Effect of fibre and digestible energy levels on retail cuts, gut characteristics and morphology of growing rabbits

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Abstract

The retail cuts, gut characteristics and morphology of rabbits fed with varying dietary fibre and digestible energy (DE) levels were measured in a 70-d feeding trial using 135 weaner rabbits. The experiment was designed as a 3 × 3 factorial arrangement of treatments having 3 levels of dietary fibre (low, optimum and high) and 3 levels of DE (low, optimum and high). The rabbits were allotted to 9 dietary groups consisting of 15 rabbits each. Main effect of fibre and DE showed that dressing out percentage ($P < 0.05$), chilled carcass weight ($P < 0.05$) and reference carcass weight ($P < 0.01$) increased with increasing inclusion levels of fibre. Rabbits fed with (430 – 456 g/kg NDF, 249 – 253 g/kg ADF) had the highest ($P < 0.05$) weights of thoracic cage, loins, hind part, small intestine, empty caecum and highest ($P < 0.05$) villus height in the duodenum and jejunum. Rabbits fed (10.5 – 11 MJ/kg) diets had the least ($P < 0.05$) chilled and reference carcass weight. Interaction effect of fibre and DE showed that rabbit fed (445.70g/kgNDF, 252.10g/kgADF and 8.01MJ/Kg) diet recorded the highest ($P < 0.05$) chilled carcass weight. Rabbit fed with low fibre (249 – 258 g/kg NDF, 149 – 157 g/kg ADF) diets not withstanding the level of DE had low ($P < 0.05$) chilled and reference carcass weight. The villus height of the duodenum and crypt depth of the jejunum increased ($P < 0.05$) with increasing level of dietary fibre irrespective of the level of digestible energy. In conclusion, feeding of (440.41 g/kg NDF, 250.09 g/kg ADF, 10.52MJ/kg) diets to rabbits favoured improved retail cuts, gut characteristics and gut morphology.

Keywords: Weaner rabbits; Carcass yield; Organ weights; Gut characteristics; Gut morphology

Introduction

Rabbits utilize low grain and high roughage diets to produce cheap source of meat which is relatively lower in cholesterol, sodium and richer in protein than beef, chicken and pork (Biobaku and Oguntona, 1997). Rabbit has a high meat to bone ratio and meat yield of about 74% with only 20% of the dressed carcass as bone (Aduku and Olukosi, 1990). The anatomical equilibrium, tissues and muscle components in rabbits were reported to be

influenced by variations in the nutritional status (Lebas and Laplace, 1991; Ouhayoun, 1998; Dalle Zotte, 2002)

Previous findings showed that dietary fibre levels affected the gut characteristics and morphology of rabbits. The size of the caecum (Jehl and Gidenne, 1996) and the relative weight of ceecal contents (Garcia *et al.*, 1999) of rabbits were reported to be influenced by dietary ADF and NDF level. Yu and Chiou (1996) reported significant changes in the jejunal villus of growing

rabbits fed varying fibre levels. Chiou *et al.* (1994) reported that varying fibre components influenced the villus height of the colon, crypt depth of the duodenum and ileum of domestic rabbits. Although few studies have been conducted in the past to investigate the effect of fibre on gut characteristics and gut morphology of rabbits (Yu and Chiou 1996; Garcia *et al.*, 1999; Tao and Li, 2006), studies on the effect of digestible energy, interaction effect of fibre and digestible energy on the retail cut parts, gut characteristics and morphology is rare. This research was designed to investigate effect of dietary inclusion of varying fibre, digestible energy levels and combined interaction effect of fibre and digestible energy on retail cuts, gut characteristics and morphology of rabbits.

Materials and methods

Experimental design and dietary treatments

The study was carried out at the rabbit unit of the Teaching and Research Farm of the University of Agriculture, Abeokuta, Nigeria. Rabbits were kept in a well ventilated building in which the maximum temperature was 30 °C and the minimum temperature was 27.6 °C. A cycle of 12 h of light and 12 h of darkness existed throughout the duration of the trial. Nine experimental diets having three levels of dietary fibre (low (249–258 g/kg NDF, 149–157 g/kg ADF), optimum (349–381 g/kg NDF, 188–193 g/kg ADF) and high (430–456 g/kg NDF, 249–253 g/kg ADF)), and in each case with three DE levels (low (8–8.5 MJ/kg), optimum (10.5–11 MJ/kg) and high (12–12.30 MJ/kg)) were formulated for a 3 × 3 factorial arrangements (Table 1). Dietary NDF (Pinheiro *et al.*, 2009) and ADF (Gidenne *et al.*, 2004) levels regarded as low fibre in this study were as reported in

previous findings. Fibre components (NDF and ADF) considered as optimum in this study was as recommended by De blas and Mateous (1998) and Chao and Li (2008). Digestible energy levels of diets similar or close to the recommended value for maximum growth and meat production as reported in previous findings were considered as optimum (INRA, 1989; Lebas, 1991). The diets were offered to the animals in mash form.

Retail cuts and gut measurements

At the end of the 70 days trial, four rabbits were selected from each treatment. The rabbits selected were such that they had live weights similar or close to the mean live weight (LW) of rabbits in each treatment. Selected rabbits were slaughtered and carcasses prepared according to the norms of the World Rabbit Science Association (WRSA) (Blasco *et al.*, 1993). The chilled carcass weight (CCW) and reference carcass weight (RCW) (carcass without head and organs) were determined while the dressing out percentage (DoP) calculated ($100 \times \text{CCW}/\text{LW}$). The weights of the following tissues as a percentage of CCW were also determined; thoracic cage, loins and hind part. The weight of the gastrointestinal tract; small intestine, empty caecum and caecum content were measured. The length of the small intestine and caecum were also measured.

Gut morphometry

Sample portions of the intestinal segments (duodenum, jejunum and ileum) were taken from each rabbit for histological measurements. Each sample (of about 0.5 cm) was taken at the median part of each intestinal segment. The samples were opened longitudinally, rinsed with cold saline and fixed in a buffered formaline solution for about 4 h and later stored in ethanol/water, 70/30 (v/v) until further analysis. Histological analysis was done

Table 1: Gross composition of experimental diets

Fibre level	Low			Optimum			High		
Digestible energy level	Low	Optimum	High	Low	Optimum	High	Low	Optimum	High
Maize	225	190	130	235	195	135	204	164	124
Maize starch	90	110	145	90	115	140	80	100	120
Vegetable oil	5	20	45	5	20	55	10	30	50
wheat offal	230	230	230	140	140	140	60	60	60
Rice bran	90	90	90	130	130	130	195	195	195
Rice husk	60	60	60	100	100	100	151	151	151
Fixedingredients	300	300	300	300	300	300	300	300	300
Determined composition (in g/kg)									
Dry matter	901.4	910.4	901.1	909.2	899.7	908.8	906.2	900.9	899.7
Organic matter	898.8	897.0	898.5	901.1	890.2	889.5	901.8	892.2	900.5
Crude ash	91.20	92.50	94.50	88.90	90.40	88.80	86.20	84.20	90.60
NDF	257.71	252.11	249.70	380.11	370.79	350.22	445.70	440.41	431.24
ADF	157.00	154.20	149.70	192.40	189.61	188.00	252.10	250.09	249.44
ADL	46.67	46.10	45.82	56.40	55.91	55.34	71.90	69.71	67.82
Gross energy (MJ/Kg)	12.03	16.09	17.62	12.67	16.95	19.13	14.19	18.56	21.29
Digestible energy ^b (MJ/Kg)	8.17	10.97	12.11	8.06	10.84	12.27	8.01	10.52	12.09
Ca	12.90	13.00	12.55	13.00	12.72	13.10	13.00	14.10	13.90
P	8.10	7.99	7.55	8.00	9.55	8.95	8.20	8.00	8.11

a Contained : 250 g/kg soyabean meal (440 g/kg crude protein), 25.0 g/kg bone meal, 15.0 g/kg oyster shell, 2.0 g/kg lysine-HCL, 2.0 g/kg DL- methionine, 3.0 g/kg salt (NaCl) and 3.0 g/kg vitamin/mineral premix (providing the following per kg of diet 0.04g manganese, 0.034 g zinc, 0.023 g iron, 0.0026 g copper, 2.48 mg retinol, 0.003 mg cholecalciferol, 5.55 mg riboflavin, 0.70 mg thiamin, 0.70 mg pyridoxine, 2.80 mg niacin, 0.35mg calcium pantothenate and 0.70 mg cyanacobalamin
^bCalculated using deBlas et al., (1992) (DE=GE × (0.867-0.0012ADF))

according to the procedure of Goodlad *et al.* (1991). The preparations were mounted between slide and strip. Intestinal villi with their crypts were individually separated under a dissecting microscope. The length and width of the villi were measured according to the procedure described by Hampson (1986) using an optical microscope, camera and an image analysis.

Statistical Analysis

Data obtained were laid out in a 3×3 factorial arrangement of treatments having three dietary fibre (low, optimum and high) and three DE levels (low, optimum and high). Data obtained were analysed using SAS (2003) Software Package. Analysis was done to determine the main effects of fibre levels, digestible energy levels and combined interaction effect of dietary fibre and digestible energy levels. Significant means were separated using Duncans Multiple Range Test as outlined by Daniel (1991).

Results

Retail cuts and Gut characteristics

Table 2 shows the main effect of dietary fibre and DE level on weights of retail cuts and guts of rabbits. Dressing out percentage ($P < 0.05$), chilled carcass weight ($P < 0.05$) and reference carcass weight ($P < 0.01$) increased with increasing dietary inclusion levels of fibre. Rabbits fed with (430 – 456 g/kg NDF, 249 - 253 g/kg ADF) also had the highest ($P < 0.05$) thoracic cage, loins, hind part, small intestine and empty caecum weights. Rabbits fed (12 – 12.30 MJ/kg) diets recorded the highest ($P < 0.05$) dressing out percentage, chilled carcass weight and reference carcass weight while those fed (10.5 – 11 MJ/kg) diets had the least ($P < 0.05$) chilled and reference carcass weight. Small intestine length reduced ($P < 0.05$) with increasing DE. The weights of thoracic cage, loins, hind parts,

small intestine, empty caecum and caecum content were not affected ($P > 0.05$) by the DE level of the diet.

There existed an interaction effect ($P < 0.05$) of dietary fibre and DE level on dressing out percentage, chilled and reference carcass weight, weight of the hind parts, caecum content and length of the small intestine (Table 3). High ($P < 0.05$) dressing out percentages were obtained with rabbits fed (370.70 g/kg NDF, 189.61 g/kg ADF and 10.84 MJ/kg), (350.22 g/kg NDF, 188.00 g/kg ADF and 12.27 MJ/kg), (445.70 g/kg NDF, 252 g/kg ADF and 8.01 MJ/kg), (440.41 g/kg NDF, 250.09 g/kg ADF and 10.52 MJ/kg) and (431.24 g/kg NDF, 249.44 g/kg ADF and 12.09 MJ/kg). Rabbit fed with diet containing (445.70 g/kg NDF, 252 g/kg ADF and 8.01 MJ/kg) showed the highest ($P < 0.05$) chilled carcass weight. Rabbit fed with low fibre diets not withstanding the level of DE, recorded low ($P < 0.05$) chilled and reference carcass weight. Similarly, all rabbits fed with ((12 – 12.30 MJ/kg) diets (irrespective of dietary fibre level) showed poor chilled carcass weight. Weights of reference carcass, hind parts and caecum content obtained for rabbits fed with (445.70 g/kg NDF, 252 g/kg ADF and 8.01 MJ/kg) and those fed (440.41 g/kg NDF, 250.09 g/kg ADF and 10.52 MJ/kg) showed statistically similar values which were higher than values obtained for rabbits fed with other treatment.

Gut Morphology

The main effect of varying dietary fibre and DE level on gut morphology of rabbits is shown in Table 4. The villus height of the duodenum and crypt depth of the jejunum increased ($P < 0.05$), whereas villus height of the ileum reduced ($P < 0.05$) with increasing level of fibre. Rabbit fed (349 – 381 g/kg NDF, 188 - 193 g/kg ADF) recorded the least ($P < 0.05$) crypt depth of

Table 2: Main effect of varying dietary fibre and digestible energy on weights of retail cuts and guts of rabbits

Parameters	Main effect of fibre					Main effect of digestible energy				
	Low	Optimum	High	SEM	P value	Low	Optimum	High	SEM	P value
Final liveweight (g)	901.00 ^c	1085.00 ^b	1140.90 ^a	101.22	0.034	1053.83	1029.33	1043.00	99.54	0.760
Dressing out percentage (%)	71.74 ^c	82.34 ^b	84.62 ^a	6.98	0.032	78.52 ^b	78.81 ^b	83.14 ^a	6.46	0.040
Chilled carcass weight (g)	646.40 ^c	893.47 ^b	965.53 ^a	28.25	0.022	826.90 ^b	811.30 ^c	867.20 ^a	26.10	0.031
Reference carcass weight (g)	538.89 ^c	778.67 ^b	863.83 ^a	25.30	0.002	736.21 ^b	663.94 ^c	781.23 ^a	33.10	0.042
Weights expressed as %										
CCW										
Thoracic cage	8.20 ^b	9.03 ^{ab}	9.57 ^a	0.97	0.044	9.30	8.90	8.61	0.76	0.055
Loins	13.09 ^b	13.97 ^{ab}	14.55 ^a	3.07	0.047	14.03	13.76	13.80	2.11	0.056
Hind part	16.02 ^b	17.29 ^{ab}	18.15 ^a	4.22	0.042	17.34	16.96	17.15	3.07	0.092
Small intestine weight	3.75 ^b	2.86 ^c	5.15 ^a	0.57	0.035	3.64	4.53	3.59	0.75	0.072
Empty caecum	1.81 ^b	2.00 ^b	2.57 ^a	0.30	0.042	1.99	2.49	1.90	0.12	0.052
Caecum content	15.88 ^{ab}	14.87 ^b	17.55 ^a	4.69	0.044	16.50	16.75	15.04	2.37	0.102
Small intestine length(cm)	26.22 ^a	24.67 ^b	22.00 ^c	8.41	0.022	26.22 ^a	24.10 ^b	21.67 ^c	5.43	0.044
Caecum length(cm)	8.67	7.67	7.67	1.33	0.775	8.33	7.67	8.00	0.29	0.077

^{a,b,c}Means on the same row with different superscripts are different significantly (P<0.05)

CCW= Chilled carcass weight

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Table 3: Interaction effect of varying dietary fibre and digestible energy on retail cuts and gut characteristics of rabbits

Fibre level	Low			Optimum			High			SEM	P value
Digestible energy level	Low	Optimum	High	Low	Optimum	High	Low	Optimum	High		
Final live weight(g)	809.50 ^h	847.50 ^g	1046.00 ^e	1130.00 ^c	1060.00 ^d	1065.70 ^d	1222.00 ^a	1180.50 ^b	1020.20 ^f	102.44	0.022
Dressing out Percentage (%)	65.19 ^c	65.54 ^c	81.84 ^b	79.91 ^b	83.73 ^{ab}	83.50 ^{ab}	85.92 ^a	83.97 ^{ab}	83.87 ^{ab}	6.03	0.032
Chilled carcass weight(g)	527.70 ^g	555.50 ^f	856.0 ^e	903.0 ^c	887.50 ^d	889.90 ^d	1050.00 ^a	990.90 ^b	855.70 ^e	26.09	0.025
Reference carcass weight(g)	424.64 ^c	422.33 ^e	769.69 ^c	802.00 ^b	752.00 ^d	782.00 ^d	982.00 ^a	817.50 ^{ab}	792.00 ^b	21.15	0.024
Weights in % CCW											
Thoracic cage	8.02	8.04	8.55	9.66	8.65	8.78	10.22	10.01	8.50	0.71	0.950
Loins	12.66	12.65	13.95	14.22	13.88	13.80	15.22	14.76	13.66	2.06	0.077
Hind part	15.25 ^c	15.76 ^c	17.04 ^b	17.52 ^b	17.12 ^b	17.22 ^b	19.26 ^a	18.00 ^{ab}	17.20 ^b	3.04	0.022
Small intestine	3.09	3.10	3.25	3.11	3.26	3.10	3.70	5.43	4.93	0.41	0.053
Empty caecum	1.56	2.60	1.27	2.00	2.00	2.00	2.40	2.86	2.44	0.02	0.090
Caecum content	17.43 ^b	17.11 ^b	13.11 ^e	13.30 ^e	15.44 ^d	15.87 ^{cd}	18.00 ^a	17.70 ^{ab}	16.14 ^c	2.49	0.032
Small intestine length(cm)	27.67 ^a	24.99 ^c	26.01 ^b	26.00 ^b	24.00 ^b	24.00 ^b	25.00 ^c	26.00 ^b	15.00 ^d	4.52	0.044
Caecum length(cm)	8.00	9.00	9.00	7.99	7.00	8.00	9.00	7.00	7.00	0.98	0.055

^{a,b,c, d,e,f,g,h} Means on the same row with different superscripts are different significantly (P<0.05), CCW= Chilled carcass weight

the duodenum, Dietary fibre level had no effect ($P > 0.05$) on villus/crypt ratio of the duodenum and jejunum, crypt depth and villus/crypt ratio of the ileum. Rabbits fed (10.5 – 11 MJ/kg) diets showed reduced ($P < 0.05$) villus height of the duodenum. However, higher values of duodenal villus height were obtained for rabbits fed either (8 – 8.5 MJ/kg) or (12 – 12.30 MJ/kg).

Interaction effect of dietary fibre and DE level on gut morphology of rabbits is shown in Table 5. Notwithstanding the level of DE of the diet, duodenal villus height and jejunal crypt depth increased ($P < 0.05$) with increasing level of dietary fibre. Rabbits fed with (430 – 456 g/kg NDF, 249 – 253 g/kg ADF) diets irrespective of the DE level of the diet showed high ($P < 0.05$) duodenal villus height, jejunal villus height and crypt depth. Rabbit fed with (249 – 258 g/kg NDF, 149 – 157 g/kg ADF) diets recorded the least ($P < 0.05$) duodenal villus height and jejunal crypt depth.

Discussion

High dressing out percentage recorded with rabbits fed high fibre diets ((370.79 g/kg NDF, 189.61 g/kg ADF and 10.84 MJ/kg), (350.22 g/kg NDF, 188.00 g/kg ADF and 12.27 MJ/kg), (445.70 g/kg NDF, 252.10 g/kg ADF and 8.01 MJ/kg), (440.41 g/kg NDF, 250.09 g/kg ADF and 10.52 MJ/kg), 431.24 g/kg NDF, 249.44 g/kg ADF and 12.09 MJ/kg in the current study implied that (430 – 456 g/kg NDF, 249 – 253 g/kg ADF) diets favoured improved carcass yield in rabbits. Dietary fibre level in rabbit nutrition seems more crucial than digestible energy level. Low chilled and reference carcass weights obtained with rabbits fed (249 – 258 g/kg NDF, 149 – 157 g/kg ADF) diets irrespective of digestible energy level are confirmatory to the findings of Tao and Li (2006) that (430 – 456 g/kg NDF, 249 – 253 g/kg ADF) diets favoured improved

carcass yield in rabbits.

The poor chilled carcass weight (this is contrary to high dressing out percentage obtained. What led to poor chilled carcass weight cannot be attributed to high DE since high fibre + DE gave high dressing out percentage) obtained in this study with rabbits fed (12 – 12.30 MJ/kg) diets (irrespective of dietary fibre level) agreed with previous studies that feeding diets highly rich in energy concentration to rabbits during post weaning period compromised growth and carcass yield (Dalle Zotte *et al.*, 1997; Xicatto *et al.*, 1998). Rabbits fed with (12 – 12.30 MJ/kg) diets have been reported to ingest less than 85 percent of the normal daily feed intake hence growth, feed efficiency and slaughters yield are seriously compromised (Quhayoun, 1998; Dalle Zotte, 2002).

In the current study, weights of liver, kidney, trachea + lung and heart were not affected ($P > 0.5$) by varying fibre and DE levels. However, increased weights of empty caecum and caecum content obtained with increasing dietary fibre level resulted from high intake of fibrous feed which lead to significant increase in weight of the gut (Chao and Li, 2008). Previous reports confirmed that increase in dietary ADF and NDF resulted in high caecal content weight and relative caecum content weight (Gidenne, 1996; Garcia *et al.*, 1999). It also agreed with Tao and Li (2006) who reported increased weight of the stomach, caecum, relative colon weight and length of colon with increased dietary intake of NDF.

An increased villus height of the duodenum, villus height and crypt depth of the jejunum obtained in this study with increasing dietary fibre (irrespective of DE level of the diet) could be associated with increased epithelial cell turnover (Fan *et al.*, 1997) and increase in surface area capable

Table 4: Main effect of varying dietary fibre and digestible energy on gut morphometry of rabbits

Parameters	Main effect of fibre					Main effect of digestible energy				
	Low	Optimum	High	SEM	P value	Low	Optimum	High	SEM	P value
Duodenum										
Villus height(μm)	490.33 ^c	519.67 ^b	582.33 ^a	10.88	0.024	534.30 ^a	524.70 ^b	533.30 ^a	12.40	0.027
Crypt depth(μm)	142.33 ^a	131.00 ^b	143.33 ^a	11.03	0.033	139.00	138.67	139.00	10.90	0.077
Villus height/Crypt Depth	3.44	3.96	4.06	0.63	0.795	3.85	3.78	3.83	0.84	0.075
Jejunum										
Villus height(μm)	490.67 ^b	492.33 ^b	552.33 ^a	13.44	0.022	511.33	511.67	512.30	13.20	0.995
Crypt depth(μm)	119.00 ^c	132.33 ^b	143.67 ^a	13.15	0.042	133.33	132.10	129.67	10.66	0.950
Villus height/Crypt Depth	4.12	3.72	3.84	0.03	0.950	3.85	3.88	3.96	0.09	0.092
Ileum										
Villus height(μm)	415.67 ^a	406.67 ^b	401.33 ^c	13.05	0.041	411.33	408.33	404.00	11.24	0.775
Crypt depth(μm)	105.33	106.00	105.33	9.87	1.095	107.67	103.00	106.00	9.91	0.950
Villus height/Crypt Depth	3.94	3.81	3.81	0.08	0.083	3.82	3.96	3.81	0.05	0.065

^{a,b,c} Means on the same row with different superscripts are different significantly (P<0.05)

Table 5: Interaction effect of varying dietary fibre and digestible energy on gut morphometry of rabbits

Fibre level	Low			High			Low				
Digestible energy level	Low	Optimu m	High	Low	Optimum	High	Low	Optimu m	High	SEM	P value
Duodenum											
Villus height(μm)	499.00 ^f	482.00 ^h	490.00 ^g	522.00 ^d	512.00 ^e	525.00 ^c	582.00 ^b	580.00 ^b	585.00 ^a	12.25	0.023
Crypt depth(μm)	145.00 ^{ab}	142.00 ^{bc}	140.00 ^c	132.00 ^d	130.00 ^d	131.00 ^d	140.00 ^c	144.00 ^{ab}	146.00 ^a	10.73	0.042
Villus height/Crypt depth	3.44	3.39	3.50	3.96	3.93	4.00	4.15	4.02	4.00	0.09	0.065
Jejunum											
Villus height(μm)	502.00 ^d	490.00 ^f	480.00 ^g	490.00 ^f	495.00 ^e	492.00 ^c	542.00 ^c	550.00 ^b	565.00 ^a	11.58	0.022
Crypt depth(μm)	120.00 ^d	122.00 ^d	115.00 ^c	135.00 ^b	132.00 ^{bc}	130.00 ^c	145.00 ^a	142.00 ^a	144.00 ^a	10.64	0.037
Villus height/Crypt depth	4.18	4.02	4.17	3.62	3.75	3.78	3.73	3.87	3.92	0.07	0.077
Ileum											
Villus height(μm)	420.00	415.00	412.00	415.00	410.00	395.00	399.00	400.00	405.00	11.25	0.096
Crypt depth(μm)	107.00	105.00	104.00	109.00	104.00	105.00	107.00	100.00	109.00	9.87	0.077
Villus height/Crypt depth	3.92	3.95	3.96	3.80	3.94	3.76	3.72	4.00	3.71	0.06	0.095

^{a,b,c, d e, f, g} Means on the same row with different superscripts are different significantly (P<0.05)

of greater absorption of available nutrients (Caspary, 1992). Samanya and Yamauchi (2002) reported that longer villi are associated with activated cell mitosis. An increase in villus height and villus /crypt ratio is known to associate with better nutrient absorption, improved disease resistance and growth performance in poultry (Wu *et al.*, 2004) and weaner pigs (Pluske *et al.*, 1996). This corroborates the improved growth and carcass yield obtained with rabbits fed (430 – 456 g/kg NDF, 249 - 253 g/kg ADF) diets. Reduced duodenal villus height and jejunal crypt depth obtained with rabbits fed (249 – 258 g/kg NDF, 149 - 157 g/kg ADF) diets are linked with low secretory activities (Brunsgaard and Eggum, 1995; Hedemann *et al.*, 2003) and implicative of poor nutrient absorption, and reduced performance (Xu *et al.*, 2003). The increase in duodenal villus height and jejunal crypt depth of rabbit observed with increasing level of dietary fibre showed an intestinal structure more oriented toward digestion with improved absorptive and hydrolysis potential. The findings of this study agreed with earlier reports on rabbits (Chiou *et al.*, 1994; Yu and Chiou, 1996).

In conclusion, dietary inclusion of (430 – 456 g/kg NDF, 249 - 253 g/kg ADF) (irrespective of digestible energy level) in rabbit nutrition favoured improved retail cuts, gut characteristics and gut morphology with no adverse effect on the weights of the organs.

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