14.3% cane molasses, 1.7% oyster shell and 1% of vitamin/trace mineral supplement).

After the adaptation period the animals were placed in individual metabolism cages designed for the total separation of urine and feces for the adjustment and collection periods. During these periods, animals were fed the experimental diets. Animals in treatment A (the control) were fed a ration containing 50% maize cob and 50% concentrate. Animals in treatments B, C and D were fed a mixture of winged bean pod and the concentrate in the ratios of 50:50, 60:40 and 40:60, respectively. Feed offered during the adjustment and collection periods was reduced to 70% of average *ad libitum* consumption. Table 1 shows the feeding schedule for the experimental animals during the adjustment and collection periods. Daily feed was divided into two equal parts and fed 0800hr and 1600hr. Water and trace mineralized salt licks were available to the animals at all time. The ingredient composition of the concentrate and the experimental diets are shown on table 2.

During the collection period total daily feces voided by each experimental animal was weighed and 10% aliquot samples were stored at 5C for later analyses. Samples of each experimental ration (50g) were also collected daily and stored (at room temperature) for further analyses. The experimental feeds and feces were analyzed for the proximate components as described in AOAC (1975), and nitrogen free extract (NFE) was obtained in the usual manner. Digestion co-efficients for components of each diet were determined by the methods described by Schneider and Flatt (1975).

Statistical Analyses:

Data for the digestion co-efficients were analyzed by the use of a one-way analysis of variance as described by Neter and Wasserman (1977). Means were compared using LSD test described by Steel and Torrie (1980).

Results and Discussion

Chemical Analyses:

The chemical composition of the concentrate and supplements are shown on table 3. Winged bean pod was in general, richer in all components except NFE than maize cob. Both the winged bean pod and maize cob are therefore potential sources of nutrients for ruminants.

In Vivo Digestion:

The percentage digestibility of individual components of each experimental diet are shown on table 4. Digestibilities of DM and OM for the various experimental diets were in the order: MC:C (50:50) = WBP:C (40:60) > WBP:C (50:50) > WBP:C (60:40); ($P < .05$). The fact that DDM and DOM were similar for the MC:C (50:50) and WBP:C (40:60) was an indirect indication that the optimum level of inclusion of WBP in the diet of growing sheep would be lower than that for MC. The result could also mean that a plateau had been reached in DDM and DOM at either MC:C (40:60) or WBP:C (40:60). The inclusion of as much as 60% WBP in the diet of growing lambs still resulted in a reasonably good DDM and DOM (57.0% and 58.9%, respectively), indicating that WBP can serve as a good source of roughage for growing lambs. The digestion co-efficients for CP for the various diets were in the order: WBP:C (40:60) > MC:C (50:50) = WBP:C (50:50) > WBP:C (60:40); ($P < .05$). The comparison of the results of DCP is less meaningful since the different diets contained different levels of concentrate, hence different levels of CP. However, the fact that diets MC:C (50:50) and WBP:C (50:50) had similar DCP (61.3% and 60.6%, respectively) was an indication that MC and WBP would result in similar DCP in the diets of growing lambs. It should be pointed out that the highest level of inclusion of WBP (60%) resulted in a 56.3% DCP.

The percentage digestibility of CF was higher for the WBP diets than for the MC diet ($P < .05$), indicating that WBP was a better source of digestible CF than MC. The fact that WBP contained more percent CF than MC (table 3) makes these results more meaningful. Among the WBP diets DCF was in the order: WBP:C (60:40) = WBP:C (50:50) > WBP:C (40:60); ($P < 05$). Thus, DCF in the WBP diets tended to increase with increasing levels of WBP. This result may indicate that WBP contains higher levels of the more digestible components of CF (such as cellulose and hemicellulose) and/or lower levels of the least digestible components (such as lignin) than MC. The digestion coefficients for ash was also higher for the WBP diets than for the MC diet ($P < .05$). Among the WBP diets D ash was in the order: WBP:C (40:60) > WBP:C (50:50) > WBP:C (60:40); ($P < .05$). Digestibility of NFE was in the order: WBP:C (40:60) > WBP:C (50:50) = WBP:C (60:40) > MC:C (50:50); ($P < 05$). Thus the WBP diets enhanced higher DNFE than the MC diet. The results showed that WBP can be successfully incorporated into the diets of growing sheep at levels of up to 60%.

Acknowledgement

The authors will like to express their profound gratitude to Professor P.T. Onesirosan of the Department of Plant Science, Obafemi Awolowo University, Ile-Ife for supplying the winged bean pod used for the experiment.

TABLE 1. DAILY FEEDING SCHEDULE (G DRY MATTER BASIS) FOR THE EXPERIMENTAL ANIMALS[a]

	Treatment			
Feedstuff	Maize cob: concentrate (50:50)	Winged bean pod: concentrate (50:50)	Winged bean pod concentrate (60:40)	Winged bean pod: concentrate (40:60)
Concentrate[b]	250.0	250.0	200.0	200.0
Maize cob	250.0	—	—	—
Winged bean pod	—	250.0	200.0	200.0
Total	500.0	500.0	500.0	500.0

[a]Daily feed was divided into two equal parts and fed at 0800 and 1600 hours.

[b]The concentrate contained 45% ground maize, 32% groundnut cake, 6% blood meal, 14.3% molasses, 1.7% oyster shell and 1% vitamin/trace mineral mix (table 2).

TABLE 2. INGREDIENT COMPOSITION OF THE CONCENTRATE AND THE EXPERIMENTAL DIETS USED FOR THE DIGESTION STUDY (DRY MATTER BASIS)

Item	Concentrate	Maize cob: Concentrate (50:50)[a]	Winged bean pod: concentrate (50:50)[b]	Winged bean pod: concentrate (60:40)[c]	Winged bean pod: concentrate (40:60)[d]
Ground maize	45.0	22.5	22.5	18.0	27.0
Groundnut cake	32.0	16.0	16.0	12.8	19.2
Blood meal	6.0	3.0	3.0	2.4	3.6
cane molasses	14.3	7.1	7.1	5.7	8.6
Oyster shell	1.7	0.9	0.9	0.7	1.0
Nutrikem[e]	1.0	0.5	0.5	0.4	0.6
Maize cob	—	50.0	—	—	—
Winged bean pod	—	—	50.0	60.0	40.0

[a]Maize cob and the concentrate were present in 50:50 ratio.
[b]Winged bean pod and the concentrate were present in 50:50 ratio.
[c]Winged bean pod and the concentrate were present in 60:40 ratio.
[d]Winged bean pod and the concentrate were present in 40:60 ratio.
[e]Contains 800,000 I.U. Vit/kg, 160,000 I.U. Vit D_3/kg, 800 I.U. Vit E/kg, 360 mg copper/kg, 8 mg selenium/kg, and 80 mg molybdenum/kg. Nutrikem Ltd. Thirsk, Yorkshire, U.K.

TABLE 3. CHEMICAL COMPOSITION OF THE CONCENTRATE AND THE SUPPLEMENTS

Item	Supplement		
	Concentrate	Maize cob	Winged bean pod
Dry matter (DM, %)	86.3	89.2	92.0
Organic matter (OM, %)	89.0	98.8	97.5
Analyses, % of DM:			
Crude protein (CP)	26.1	3.0	7.5
Crude fiber (CF)	7.6	33.5	40.3
Ash	11.0	1.2	2.5
Ether extract (EE)	3.0	0.3	0.6
Nitrogen-free extract (NFE)	52.3	62.0	49.1

TABLE 4. DIGESTIBILITY (PERCENTAGE) OF INDIVIDUAL COMPONENTS OF EACH EXPERIMENTAL DIET (MEANS OF SIX LAMBS)

	Diet				
	Maize cob (MC): concentrate (C) (50:50)	Winged bean pod (WBP): concentrate (C) (50:50)	Winged bean pod (WBP): concentrate (C) (60:40)	Winged bean pod (WBP): concentrate (C) (40:60)	SEM
Dry matter (DDM)	65.2^{c}	61.5^{b}	57.0^{a}	65.1^{c}	.7
Organic matter (DOM)	68.0^{c}	62.8^{b}	58.9^{a}	67.3^{c}	..8
Crude protein (DCP)	61.3^{b}	60.6^{b}	56.3^{a}	65.9^{c}	1.0
Crude fiber (DCF)	38.7^{a}	55.2^{c}	56.4^{c}	52.5^{b}	.9
Ash (D Ash)	37.0^{a}	53.2^{c}	44.8^{b}	57.0^{d}	2.1
Ether extract (DEE)	85.4	85.7	85.9	86.1	1.9
Nitrogen-free extract (DNFE)	80.5^{a}	83.3^{b}	83.1^{b}	86.9^{c}	.7

^{a,b,c,d}Means in the same row with different superscripts are different (P .05)

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