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**SUSTAINABILITY OF THE
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IN 2000AD**

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Comparative Effects of Unprocessed Sorghum as a substitute for Maize in the Diets of growing Rabbits

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Introduction: Maize (*Zea mays*) usually constitute a major component in the diets of monogastrics. However, sorghum (*Sorghum bicolor*) is more widely grown in the dry semi-arid regions of Africa. Most of the sorghum cultivated in the drier regions of the tropics has been found to be directly consumed by the human population as well as to livestock (El-Zubair *et al.*, 1990; Singh and Singh, 1991). The closeness of sorghum to maize in energy value and its superiority in crude protein makes it a possible substitute for maize in feeding livestock. However, the tannin in sorghum has been found to limit its utilisation in livestock feeding (El-Zubair *et al.*, 1992). Osuntogun *et al.* (1987) confirmed that tannin in sorghum combine with proteins, thereby inhibiting the digestibility of the latter. Cooking reduces the protein digestibility of sorghum (Mosh *et al.*, 1983; Hamaker *et al.*, 1986). These authors also found that uncooked sorghum was almost as digestible as uncooked maize. Sorghum gluten feed has been successfully fed to poultry (El-Zubair *et al.*, 1990; Khalifa and El-Zubair, 1990; Mustafa and El-Zubair, 1993). This study was undertaken to investigate the effect of substituting unprocessed red coloured variety of sorghum for maize at 0, 25, 50, 75 and 100% levels on the performance of growing rabbits. The parameters studied were growth rate, feed efficiency and carcass characteristics.

Materials and Methods: A total of thirty New Zealand White rabbits averaging 580.03 ± 6.69 g was randomly allotted to individual cages of five treatment groups. Each treatment group had six rabbits. The rabbits were fed and given water *ad libitum* for a period of twelve weeks. Coprophagy was not prevented. Weight gain, feed intake and water consumption were recorded. Ingredient composition and chemical analysis of the rations are shown in Tables 1 and 2 respectively. The diets were formulated such that sorghum was used to replace maize at 0, 25, 50, 75 and 100% levels. No attempt was made to make the diets isocaloric and nitrogenous, and the diets were fed in mash form

Table 1. Composition of ration (%)*

Ingredients	Levels of substitution of maize for sorghum				
	0%	25%	50%	75%	100%
Maize	33.0	24.75	16.50	8.25	0.0
Sorghum	0.0	8.25	16.50	24.75	33.0
Brewers' dried grains	24.08	24.08	24.08	24.08	24.08
Corn offal	24.08	24.08	24.08	24.08	24.08
Full fat soyabean meal	14.84	14.84	14.84	14.84	14.84
Bone meal	2.0	2.0	2.0	2.0	2.0
Oyster shell	1.0	1.0	1.0	1.0	1.0
Salt	0.5	0.5	0.5	0.5	0.5
Vitamin mix**	0.5	0.5	0.5	0.5	0.5
Total	100	100	100	100	100

*Diet composition on "as fed basis".

**Vitamin mineral premix per kg contained; Vit A, 4,000,000 I.U.; Vit D₃, 1,200,000 I.U.; Vit E, 3,200 I.U.; Vit K, 800mg; Vit B₁, 800mg; Vit B₂, 2,200mg; Vit B₆, 480mg; Vit B₁₂, 4.3mg; Biotin, 12mg; Pantothenic acid, 2,800mg; Folic acid, 240mg; Choline Chloride, 200,000mg; Vit C, 4,000mg; Fe, 2,400mg; Mn, 32,000mg; Copper, 3,200mg; Zn, 20,000mg; Co, 180mg; Iodine, 300mg; Selenium, 40mg; Anti-oxidant, 2,400mg; Calcium Carbonate, Q.S. 1,000mg.

At the end of the feeding trial the rabbits were starved of feed for 12hr, weighed and then killed by neck dislocation. The head, forelegs, hind legs and pelt were removed. The internal organs and the carcass were weighed immediately. The feed samples were analysed according to AOAC (1995) methods. The results were subjected to analyses of variance (Steel and Torrie, 1980) and significant means were tested according to Duncan's Multiple Range Test (Duncan, 1958).

Results and Discussion

The chemical analyses of the diets are given in Table 2. The values obtained showed that all the diets met the minimum requirements for CP and CF recommended for growing rabbits. Table 3 shows the performance characteristics of the rabbits. The rabbits fed the diet without sorghum recorded the highest average daily feed intake of 70.32 g while those on the diets in which maize was substituted for sorghum at 75 and 100% recorded daily feed intake of 62.88 g and 60.25 g respectively, and these values were significantly different ($p < 0.05$) from values obtained for rabbits on the other treatments. The inclusion of sorghum tended to reduce feed intake. However, a reversed trend was observed in terms of average daily water intake. The rabbits on the 75% and 100% sorghum diets consumed more water than the rabbits on the other treatments (fig 1).

Table 2. Chemical composition of diet (g/kg)

Items (%)	Levels of substitution of maize for sorghum				
	0%	25%	50%	75%	100%
Dry matter	883.2	880.0	875.0	888.0	873.1
Crude protein	163.4	164.0	163.8	165.2	166.5
Crude fibre	90.2	102.2	115.3	127.7	138.6
Ether extractives	42.8	43.0	43.2	44.7	42.8
Ash	102.5	108.0	96.6	97.2	101.0
Energy ME MJ/Kg*	11.1	11.1	11.0	11.0	11.0

*Calculated values

Table 3: Performance characteristics of rabbits fed diets containing sorghum as a replacement for maize

Performance characteristics	Levels of substitution of maize for sorghum					SEM
	0%	25%	50%	75%	100%	
Initial body weight (g)	575.2	580.4	581.5	572.9	590.2	10.2
Final body weight (g)	1782.3	1693.5	1752.8	1623.5	1682.9	30.8
Body weight gain (g)	1207.1	1113.1	1171.3	1050.5	1092.7	48.2
Ave. daily DM intake (g)	70.3 ^a	63.4 ^b	67.3 ^b	62.9 ^c	60.3 ^c	15.7
Ave. daily weight gain (g)	24.4 ^a	13.3 ^b	13.9 ^{ab}	12.5 ^c	13.0 ^c	1.0
Average daily water intake (ml)	120.0 ^c	223.0 ^a	220.5 ^b	220.8 ^b	240.5 ^a	10.5
Mortality	NIL	NIL	NIL	NIL	NIL	-

a, b, c,.....Means without common superscripts in the same horizontal column are significantly different ($p < 0.05$)

The average daily weight gains varied between 12.50 and 14.37g. Rabbits on treatment 1 (control) had the highest average daily weight gain. However, there was no significant difference ($p > 0.05$) between rabbits on diet 1 and diets 2 and 3. The feed conversion ratio for all the treatments were not significantly different ($p > 0.05$). Sorghum can replace maize up to 50% in the diet without adverse effects on daily weight gains. The weight gains recorded in this study were higher than those reported by Alawa *et al.* 1989; Abu and Ekpenyong 1993; Abu and Onifade, 1996; Abu and Tewe, 1998. The observation that total replacement of maize with unprocessed sorghum led to depression in dry matter and crude protein digestibility was however contrary to that of Hamaker *et al.* (1986) who reported that sorghum is almost as digestible as maize. There is likelihood the tannin levels in the sorghum may be variety dependent (El-Zubair *et al.*, 1992). El-Zubair *et al.* (1990) observed no significant ($p > 0.05$) effect on feed intake, weight gain, feed conversion ratio (FCR) and mortality in broilers fed partial and total sorghum gluten diets. Dressing percentage, eviscerated carcass weights, colour, flavour, tenderness and juiciness of meat

also were not affected. Table 4 shows the slaughter data of the rabbits. There was no significant difference ($p > 0.05$) in the dressing percentage, forelegs, hind legs and kidneys of the rabbits for all dietary treatments. An increase in liver weights were observed as the level of sorghum in the diet increased ($p > 0.05$). The kidney and abdominal fat tended to increase as the level of sorghum in the diet decreased ($p < 0.05$). The increase in the kidney and abdominal fat may be due to the difference in the carbohydrate metabolism of maize and sorghum. Osuntogun *et al.* (1987) had earlier explained that tannins inhibit the digestibility of proteins in the diet containing leaf protein concentrates.

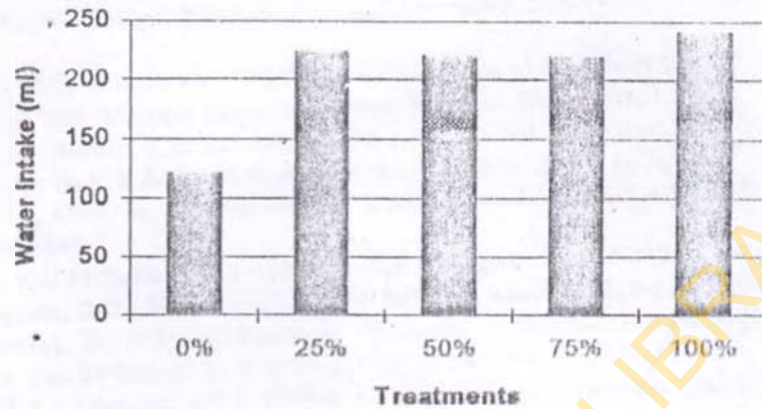


Fig. 1: Average daily water intake (ml) of rabbits fed maize-sorghum based diets

Table 4: Slaughter data of rabbits fed diets containing sorghum

Items	Levels of substitution of maize for sorghum					SEM
	0%	25%	50%	75%	100%	
No of rabbits	4	4	4	4	4	-
Final live wt. (kg)	1.78	1.69	1.75	1.62	1.68	30.8
Dressing percentage ⁺	57.8	58.2	58.1	58.2	58.6	3.6
<u>Body composition</u>						
<u>(% of empty body wt)</u>						
Head	13.3	13.2	13.5	13.3	13.2	1.5
Forelegs	0.9	0.9	0.9	0.9	0.9	0.001
Hind legs	1.9	2.2	2.2	2.3	2.3	0.002
Liver	2.7 ^a	3.1 ^b	2.9 ^b	3.4 ^c	3.4 ^c	0.005
Kidney fat	2.2 ^a	2.1 ^a	2.0 ^a	1.9 ^b	1.7 ^c	0.003
Abdominal fat	3.2 ^a	3.2 ^a	3.0 ^b	2.5 ^c	2.2 ^d	0.1
Heart	0.30 ^a	0.32 ^c	0.37 ^{ab}	0.35 ^b	0.38 ^a	0.004
Pelt	9.8 ^b	9.9 ^b	10.0 ^b	10.6 ^a	10.3 ^a	0.25

a, b, c.....Means without common superscripts in the same horizontal column are significantly different ($p < 0.05$)

⁺Calculated as $\frac{\text{Carcass weight}}{\text{Live weight} - \text{gut content}} \times 100$

Conclusion: This study revealed that sorghum can replace maize up to 50% in the diet of growing rabbits without compromising performance. However, complete replacement of maize with sorghum led to depression in feed intake and body weight gain.

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