Journal of Agriculture and Veterinary Sciences
Volume 8, Number 1, 2016
ISSN: 2277-0062

CARCASS AND GUT CHARACTERISTICS OF BROILER CHICKEN FED VARYING LEVELS OF PARTIALLY SPROUTED BAMBARANUT

A. Umar, U.D. Doma, & K.M. Bello

Animal Production Programme,
Abubakar Tafawa Balewa University, Bauchi, Nigeria
Email: malikhassan797@yahoo.com

ABSTRACT

The effect of feeding broiler chicken with varying levels of partially sprouted bambaranut on the carcass and gut characteristics was investigated. Five diets were formulated in which partially sprouted bambaranut was included at 0, 10, 20, 30 and 40% replacing soybean and coded as diets 1, 2, 3, 4 and 5, respectively. Two hundred day old marshal unsexed broiler chicks were randomly allocated to five dietary treatments in a completely randomized design and each of the treatment was replicated three times. Results showed that live weight and carcass parameters such plucked weight, eviscerated weight and carcass weight all differs significantly ($p<0.001$) with diet 5 recording the highest weight, whereas dressing %,kidney, spleen, heart, gizzard, pancreas, small intestine, large intestine, abdominal fat, caecal, liver, head and leg weight did not differ significantly ($p<0.05$). The study therefore reveals that using partially sprouted bambaranut has no adverse effect on the carcass and gut characteristics of broiler chickens.

Keywords: Broiler Chickens, Sprouted, Bambaranut, Antinutritional Factors.

INTRODUCTION

Bambaranut is probably the most drought-resistant of the grain legumes and may be found growing successfully where annual rainfall is below 500mm and optimum between 900-1000mm per year. The crop can be grown under dry climatic conditions where the rainfall during the rainy season would be adequate to enable them to accomplish their vegetative cycle (Borget, 1992). An evenly distributed rainfall in the range 600-1000mm encourages optimum growth but satisfactory yields can be obtained in areas with a pronounced dry season since the crop is relatively drought resistant (Messaien, 1992). Bambaranut is resistant to high temperatures and can be grown on poor marginal soils not suitable for other leguminous crops (Yamaguchi, 1993). The crop is not attacked by diseases and pests in any of its production regions. However, in damp conditions, it may be susceptible to various fungal diseases (Baudoin and Mergeai, 2001). It has a very low insect pest and disease susceptibility (Tweneboah, 2000). The crop ranks third among the grain legume crop of Africa in terms of production and consumption after groundnut and cowpea. Dry bambaranut seeds contain 17.3 - 22.9% crude protein (Ndiokwere, 1982) while the waste contains 16.19% crude protein (Okeke, 2000). Bambaranut has been identified as an underutilized feed resource of livestock and is indigenous to Africa. It has high nutritional quality (CP 27%, NFE 60%, EE 9% and gross 19MJ/kg DM) (Pfetter*et al.,* 2002).

It is widely grown and distributed in a number of states in Nigeria. Studies in livestock production have shown that bambaranut can be used in the feeding of poultry and rabbits (Maidala*et al.*, 2011). The use of bambaranut and its products are limited due to the presence of anti-nutritional factors such as cyanogens, flatulence factors, tannins, trypsin inhibitors and haemugluttinins in the raw state (Doku and Karikari, 1981; Ensminger, 1998). The methods of processing the seeds against these anti-nutritional factors have been a major challenge to most poultry farmers (Okogbare and Akpodiete, 2006). Akande and Fabiyi (2010) reported different methods of eliminating /reducing anti nutritional factors of raw legumes to a tolerable limit by various methods which includes application of heat treatment, germination (sprouting), fermentation, extrusion, salt treatment, toasting and chemical treatment. It is against this background that this research work attempt to evaluate the sprouting processing method of bambaranut on the production of broiler chickens.

MATERIALS AND METHODS

EXPERIMENTAL SITE

The study was conducted at the Poultry Research Farm of Abubakar Tafawa Balewa University Bauchi, Bauchi State. The state occupies a land area of about 66,000 square kilometers. The state lies between Longitude 10^0 10 to 100 33' N and Latitudes 9^0 40' to 10^0 31' E at an altitude of 6902 meter above sea level. Data on major weather elements showed that the state has two main seasons, rainy season (June–October) and dry season (November–May). The total mean rainfall is 700-900mm for southern zone, 690–1031mm for central zone and 900 – 1300mm for western zone, (BSADP, 2003). The temperature ranges from 19.15^0C to 38.5^0C, the hottest months being March and April while the coldest months are January and February. Similarly, August recorded the highest relative humidity (99%) and February has the lowest (57%), (Anonymous, 1999).

MANAGEMENT OF THE EXPERIMENTAL BIRDS AND DESIGN

Prior to the arrival of the day-old chicks, the brooding room and pens were thoroughly washed, disinfected fumigated using 35g of potassium permanganate crystals and 2mls of 40% formaldehyde solution which produced formalin gas that killed all germs and pathogens in the room. A total of two hundred day-old Marshal unsexed broiler chicks were purchased from Bukuru, Plateau State. On arrival of the chicks, they were allowed access to water containing anti stress (Biovit) and antibiotics to aid their adjustment. The birds were brooded for one week on deep litter at temperature of between 32–35^{0}C using 200 watts electricity bulb and hurricane lantern as sources of heat. Commercial broiler starter was fed to them during the seven days brooding period. After brooding, the chicks were randomly assigned to five dietary treatments replicated three times with thirteen birds per pen. The remaining five birds were distributed to each treatment.

EXPERIMENTAL DIETS

Five experimental diets were formulated in which partially sprouted bambaranut was included at 0, 10, 20, 30 and 40% inclusion levels. Maize was the source of energy while partially germinated bambaranut and fish meal were the protein sources. The diet were formulated to supply approximately 3000 kcal/kg ME, 23 and 20% crude protein for both starter and finisher phase. Wheat offal, premix, bone meal, salt, lysine and methionine were also used as supplements in the diets. The ingredients chemical composition and calculated analysis of the experimental diet for both starter and finisher phases are shown in Tables 2 and 3 respectively.

STATISTICAL ANALYSIS

Data generated for all the parameters studied (feed intake, daily weight gain, feed conversion ratio, mortality, and carcass characteristics as well as the economic analysis) were subjected to analysis of variance techniques as outlined by Steel and Torrie (1980). Differences between treatment means were using Duncan's Multiple Range Test (Duncan, 1995).

RESULTS

The chemical composition of raw and partially sprouted bambaranut including antinutritional factors were determined by the methods outlined by AOAC

(1990) and shown in Table 1. Results showed that partially sprouted bambaranut contains higher crude protein (21.0%), crude fiber (5.30%) and ash (3.79%) but lower ether extract (4.67%), nitrogen free extract (56.67%) and dry matter (80.10%). Also, the antinutritional factors were significantly reduced in the partially sprouted bambaranut as compared to the raw bambaranut. Result of carcass and gut characteristics are as presented in Table 4. Significant differences ($P < 0.001$) were observed among the treatment for live weight (1.57 to 2.37 kg). The highest live weight was recorded in birds fed diet 5 (40% bambaranut inclusion), while the lowest was recorded in the control (0% bambaranut inclusion). There was significant differences ($p<0.001$) in plucked weight which ranged from 1.46 to 2.20 kg, birds fed diet 5 recorded the highest plucked weight. Whereas, there was no significant difference in birds fed diets 1, 2, 3 and 4 respectively. Significant difference ($p<0.001$) was observed among the treatments for eviscerated weight which ranged between (1.20 to 1.83kg). The highest value was recorded in birds fed diet, while diets 1, 2, 3 and 4 did not differ significantly. Carcass weight varied from 1.06 to 1.68kg however there was significant difference ($p<0.001$) in the diet, diet 5 also recorded the highest weight.

Dressing percentage ranged from 66.21 to 72.51, however there was no significant difference across the dietary treatments. The highest value was observed in birds fed diet 3 (20% bambaranut inclusion), the lowest value was observed in birds fed diet 4. There was no significant difference among diets for head and leg weight, the values were as follows diet 4 (7.58%) had a higher head and leg weight when compared to diet 3 (7.40%), 1 (7.28%) and 2 (7.21%) while birds on diet 5 (6.56%) recorded the lowest head and leg weight. There was also no significance difference among the diets for lungs weight. Diet 2 (0.62%) had the highest lung weight while birds on diet 1 (0.62%) and 5 (0.62%) recorded statistically the same weight. Diet 3 (0.50%) recorded the lowest lung weight. There was no significant difference among diets for kidney weight, the values ranges from 0.29% for diet 1, diet 2 (0.25%), 4 (0.25%) and 5 (0.25%) all recorded the same weight. However, diet 3 (0.21%) recorded the lowest kidney weight.

Similarly, there was also no significant difference among diets for spleen weight, though the highest weights were recorded on diet 1 (0.14%) and 4 (0.14%) which both recorded similar weight. Just as diet 2 (0.10%) and 5 (0.10%) equally recorded similar weight. There was no significant difference among diets for heart weight, birds on dietary diet 1 (0.49%) had the highest heart weight, followed by both diets 2 (0.48%) and 4 (0.48%) that recorded similar heart weight. Diet 5 (0.43%) recorded the lowest heart weight. There was no significant difference among diets for gizzard weight, birds on dietary 1 (2.55%) recorded the highest gizzard weight while diet 5 (2.23%) recorded the lowest gizzard weight. There was no significant difference among diets for pancreas weight, birds on diet 2 (0.43%) recorded numerically higher value, while birds on diet 4 (0.28%) recorded the least value. Also, no significant difference was recorded among diets for small intestine weight, birds on diet 1(5.65%) recorded the highest small intestine weight while the lowest small intestine weight (5.09%) was recorded on diet 3. Similarly, no significant difference was recorded among diets for large intestine weight, birds on diet 1 (0.28%) recorded the highest weight followed by diet 2 (0.26%). Diet 4 (0.24%) and 5 (0.24%) recorded similar large intestine weight. There was no significant difference in abdominal fat percentage, however diet 2 (1.48%) had a higher weight when compared to diets 1 (1.45%), 3 (1.43%) and 5 (1.35%). However, the least abdominal fat weight was observed in birds fed diet 4 (1.20%). There was no significant difference observed in caecal weight among the diets, however birds on diet 1 (0.88%) had a higher caecal weight when compared to others. The lowest caecal weight (0.69%) was observed in diet 2. There was no significant difference among the diet means for liver weight. Diet 1 (2.43%) recorded the highest liver weight when compared to other diets. Diet 5 (2.02%) recorded the lowest liver weight.

DISCUSSION

The effect of diets shows significantly ($P < 0.001$) difference on the live weight, plucked weight, eviscerated weight and carcass weight. Birds on diet 5 recorded the highest live weight (2.37kg), meaning that as the level of partially sprouted bambaranut meal increases so also the body weight. The values of live weight reported in this study are within the range reported by Ekenyem and Odor (2011) on bambaranut sievate. The slaughtered weight followed the same trend being higher with diet 5. The plucked weight followed the same trend being significantly higher at diet 5. The enhanced plucked weight of diet 5 (2.20kg), eviscerated weight (1.83kg) and carcass weight (1.68kg) are all functions of live weight which indicate efficient utilization of the feed. This finding agrees with the work of Dauda (2005) that increase in the level of bambaranut results in increase in live weight. Also this finding equally agrees with that reported by Yusuf (2000) which according to him broilers placed on high energy – protein ratio diet tend to have improve carcass weight than those placed on low energy – protein ratio diet.

The result obtained was slightly lower than that reported by Dauda (2005) who fed graded levels of bambaranut and observed a range of 2.49 – 2.68kg. The finding also disagrees with the work of Musa (2006) who reported that increase in roasted bambaranut level results in decrease in body weight. The result obtained was slightly higher than the one reported by Kperegheyi *et al.* (2007) who studied the effect of raw and toasted bambaranut on the performance of growing cockerels and reported poor performance by birds fed toasted bambaranut diet. McDonald *et al.*, (1998) attributed poor performance of birds fed toasted bambaranut probably due to heating process during toasting which may have denatured the proteins in the bambaranut making them unavailable for the birds. The significant difference ($P < 0.01$) in carcass weight was as result of the significant difference in the live weight of the birds slaughtered. This result agrees with the findings of Yisa (2008) who reported that carcass yield of broiler finisher fed diets containing pigeon pea which has crude protein that ranges between 17.9 – 30% similar to that of bambaranut can be successfully used in broiler ratio of up to 50% level with no adverse effect on performance.

The birds were able to effectively utilize the partially sprouted bambaranut because during sprouting, storage proteins are hydrolyzed and the amino acids are transported into the growing seedling axis. The increase in hydrolytic activities of the enzymes of sprouting resulted in improvement in the constituent of total protein due to disappearance of starch (Anonymous, 2008). Phytic acid serves as an important reserve of phosphate generated by the action of phatase during seed germination for the developing seedling. Sharma *et al.* (1996) reported that reduction in the levels of phytic acid increased the availability of the minerals in the digestive tract of animals as the chelating capacity of phytic is reduced.

The process of sprouting is believed to facilitate the inactivation process of concanavalin A in seeds since haemagglutinating activity has been reported to decrease with germination. Also, Pusztai (1989) reported that haemagglutinnins has severe negative effects on protein and carbohydrate metabolism, hormonal function, enzyme activities and immune functions. It has also been noted to result in severe reduction in feed intake of monogastrics and thus leading to growth depression (Larue-Achagiotis *et al.*, 1992). Trypsin inhibitor has been implicated in reducing protein digestibility and in pancreatic hypertrophy. Liener and Kakade (1980) observed that trypsin inhibitor inhibits the proteolytic activity of the digestive enzymes trypsin which can lead to reduction in the availability of amino acids. The dressing percentage was not affected by the dietary levels, the value reported in this work is similar to the values reported by Musa, 2006; Dauda, 2005. All the other parameters measured which include head/legs, lung, kidney, spleen, heart, gizzard, pancreas, small intestine, large intestine, abdominal fat, caecal and liver did not show any significant difference. The result of this study on the internal organs is in conformity with a report by Musa (2006) on carcass analysis which showed that there was no significant difference on leg/head, and internal organs such as lungs, kidney, spleen, heart, gizzard, pancreas, small intestine, large intestine, abdominal fat, caecal and liver weights.

ACKNOWLEDGEMENT
My profound gratitude goes to the entire management of Animal production laboratory for carrying out my analysis. Also, to my supervisors: Professor Umar Doma Dass and Dr. (Mrs) Khadija Bello.

REFERENCES

Akande, K.E. and Fabiyi, E.F., 2010. Effect of Processing Methods on some Antinutritional Factors in Legume Seeds for Poultry Feeding. *International Journal of Poultry Science,* **9** (10): 996-1001

Anonymous, 2008. Sprouting Nutrition Information. Http//enwik.pedia.org Accessed Date 23/2/2008

Anonymous, 1999. Weather Records Collected from Bauchi Airport Meteorological Station. Bauchi, Bauchi State.

AOAC (1995). Official Methods of Analysis. 16th Ed. Association of Official Analytical Chemists.

Bauchi State Agricultural Development Programme (BSADP) (2003). Annual Report

Baudoin, J.P. and Mergeai, G., 2001. Grain Legumes in Crop Production in Tropical Africa. Pp. 313-317

Borget, M. (1992). Food Legumes. In: The Tropical Agriculturalist, CTA Macmillan.

Dauda, S.,2005. Nutritional Evaluation of Bambaranut Based Diet Fed to Broiler Chickens. M.Sc Thesis, Abubakar Tafawa Balewa University, Bauchi. Pp 84

Doku, J.A. and Karikari, O.O., 1981. Tropical Grass Legume Bulletin. **31**: 20-22 Duncan, D.B., 1995. Multiple Range and F.Test *Biometrics* **11**: 1-42

Ekenyem, B.U. and Odor, B.I., 2011. Effect of Replacement of Soya Bean Meal by Bambaranut Sievate on the Carcass and Organ Parameters of Finisher Broiler Chicks. *Open Journal of Animal Science,* **1** (3): 93-96

Ensminger, M.C. Oldfield, J.E. and Heinemann, W.N., 1996. Feeds and Nutrition. (The Ensminger Publishing Company; Clovis Carlifornia, USA) Pp 324-366

Kperegbeyi, J.I. and Onwumere, O.S., 2007. Effect of Raw and Toasted Bambara Groundnut on the Performance of Growing Cockerels. **Proceedings of the 32nd Annual Conference of the Nigerian Society for Animal Production** 18-21 March 2007, Calabar- Nigeria.

Larue-Achagiotis, C., Pichard, M. and Louis-Sylvestre, J., 1992. Feeding Behaviour in Rats on a Complete Diet Containing Concanavalin A. *Reproduction and Nutrition Development,* **32**: 343-350

Liener, I.E. and Kakade, M.I. (1980). Protease Inhibitors. **In**: Toxic Constituents of Plant Foodstuffs (Ed. Liener, I.E.) New York; Academic Press, Pp. 7-71

Maidala, A., Zagi, S. P. and Ajighjigh, D.T., 2011. Performance of Weaner Rabbits Fed Graded Levels of Toasted Bambaranut (Vigna subterranean (L.) Verdc) as a Partial Replacement for Soya Bean. *Journal of Environment, Technology and Sustainable Agriculture*, **1** (1): 128-131

McDonald, P., Edwards, R.A., Greenhalgh, J.F. and Morgan, C.A. (1998). **Animal Nutrition. Fifth Edition.** Longman Pp 514 - 515

Messiaen, C.M. (1992). The Vegetable Garden, Macmillan Press Limited. P. 318.

Musa, I., 2006. Utilization of Various Levels of Boiled Bambaranut by Broiler Chickens. M.Sc. Thesis, Abubakar Tafawa Balewa University, Bauchi. Pp. 48

Ndiokwere, C.L., 1982. Determination of Crude Protein and some Mineral Content of Edible Nigerian Legumes using Neutron Activation Analytical Technique. *Legume Research,* **(5)**: 87-90

Okagbare, G. O. and Akpodiete, O.J., 2006. Soybean in Pre-Ruminant Nutrition: A Review. *Nigeria Journal of Animal Production*, **33** (1): 83-86

Okeke, D.P., 2000. Replacement of Soybean Meal with Bambara Waste in Broiler Diets. M.Sc. Thesis. Department of Animal Science, University of Nigeria, Nsukka, Nigeria

Pfetter, E., Niess, E. and Nji, F.F., 2002. Performance of Growing Broiler Chicks Fed Bambara Groundnut. *Investigation of Animal Nutrition,* **4**: 56-61

Pusztai, A., 1989. Biological Effects of Dietary Lectins. **In**: Recent Advances of Research in Antinutritional Factors in Legume Seeds; (Ed. Huismay) Wagenningen. The Netherlands, Pp 17-29

Sharma, A., S. Jood and S. Seghal. 1996. Anti-Nutrients (Phytic acid, Polyphenols) and Minerals (Ca, Fe) Availability (*In-Vitro*) of Chickpea and Lentil Cultivars. *Nahrung*, **40**: 182-184

Steel, R.G.D. and Torrie, J.H., 1980. **Principles and Procedures of Statistics**. A Biometric Approach 2nd Edition Mcgraw – Hillbook Company Inc. New York

Tweneboah, C.K., 2000. Modern Agriculture in the Tropics, Food Crops. Co-Wood Publishers.

Yamaguchi, M., 1983. World Vegetables. Van Nostrand Reinhold, 115 Fifth Avenue, Newyork 100003.

Yisa, A. G., Edachi, J. A., Nyem, D.C., P.D., Menegba, J.A. and Bogoro, S.E., 2008. Carcass Yield of Broiler Finishers Fed Diets Containing Pigeon Pea Processed by Different Methods. **Proceedings of the 13th Annual Conference of the Animal Science of Nigeria, 15- 19th September, 2008, Zaria - Nigeria**

Yusuf, H.B., 2000. The Effects of Dietary Energy – Protein Ratio on the Performance of Broilers. M.Sc. Thesis. Animal Production Programme, Abubakar Tafawa Balewa University, Bauchi-Nigeria. Pp 35

References to this paper should be made as follows: A. Umar; et al (2016), Carcass and Gut Characteristics of Broiler Chicken Fed Varying Levels of Partially Sprouted Bambaranut. *J. of Agriculture and Veterinary Sciences,* Vol. 8, No. 1, Pp. 60 – 70.

TABLE 1: CHEMICAL COMPOSITION (%) OF RAW AND PARTIALLY SPROUTED BAMBARANUT

Components	Raw	Partially Sprouted
Dry matter	83.20	80.10
Crude protein	19.79	21.0
Crude fiber	2.03	5.30
Ether extract	7.48	4.67
Ash	3.28	3.79
Nitrogen free extract	66.10	56.67
Anti-nutritional factors/mg protein		
Tannin	0.74	0.07
Phytates	9.29	1.21
Trypsin inhibitor	9.4	1.3
Haemagglutinin	5.0	0.4

TABLE 2: INGREDIENTS AND CHEMICAL COMPOSITION (%) OF BAMBARANUT BASED DIETS FED TO BROILERS AT STARTER PHASE (1 – 4 WEEKS)

Diet Ingredients	1	2	3	4	5
Maize	49.1	43.10	37.10	31.05	24.80
Soya bean	30.7	26.70	22.70	18.74	15.00
Bambaranut	0.00	10.00	20.00	30.00	40.00
Wheat offal	10.0	10.0	10.0	10.0	10.0
Fish meal	7.0	7.0	7.0	7.0	7.0
Bone meal	2.5	2.5	2.5	2.5	2.5
Salt	0.25	0.25	0.25	0.25	0.25
Premix	0.25	0.25	0.25	0.25	0.25
Methionine	0.10	0.10	0.10	0.10	0.10
Lysine	0.10	0.10	0.10	0.10	0.10
Total	**100**	**100**	**100**	**100**	**100**
Calculated analysis:					
Crude protein (%)	23.0	23.0	23.0	23.0	23.0
ME (Kcal/kg)	3023	2988	2952	2915	2880
CF (%)	8.24	7.87	7.48	7.09	6.70
Ca (%)	1.40	1.40	1.40	1.40	1.40
Phosphorus (%)	0.99	0.95	0.91	0.90	0.90

TABLE 3: INGREDIENTS AND CHEMICAL COMPOSITION (%) OF BAMBARANUT BASED DIETS FED TO BROILERS AT FINISHER PHASE (5 – 9 WEEKS)

Diets Ingredients	**1**	**2**	**3**	**4**	**5**
Maize	59.08	53.07	47.06	41.07	35.06
Soya bean	20.72	16.73	12.74	08.73	04.74
Bambaranut	0.00	10.00	20.00	30.00	40.00
Wheat offal	10.0	10.0	10.0	10.0	10.0
Fish meal	7.0	7.0	7.0	7.0	7.0
Bone meal	2.5	2.5	2.5	2.5	2.5
Salt	0.25	0.25	0.25	0.25	0.25
Premix	0.25	0.25	0.25	0.25	0.25
Methionine	0.10	0.10	0.10	0.10	0.10
Lysine	0.10	0.10	0.10	0.10	0.10
Total	**100**	**100**	**100**	**100**	**100**

Calculated Analysis:					
Crude protein (%)	20.0	20.0	20.0	20.0	20.0
ME (Kcal/kg)	3037	3001	2965	2925	2894
CF (%)	8.64	8.26	7.88	7.49	7.11
Ca (%)	1.4	1.4	1.4	1.6	1.6
Phosphorus (%)	0.96	0.93	0.96	1.3	1.3

TABLE 4: CARCASS AND GUT CHARACTERISTICS OF BROILERS FED DIET CONTAINING VARYING LEVELS OF PARTIALLY SPROUTED BAMBARANUT

Diets	**1**	**2**	**3**	**4**	**5**	**SAM**
Live weight kg)	1.57^{b}	1.59^{b}	1.71	1.77^{b}	2.37^{a}	0.13***
Plucked weight (kg)	1.46^{b}	1.49^{b}	1.58^{b}	1.59^{b}	2.20^{a}	0.13***
Eviscerated weight (kg)	1.20^{b}	1.21^{b}	1.32^{b}	1.30^{b}	1.83^{a}	0.11***
Carcass weight (kg)	1.06^{b}	1.10^{b}	1.24^{b}	1.16^{b}	1.68^{a}	0.11***
Dressing %	67.52	69.18	72.51	66.21	70.77	2.21^{NS}
Head/Leg weight (%)	7.28	7.21	7.40	7.58	6.56	0.46^{NS}
Lungs weight (%)	0.6	0.30	0.50	0.56	0.62	0.07^{NS}
Kidney weight (%)	029	0.25	0.21	0.25	0.25	0.04^{NS}
Spleen weight (%)	0.1	0.10	0.13	0.14	0.10	0.03^{NS}
Heart weight (%)	0.4	0.48	0.44	0.48	0.43	0.05^{NS}
Gizzard weight (%)	2.55	2.27	2.39	2.36	2.23	0.27^{NS}
Pancreas weight (%)	0.35	0.43	0.35	0.39	0.28	0.06^{NS}
Small intestine weight (%)	5.65	5.25	5.42	5.09	5.45	0.68^{NS}
Large intestine weight (%)	0.28	0.26	0.25	0.24	0.24	0.05^{NS}
Abdominal fat (%)	1.45	1.48	1.43	1.20	1.35	0.30^{NS}
Caecal weight (%)	0.88	0.69	0.82	0.79	0.72	0.11^{NS}
Liver weight (%)	2.43	2.03	2.39	2.31	2.02	0.24^{NS}

^{abc,} means in the same row with different superscripts are significantly different (***p<0.001), NS: Not significant, SEM: Standard error of the mean