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Carcass Characteristics of Growing Rabbits Fed Graded Levels of *Acacia albida* Pods

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ABSTRACT
In an 84-day feeding trial, the effect of feeding varying dietary levels of *Acacia albida* pods (AAP) on the carcass parameters of growing rabbits was studied. AAP was included at 0, 10, 20, 30 and 40% levels in diets, 1, 2, 3, 4 and 5 respectively. The diets and clean drinking water were provided *ad libitum.* At the end of the study, five rabbits (3 males and 2 females) were slaughtered to obtain carcass data. The slaughter weights (1532.9, 1484.0 and 1478.0 g), dressed weight (757.24, 771.48 and 759.08 g), hot carcass weight (757.24, 771.48 and 759.08 g) and cold carcass weight (751.13, 765.28 and 748.86 g) of rabbits on diets 1, 2, and 3 respectively were superior ($p<0.05$) to those on diets 4 and 5. Similarly, shoulder, rack and loin were heavier ($p<0.05$) for diets 1, 2, and 3 than 4 and 5. Thigh did not differ significantly ($p>0.05$) among the diets. However the weight of head, gastrointestinal tract (GIT), stomach, caecum and kidney fat differed significantly ($p<0.05$) between the groups. Dressing percentage was highest for rabbits on diet 2(52.0%) while diets 4 (48.99%) and 5 (48.21%) had the least. From the study, including more than 20% AAP in the diet of growing rabbits could have adverse effect on their meat yield and carcass characteristics.

Key words: Rabbits, *Acacia albida* pods, carcass components

INTRODUCTION
Acacia albida trees (Gawo) are common leguminous trees in the semi arid areas of Nigeria. Since they produce abundant foliage and pods during the dry season, they help to sustain livestock in these areas during periods of feed scarcity. Tanner *et al.* (1990) described *A. albida* pods as low cost and widely occurring feed in the dry areas of West Africa. The potentials of Acacia albida pods (AAP) as a dry season supplementary feed for small ruminants have been reported. (Tanner *et al.*, 1990; Mohammed, 1996). De leeuw *et al.* (1986) showed that *Acacia albida* pods when fed to small ruminants during the dry season were capable of supporting growth rates of 21.60 g/day.

In rabbits, Igwebuike *et al.* (2003) demonstrated that 20% AAP could be incorporated in the diets of growing rabbits without adverse effect on growth and carcass characteristics of the rabbits. In a related study, Abdel-Samee *et al.* (1994) examined the efficacy of *A. saligna* as a cheap source of energy and protein for growing rabbits and concluded that growing rabbits could tolerate up to 40% *A. saligna* in their diets without adverse effect on their body weight, blood parameters and carcass values. This study was aimed at determining the effects of graded levels of *A. albida* pods (AAP) in the diets of growing rabbits on the carcass components.

MATERIALS AND METHODS
The study, which lasted for 12 weeks (84 days), was conducted at the Livestock and Research Farm, University of Maiduguri, Maiduguri, Nigeria. Sixty cross bred (Dutch X New Zealand White) rabbits, 7 - 8 weeks with an average weight of 790.09 g were randomly assigned to the five experimental diets in groups of 12 rabbits each (group 1, 2, 3, 4 and 5). The composition of the experimental diets is shown in Table 1. The experimental diets contained 0, 10, 20, 30 and 40% *Acacia albida* pods (AAP) in groups 1, 2, 3, 4, and 5 respectively. The crude protein and metabolisable energy (Pauzenga, 1985) were maintained at about 18% and at least 3100 Kcal/kg respectively for each diet. Rabbits were accommodated individually in wire netting cages where the experimental diets and clean drinking water were offered *ad libitum.*

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At the end of the 12 week feeding trial, 5 rabbits (3 males and 2 females) were selected randomly per group. The mean body weights were representative of the range of body weight within each group. They were denied access to feed for 12 hours before slaughter to reduce the amount of faecal material in the gut but drinking water was provided. The rabbits were slaughtered according to locally accepted practices (Mann, 1960) and later opened, dressed and split into retail cuts as described by Blasco *et al.* (1993). The hot dressed carcass was weighed and compared with the slaughter weight to obtain the carcass yield (dressing percentage). The various body components (head, feet, skin (pelt and tail), kidney fat and organs (heart, liver, lungs, kidney and spleen) were excised, weighed individually and expressed as percentage slaughter weight.

The entire gastrointestinal tract (GIT) and its various components (stomach, small and large intestines and caecum) were removed, weighed and their length measured. The carcass length (expressed in cm) was measured as the distance between the atlas and the *Os ischii* (Blasco *et al.*, 1993). The dressed carcass was cut into retail cuts (shoulder/forelegs, racks/ribs, loin and thigh/hind legs) and weighed. They were chilled overnight in a refrigerator and weighed again to obtain the cold carcass weight and drip loss percentage (DLP) calculated using methods described by Blasco *et al.* (1993).

$$\text{DLP} = \frac{\text{Hot carcass weight} - \text{Cold carcass weight}}{\text{Hot carcass weight}} \times 100$$

The proximate analysis of the diets was carried out according to AOAC (1980) while tannin and phytin contents of the diets were determined using methods described by AOAC (1980) and Stewart (1974), respectively. Data were subjected to analysis of variance (ANOVA) and significant differences among treatments were compared by Duncan's multiple range tests (Steel and Torrie, 1980).

RESULTS

The chemical composition, tannin and phytin content of the experimental diets are presented in Table 1. The CP contents of the diets were approximately 18%, a level adequate to meet the needs of growing rabbits. The crude fibre levels ranged from 11.22% in diet 1 (0% AAP) to 14.84% in diet 5 (40% AAP). The fibre levels appreciated with increasing levels of AAP. The ether extract (EE) similarly increased with increasing levels of AAP in the diets. The calculated energy levels of the diets were between 3184.54 to 3287.56 Kcal/kg diets. The tannin and phytin levels expectedly increased with increasing levels of AAP in the diets.

The body components and organ weights of the rabbits expressed as percentages of slaughter weight are summarized in Table 2. The head expressed as percentage of slaughter weight were higher in rabbits on diets 4 and 5 than diet 1. The highest ($p<0.05$) relatively kidney fat (2.03%) and the lowest (0.64%) were recorded in diets 1 and 5 respectively. The entire weight of gastrointestinal tract (GIT) and stomach (as percentage of slaughter weight) of rabbits on diets 5 were higher ($p<0.05$) than those of rabbits on diets 2, 3 and 4 but similar to the control (diet 1). The large and small intestines were similar ($p>0.05$) in all the diets.

The retail cuts (shoulder/forelegs, rack. ribs, loin and thigh/hind legs) expressed as percentage of slaughter weight showed that shoulder was heavier in rabbits on diets 2 and 5 and racks in diet 1 than 5 while relative loin weight were better in diets 2, 3 and 5 than 1 and 4. The thighs were similar and did not differ significantly ($p>0.05$) in all the diets. Dressing percentage was highest ($p<0.05$) in diet 2 (52.0%) while the least were in diets 4 (48.00%) and 5 (48.21%). However, the dressing percentages of rabbits on diet 1 were similar ($p>0.05$) to those of rabbits on diets 3, 4 and 5 despite the differences in their slaughter weight.

The weights of the hot and cold carcasses and the retail cuts are shown in Table 3. The hot and cold carcass weights of the rabbits on diets 1, 2 and 3 were superior ($p<0.05$) to those on diets 4 and 5. However, the cold carcass weight (CCW) expressed as percentage of hot carcass weight (HCW) and the drip loss percentage (DLP) did not differ significantly ($p>0.05$) among the groups. Similarly, the weight of the hot and cold retail cuts especially shoulder, rack and loin of rabbits on diets 1, 2 and 3 were hevier ($p>0.05$) than those of rabbits on diets 4 and 5. The thighs were however similar ($p>0.05$) in all the diets despite the lower values of rabbits on diets 4 and 5. When the hot and cold retail cuts were expressed as percentages of carcass weight, the shoulder and thighs of rabbits on diet 5 were significantly ($p<0.05$) lower than those on the other diets. The rack and loin (as percentage of HCW and CCW) were not affected ($p>0.05$) by the various dietary levels of AAP.

DISCUSSION

The head expressed as percentage of slaughter weight were higher in rabbits on diets 4 and 5 than the control (diet 1) and this agrees with the observation of Sandford (1979) who reported that heads of rabbits that are underdeveloped will be large in proportion to the rest of its body. In this work, weight of the head (as percentage of slaughter weight) was 8.55% at slaughter weight of 1532 and 9.85% at slaughter weight of 1200 g, but Latimer and Sawin (1955) slaughtered heavier rabbits (3352 g) and obtained 5.3%. However, the weight of most of the body components and organs (heart, liver, lungs, spleen and kidneys) were similar in all the treatments and compared favourably with values reported by MAFF (1978) for healthy young rabbits. This indicates that development and growth of these organs were not adversely affected by the level of AAP in the diets. In addition, Zhao *et al.* (1995) reported that the relative sizes of the liver, heart and kidney are hardly affected by the fibre levels of the diet in rats.

Table 1. Ingredients and chemical composition of the experimental diets.

	Diets				
Ingredients (%)	1	2	3	4	5
Maize	41.93	35.41	29.21	22.97	16.57
AAP[1]	0.00	10.00	20.00	30.00	40.00
Maize bran	20.00	15.00	10.00	5.00	0.00
Groundnut haulms	10.00	10.00	10.00	10.00	10.00
Groundnut cake	24.92	25.44	25.64	25.88	26.28
Palm oil	0.00	1.00	2.00	3.00	4.00
Bone meal	2.50	2.50	2.50	2.50	2.50
Salt (NaCl)	0.50	0.50	0.50	0.50	0.50
Premix[*]	0.15	0.15	0.15	0.15	0.15
Total	100.00	100.00	100.00	100.00	100.00
Analyzed chemical composition (%)					
ME(Kcal/kg)[2]	3239.45	3287.56	3212.99	3184.54	3145.76
Dry matter	94.60	95.40	95.40	95.20	95.20
Crude protein	18.12	18.10	17.94	17.64	18.14
Crude fibre	11.22	11.87	12.42	13.15	14.84
Crude fat (Ether extract)	4.78	6.47	6.74	6.78	6.91
Ash	4.42	4.58	6.47	6.58	6.14
Nitrogen-free extract	61.46	58.98	56.43	55.85	53.94
Calcium (Ca)	1.06	0.92	1.21	1.29	1.15
Phosphorus (P)	0.60	0.60	0.84	0.74	1.15
Ca : P ratio	1.77	1.53	1.44	1.74	1.77
Energy : protein ratio	210.46	213.19	210.43	212.39	205.45
Tannins (%)	0.099	0.23	0.53	0.73	1.09
Phytins (mg/100 g)	128.88	142.86	142.86	182.15	285.71

[1]AAP = *Acacia albida* pods; [2]ME = metabolisable energy (calculated according to Pauzenga, 1985); [*]Premix (VitaDIZ B.P) manufactured by DIZPHARM (NIG); LAGOS; Supplying the following per kg: Vitamin A, 6250000 IU; Vitamin D_3 1250000 IU; Vitamin E, 15000 IU; Vitamin K, 1,250 mg; riboflavin, 3000 mg; pantothenic acid, 500 mg; pyridoxine, 1750 mg; Vitamin B_1 1000 mg; niacin, 15000 mg; Vitamin B_{12}, 10 mg; biotin, 25 mg; folic acid, 500 mg; choline chloride, 150 g, antioxidant, 62.5 g; iron, 50 g; manganese, 50 g; Zn, 50 g; iodine, 0.78 g; cobalt, 0.25 g; selenium, 0.05 g; copper, 5.0 g

The kidney fats (as percentage of slaughter weight) were higher in the rabbits on diets 1, 2, 3 and 4 than in the group on diet 5. Differences in the energy utilization of rabbits on the various diets may also account for the kidney fat since Zhao *et al.*. (1995) reported that rats receiving higher fibre diets dissipated higher proportion of the metabolisable energy intake as heat, thus having less energy left for fat synthesis. Ikurior and Kayode (1995) made similar observations in rabbits.

The significantly ($p<0.05$) heavier caecum in rabbits on diets 5 (high AAP 40% and CF of 14.84%) corroborates the results of Doma and Adegbola (1998) and Zhao *et al.* (1995) who observed an increase in relative size of caecum with increasing levels of fibre source in the diets, probably due to the fact that the caecum is the major site of fibre fermentation in rabbits.

The dressing percentage obtained in this study (48.21 to 52.0%) were close to the 50% reported by Fielding (1991) who observed that dressing percentage will tend to be 50% or less if the rabbit slaughtered is young or thin. The influence of slaughter weight on dressing percentage was previously reported by Garcia *et al.* (1993) and Onifade and Abu (1998). Garcia *et al.* (1993) reported dressing percentages of 58 and 60% for rabbits weighing 2.00 and 2.50 kg respectively, while Onifade and Abu (1998) obtained 52.8 and 54.1% from rabbits weighing 1.63 and 1.86 kg respectively. In this study, dressing percentage of 48.21 to 52% was obtained from rabbits weighing between 1.2 and 1.53 kg.

Table 2. Effect of feeding graded levels of *Acacia albida* pods on the body and organs of rabbits expressed percentage of the slaughter weight

Parameters	Diets/group number 1	2	3	4	5	
Levels of AAP[1](%)	0	10	20	30	40	SEM
No. of rabbits	5	5	5	5	5	-
Slaughter weight (g)	1532.0^{a}	1484.0^{a}	1478.0^{ab}	1386.0^{b}	1200.0^{b}	31.02^{*}
Dressed weight (g)	757.24^{a}	771.48^{a}	759.08^{a}	678.70^{b}	592.87^{c}	22.41^{*}
Percentage (%)	49.41^{bc}	52.0^{a}	51.32^{ab}	48.99^{c}	48.21^{c}	0.69^{*}
Weight of body components/organs as percentage of slaughter weight (%)						
Head	8.55^{a}	8.97^{ab}	9.02^{ab}	9.60^{a}	9.85^{a}	0.30^{*}
Skin (pelt)	8.69^{a}	8.72^{a}	8.26^{a}	8.89^{a}	7.94^{a}	0.23^{ns}
Tail	0.42^{a}	0.38^{a}	0.54^{a}	0.52^{a}	0.45^{a}	0.09^{ns}
Feet	2.22^{a}	2.12^{a}	2.16^{a}	2.35^{a}	2.26^{a}	0.09^{ns}
Heart	0.21^{a}	0.22^{a}	0.24^{a}	0.22^{a}	0.24^{a}	0.15^{ns}
Liver	2.39^{a}	2.39^{a}	2.51^{a}	2.56^{a}	2.78^{a}	0.11^{ns}
Lungs	0.65^{a}	0.76^{a}	0.67^{a}	0.67^{a}	0.58^{a}	0.05^{ns}
Spleen	0.04^{a}	0.05^{a}	0.03^{a}	0.04^{a}	0.05^{a}	0.007^{ns}
Kidneys	0.59^{a}	0.57^{a}	0.56^{a}	0.60^{a}	0.67^{a}	0.04^{ns}
GIT	14.67^{ab}	13.01^{bc}	11.06^{c}	13.53^{b}	16.34^{a}	0.82^{*}
Stomach	4.00^{a}	2.88^{b}	2.53^{b}	2.64^{b}	4.33^{a}	0.25^{*}
Small intestines	2.74^{a}	2.41^{a}	2.04^{a}	2.29^{a}	2.29^{a}	0.23^{ns}
Large intestines	2.20^{a}	2.18^{a}	1.46^{a}	2.50^{a}	1.95^{a}	0.24^{ns}
Caecum	4.88^{b}	5.06^{b}	5.22^{b}	6.23^{b}	7.19^{a}	0.51^{*}
Kidney fat	2.03^{a}	1.48^{ab}	1.70^{ab}	1.19^{ab}	0.64^{b}	0.35^{*}
Retail cuts as % of slaughter weight (%)						
Shoulder/forelegs	14.94^{ab}	15.91^{a}	15.10^{ab}	14.49^{bc}	13.84^{c}	0.36^{*}
Racks/ribs	4.46^{a}	4.24^{ab}	4.30^{ab}	3.76^{b}	3.75^{b}	0.18^{*}
Loin	11.28^{b}	12.02^{a}	12.02^{a}	11.33^{b}	11.89^{a}	0.09^{*}
Thighs/hind legs	18.98^{a}	19.76^{a}	19.88^{a}	19.30^{a}	19.85^{a}	0.59^{ns}

AAP = untreated *Acacia albida* pods; SEM = standard error of the means; a,b,c = means in the same row bearing different superscripts differ significantly ($p<0.05$); ns = not significant ($p>0.05$); GIT = gastrointestinal tract; * = significant ($p<0.05$)

As shown in Table 3, the weights of hot and cold retail cuts, especially shoulder, rack and loins of rabbits on diets 1, 2 and 3 were heavier and significantly ($p<0.05$) different from those on diets 4 and 5. The thighs however were similar for all the diets. The racks and loin (as percentage of hot and cold carcass weight) were not affected by the various dietary levels of AAP. The shoulder, loins and thighs constitute over 90% of the carcass weight and this explains why rabbits on diets 1, 2 and 3 with heavier shoulders, loins and thighs have heavier carcasses and hence higher meat yields. Oluokun (1985) reported similar findings in growing rabbits.

CONCLUSION

Levels of AAP beyond 20% inclusion in the diet may adversely affect the meat yield and carcass characteristics of growing rabbits.

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Table 3. Weight of carcass and retail cuts of rabbits fed graded levels of *Acacia albida* pods

	Diets					
Parameters	1	2	3	4	5	
Levels of AAP[1](%)	0	10	20	30	40	SEM
No. of rabbits	5	5	5	5	5	-
Hot carcass weight (HCW) (g)	757.24[a]	771.48[a]	759.08[a]	678.70[b]	529.87[c]	22.41[*]
Cold carcass weight (HCW) (g)	751.13[a]	765.28[a]	748.86[a]	672.25[b]	588.52[c]	21.98[*]
CCW as % of HCW (%)	98.60[a]	99.20[a]	98.66[a]	99.06[a]	99.26[a]	0.29[ns]
Drip loss percentage (%)	1.40[a]	0.80[a]	1.34[a]	0.94[a]	0.74[a]	0.29[ns]
Retail cuts (g)						
Shoulder/forelegs						
(Hot)	231.58[a]	236.18[a]	223.40[ab]	200.80[b]	167.50[c]	7.59[*]
(Cold)	223.26[a]	234.83[a]	220.14[ab]	198.79[b]	166.38[c]	8.03[*]
Racks/ribs						
(Hot)	68.19[a]	62.92[a]	63.60[a]	52.14[b]	45.18[b]	3.54[*]
(Cold)	67.42[a]	62.12[a]	62.54[a]	51.77[b]	44.93[b]	3.44[*]
Loin						
(Hot)	171.22[a]	178.19[a]	177.89[a]	156.85[b]	131.82[b]	6.13[*]
(Cold)	169.82[a]	177.02[a]	175.33[a]	155.80[a]	131.00[b]	5.66[*]
Thighs/hind legs						
(Hot)	289.33[a]	293.02[a]	294.08[a]	267.37[a]	250.91[a]	12.31[ns]
(Cold)	287.43[a]	291.53[a]	290.85[a]	265.88[a]	246.21[a]	11.86[ns]
Retail cuts as % of HCW and as % of CCW (%)						
Shoulder as						
% of HCW	30.04[a]	30.60[a]	29.40[ab]	29.60[ab]	28.22[b]	0.44[*]
% of CCW	30.19[a]	30.66[a]	29.36[ab]	29.58[ab]	28.25[b]	0.44[*]
Racks/ribs as						
% of HCW	8.97[a]	8.14[a]	8.40[a]	7.69[a]	7.69[a]	0.40[*]
% of CCW	8.94[a]	8.10[a]	8.37[a]	7.71[a]	7.70[a]	0.39[ns]
Loin as						
% of HCW	22.71[a]	23.10[a]	23.47[a]	23.09[a]	22.27[a]	0.79[ns]
% of CCW	22.71[a]	23.16[a]	23.44[a]	23.16[a]	22.29[a]	0.76[ns]
Thighs/hind legs						
% of HCW	38.10[b]	37.99[b]	38.72[b]	39.40[b]	42.22[a]	0.89[*]
% of CCW	38.16[b]	38.10[b]	38.83[b]	39.55[b]	41.76[a]	0.83[*]

AAP = untreated *Acacia albida* pods; SEM = standard error of the means; a,b,c = means in the same row bearing different superscripts differ significantly (p<0.05); ns = not significant (p>0.05); * = significant (p<0.05)

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