G.J.A.S.R

Global Journal of Animal Scientific Research

Journal homepage: www.gjasr.com

Print ISSN:2345-4377 *Online ISSN:2345-4385*

Original Article

Effect of Conventional or Plant-Based Diets on the Productivity of Broiler Chickens

M.A. Hossain[1,*] and P.A. Iji[2]

[1]Institute of Tropical Agriculture, UPM, Serdang, Malaysia
[2]School of Environmental & Rural Science, University of New England, Armidale, NSW-2351, Australia

ARTICLE INFO

Corresponding Author:
M. A. Hossain
mhossainmu@yahoo.com

How to Cite this Article:
Hossain, M.A., and Iji, P.A. (2015). Effect of Conventional or Plant-Based Diets on the Productivity of Broiler Chickens. *Global Journal of Animal Scientific Research*, 3(2), 477-486.

Article History:
Received: 26 February 2014
Accepted: 1 April 2015

ABSTRACT

The study was conducted to investigate the gross responses, meat yield traits and excreta/litter quality of broilers fed diets based on only plant ingredients or conventional diets containing animal protein. A total of 320 day-old male broiler chicks (Cobb 500) was distributed randomly into five treatments (T_1, T_2, T_3, T_4 and T_5), each replicated eight times with eight chicks per replicate in a completely randomized block design. Diets T_1 and T_2 were formulated with entirely plant ingredients, whereas diets T_3 and T_4 were conventional, and contained both plant and animal ingredients. Diet T_5 was used as control, basically contained plant ingredients except for tallow mixer. All diets were iso-energetic and iso-nitrogenous in nature, cold-pelleted and fed the birds *ad libitum* from d1-35 days. Live weight up to 35d was improved ($P<0.05$) in the birds that were fed greater ($P<0.01$) amount of conventional diets (T_3, T_4) than those on plant-based or control diets. Feed conversion ratio (FCR) and performance index (PI) differed significantly ($P<0.01$) between treatment up to 14 days only. Birds fed conventional (T_3 and T_4) diets tended to be more efficient in both FCR and PI than those of other diet group, although the differences between treatment were non-significant ($P>0.05$) on day 35. Mortality was unaffected ($P>0.05$) between treatment. Excreta pH values and the concentration of ammonia were not influenced ($P>0.05$) by treatment. Higher ($P<0.01$) dry matter content was found in the conventional diets (T_3 and T_4) than the plant-based (T_1, T_2) or control diets (T_5). Except for abdominal fat content, the other meat yield characteristics such as dressing percentage, breast weight, thigh weight, drumstick weight, giblet weight, shank weight, neck weight etc., were not influenced ($P>0.05$) by dietary treatments. Birds fed conventional diets (T_3 and T_4) demonstrated increased ($P<0.01$) abdominal fat content compared to other dietary treatments. Breast weight (%) tended to be increased ($P<0.08$) in the birds when the birds fed on plant-based diet (T_1). In conclusion, the productivity of broilers fed conventional diets was better than those fed on plant-based diets only.

Keywords: Broiler chickens, growth, carcass yield traits, litter quality, conventional diets, vegetable diets.

INTRODUCTION

Poultry production is increasing steadily around the globe in order to supply premium quality meat and egg to the consumers. Poultry is mostly reared with conventional diets to satisfy their nutrient requirement, and to optimize their productivity with a better quality and quantity of poultry products (i.e meat and egg).

Poultry diet that contains both animal and vegetable feed ingredients, and is being used consistently by commercial poultry integrators, termed as conventional or traditional diet. The conventional feedstuffs (e.g. meat meal, meat and bone meal, fish meal) of animal origin are commonly used in monogastric animal diets, and are considered as excellent protein sources for meat chickens (Parson *et al*., 1997; Robinson and Singh, 2001; Giang *et al*., 2001). Meat chickens fed on conventional diets, demonstrated better productivity and increased performance than those birds fed exclusively on plant-based diets (Hossain *et al.,* 2012, 2013). However, it is assumed that, most crucial protein sources and conventional diets are more costly in some regions of the world.

Oluyemi and Robert (2000) reported that, a critical cost appraisal of poultry feed formulate would show that protein, especially proteins of animal origin, are the most expensive per unit cost of production. Therefore, the poultry industry is always exploring the cheapest sources of feed ingredients to gain maximum profit with the lowest investment in feed.

Producing poultry products, i.e meat and eggs, at economical rate may be feasible using vegetable feed sources in practical diets, as these ingredients are considered cheaper and safer than animal protein sources.

Despite cutting feed cost considerably, these ingredients can serve as excellent sources of nutrient for poultry when processed properly and supplemented with other pro-nutrients (Cruz *et al*., 2009). However, consumer preference or demand for meat and egg may be affected severely by their quality characters possessed by individual bird.

So poultry industry is very concerned about quality meat and egg supply to the consumer world. The extra fat accumulation in the carcass and egg, is generally considered as the unfavourable trait in the poultry industry (Remignon and Le Bihan-Duval, 2003).

Many strategies can be undertaken to produce quality meat and egg, and to meet consumer demand or satisfaction. Meat chickens produced from plant-based diets, devoid of any growth promoter or animal by-products, may be considered as organic meat, which has great demand in the world food market (Mendes, 2003).

Besides, adoption of suitable feeding strategy may help to reduce extra-fat content of broiler carcasses, and thereby improve the meat quality. Many researchers have been reported that broiler chickens contain less abdominal fat when the birds fed diets comprised of all-vegetable ingredients than those fed on animal protein or conventional diets (Jensen *et al.,* 1980; Pawlak *et al*., 2005; Hossain *et al*., 2013; 2015).

The merit of this concept can be used in the formulation of diets for poultry and other livestock. When lean meat is desired, animals may be fed plant–based diets, which will result in low fat and higher protein deposition in their carcasses (Singh and Panda, 1992). Moreover, chicken meat fed on all-vegetable diets may also contribute a better profile of fatty acids in their carcasses, which may enhance the shelf life or preservation quality of meat as well as draw consumer's preference.

Moreover, this will not only reduce fat waste at processing plants but also result in a better quality product for the consumer. The shelf life of such meat may also be increased (Hossain *et al.,* 2015). So this strategy of producing meat chickens excluding conventional or animal by-products could, therefore, bring about nutritional and economic benefits to consumers and producers alike.

Vegetable diets or plant protein ingredients are safer and cheaper than conventional or animal protein diets, but the former are often unbalanced in nutrients and contain numerous anti-nutritive factors. These may affect the nutrients digestibility and productivity of broiler chickens when used in diet formulation. To explore this, the present study was undertaken to investigate the effect of plant-based diets on growth performances, meat yield characteristics and litter quality of broiler chickens.

MATERIALS AND METHODS

Experimental Design and Bird Management

A total of 320 day-old (Cobb 500) male broiler chicks was procured from the local hatchery and tested from hatch to 35 days in a cage rearing system with an environmentally controlled house. The chicks were weighed on receipt, and distributed randomly into five dietary treatments (shown details below), each treatments replicated eight times with eight birds per replicate in a completely randomized block deign. For the first two days the chicks were brooded with a temperature of 33˚C. The temperature was then gradually reduced by 1 or 2˚C every 1 or 2 days until the chicks were 19 days old at which point the temperature was maintained at 24˚C for the rest of the trial. Birds were reared in brooder cages for the first 3 weeks and then shifted to the larger metabolic cages for the last two weeks of the trial period. Wood–shaving litter materials were spread on the surface of the tray to provide comfortable environmental condition. Birds had a free access to cold-pelleted feed and water *ad libitum* entire the trial period.

Dietary Treatment

Five experimental diets coded as T_1, T_2, T_3, T_4 and T_5 were formulated with maize, wheat, sorghum, vegetable oil, tallow mixer as energy sources, soybean meal, canola meal, fish meal and mung bean as protein sources along with other feedstuffs, and later pelleted to reduce segregation (Tables 1 & 2). Diets T_1 and T_2 were all-vegetable diets formulated exclusively with plant ingredients to meet or exceed NRC (1994) specifications. Diets (T_3 and T_4) were conventional or animal protein or traditional diets, as these were formulated with both animal and plant feedstuffs from conventional feed sources. A fifth diet (T_5), is treated here as control, was a commercial type diet containing sorghum, wheat and tallow mixer as energy sources, soybean, canola and mung bean as protein sources including other micro-nutrients. All diets were iso-energetic and iso-nitrogenous in nature, and further supplemented with carbohydrase and phystase enzymes as well as zincbacitracin. Starter diet was provided the birds for the first three weeks, and later finisher diet was used for the last two weeks of trial period.

Data Collection, Measurement and Analyses

Feed intake (FI), live weight (LW), feed conversion ratio (FCR), and performance index (PI) of broiler chickens were recorded weekly. To calculate PI of birds, LW (kg) was divided by FCR, and then multiplied by one hundred. Mortality was calculated as it occurred. On day 21, excreta material was collected from each replicate cage by spreading aluminium foil paper underneath the tray, to enable assessment of litter quality of broilers, with respect to determination of excreta dry matter (DM) or moisture level, pH and ammonia (NH_3) content. Collected excreta samples were stored at -20˚C, after that dry matter (DM) or moisture, pH and ammonia were determined by laboratory analyses to examine the effects of excreta materials on birds productivity or performance. On day 35, two birds per replicate cage were selected randomly, weighed and killed humanely to measure meat yield traits (breast weight, thigh weight, drumstick weight, giblet weight, shank weight, and neck weight) and abdominal fat content.

Chemical Analysis of Excreta DM or Moisture Level, pH and Ammonia

Excreta DM or moisture content was determined according to the method described in AOAC (1994). The pH of excreta samples was measured using a pH meter (Model LS, Sargent-Welch Co., Springfield, N. J). Five grams of each faecal sample was placed into 50 mL plastic tubes, 40 mL Mili-Q water were added and then the samples were homogenised using a homogeniser for two minutes (11,000 rpm). After that, the samples were filtered through Whatmann-1 and diluted. The filtrate was used for pH and ammonia measurements. Excreta ammonia was measured as per the technique of an ammonia assay kit (Catalogue Number AA0100), (Sigma-Aldrich, 3050 Spruce Street, Saint Louis, Missouri 63103, USA).

Statistical Analyses

Statistical analyses were performed using Minitab software (Minitab version 15, 2000). The data were analysed using a one-way ANOVA with diet as factor. The significance of differences between means was determined by Fisher's least significant difference at $P \leq 0.05$.

Table 1: Starter diets (0-21 days)

	Starter Diets				
	T_1	T_2	T_3	T_4	T_5
Ingredient composition (%)					
Corn	40.59	37.75	41.27	40.71	0.00
Wheat	21.50	18.75	20.38	21.50	26.50
Sorghum	0.00	0.00	0.00	0.00	32.00
Vegetable oil	0.00	2.03	0.00	0.00	0.00
Tallow mixer	0.00	0.00	0.00	0.00	1.00
Soybean meal (47.0%)	24.69	9.37	15.49	8.39	20.00
Canola meal (33.6%)	8.23	28.12	7.745	16.79	5.25
Fish meal	0.00	0.00	7.745	8.39	0.00
Mung bean	0.00	0.00	0.00	0.00	10.00
Limestone	3.00	1.50	2.57	1.35	2.58
DCP	0.90	1.09	3.00	1.55	1.20
DL-Methionine	0.20	0.14	0.17	0.20	0.21
Lysine	0.27	0.13	0.21	0.19	0.21
Plain Salt (NaCl)	0.20	0.24	0.50	0.50	0.50
Vitamins min-Premix	0.25	0.20	0.25	0.25	0.20
Choline chloride	0.06	0.06	0.06	0.06	0.06
Avizyme-1502	0.05	0.05	0.05	0.05	0.00
Phyzymes-XP	0.01	0.01	0.01	0.01	0.00
$NaHCO_3$	0.00	0.00	0.00	0.00	0.20
Ronozyme -Wx	0.00	0.00	0.00	0.00	0.025
Ronozyme -P	0.00	0.00	0.00	0.00	0.015
Zincbacitracin	0.05	0.05	0.05	0.05	0.05
Nutrient composition (%)					
ME (Kcal/kg)	2955.84	2958.51	2955.65	2957.80	2955.75
Crude Protein	21.20	21.13	21.15	21.17	21.18
Crude Fibre	3.24	4.70	3.05	3.96	3.52
Ether Extract	5.60	3.85	3.92	3.36	5.21
Ca	1.54	1.12	2.35	1.60	1.61
Available P	0.77	0.55	1.13	0.79	0.77
Ca:P ratio	2:1	2:1	2:1	2:1	2:1
Lysine	1.16	1.20	1.20	1.18	1.22
Methionine	0.51	0.50	0.54	0.57	0.54
Arginine	1.30	1.25	1.27	1.28	1.29

RESULTS

Results of live weight (LW), feed intake (FI), feed conversion ratio (FCR), performance index (PI), and mortality of broiler chickens are shown in Table 3. Results demonstrated that LW up to 28d was unaffected (P>0.05), but LW to 14d (P<0.01) and to 35d (P<0.05) was influenced significantly by dietary treatments. Birds fed conventional diet group (T_3, T_4) gained similar but significantly (P<0.05) higher LW than those fed on all-vegetable or control diets at 1-35d. FI was also affected (P<0.01) by dietary treatments entire the trial period (1-35d).

Birds on conventional diet group (T_3, T_4) consumed higher (P<0.01) feeds than those birds fed on all-vegetable or control diets. FCR and PI up to 14d were influenced (P<0.01) by treatments with showing insignificant (P>0.05) effect for rest of the trial period. Although the FCR and PI values had no effect (P>0.05) between treatments at 35d, birds on conventional diet group (T_3, T_4) were assumed to be more efficient in FCR and PI than those birds fed on all-vegetable or control diets. Mortality of birds was similar (P>0.05) during the entire experimental period (1-35), and the differences were found non-significant (P=0.21) between treatments.

Table 4 indicate that except for abdominal fat (%), other parameters such as dressing percentage, breast weight, drumstick weight, thigh weight, giblet weight, shank weight, neck weight) of broiler chickens measured herein this study were not influenced (P>0.05) by dietary treatments. Only the abdominal fat content (%) was affected (P<0.01) by treatment. Birds fed conventional diet group (T_3, T_4) accumulated higher (P<0.01) fat content (%) than the birds fed on plant-based or control diets. Breast weight (%) tended to be significant (P<0.08)

between treatment. Birds fed plant-based diet (T_1) attained higher breast weight (25.06 %) than other diet group, although the difference between treatment was found insignificant (P=0.08).

Table 2: Finisher diets (22-35 days)

	Finisher Diets				
	T1	**T2**	**T3**	**T4**	**T5**
Ingredient composition (%)					
Corn	41.37	39.64	43.4	41.51	0.00
Wheat	20.40	20.20	21.10	23.20	24.80
Sorghum	0.00	0.00	0.00	0.00	35.75
Vegetable oil	0.00	2.12	0.00	0.00	0.00
Tallow mixer	0.00	0.00	0.00	0.00	1.00
Soybean meal (47.0%)	22.50	8.10	14.37	7.00	19.50
Canola meal (33.6%)	7.50	24.30	7.18	14.00	3.50
Fish meal	0.00	0.00	7.18	7.00	0.00
Mung bean	0.00	0.00	0.00	0.00	8.67
Limestone	3.52	2.20	2.45	2.36	2.68
DCP	3.45	2.11	3.04	3.57	2.23
DL-Methionine	0.14	0.15	0.17	0.16	0.30
Lysine	0.20	0.26	0.18	0.18	0.25
Plain Salt (NaCl)	0.50	0.50	0.50	0.50	0.00
Vitamins min-Premix	0.25	0.25	0.25	0.25	0.5
Choline chloride	0.06	0.06	0.06	0.06	0.06
Avizyme-1502	0.05	0.05	0.05	0.05	0.00
Phyzymes-XP	0.01	0.01	0.01	0.01	0.00
NaHCO3	0.00	0.00	0.00	0.00	0.20
Ronozyme -Wx	0.00	0.00	0.00	0.00	0.025
Ronozyme -P	0.00	0.00	0.00	0.00	0.015
Zincbacitracin	0.05	0.05	0.05	0.05	0.50
Nutrient composition (%)					
ME (Kcal/kg)	2963.86	2964.78	2963.80	2964.75	2964.82
Crude Protein	19.19	19.14	19.18	19.13	19.31
Crude Fibre	2.94	4.50	2.76	3.58	2.57
Ether Extract	3.66	3.68	2.96	3.04	2.78
Ca	2.37	1.70	2.30	2.48	1.60
Available P	1.18	0.81	1.11	1.18	0.78
Ca:P ratio	2:1	2:1	2:1	2:1	2:1
Lysine	1.17	1.14	1.16	1.18	1.20
Methionine	0.44	0.48	0.52	0.51	0.60
Arginine	1.23	1.18	1.19	1.21	1.26

Except for DM (%), pH and ammonia of broiler excreta material were not influenced (P>0.05) by dietary treatment group (Figure 1). Results demonstrated that DM (%) of broiler excreta was found 4.82 % higher in the conventional diet group (T_3, T_4) than those fed on plant-based or control diets. It indicates that birds fed all-vegetable diets increased 4.82 % (average) moisture level in the excreta materials compared to those fed on conventional diets.

DISCUSSION

The results from our current study indicate that birds fed conventional diets (T_3, T_4) improved body weight as compared to the birds fed solely on plant-based diets. Birds those were access on conventional diets consumed also a greater amount of diets containing animal protein as opposed to other diets as seen in our present study.

The improved body growth of broilers on animal protein (T_3, T_4) diets may have been due to higher feed preference and increased feed consumption of broiler chickens.

This is supported by some previous researchers (Bhuiyan *et al.*, 2012 a,b; Hossain *et al.*, 2014; 2015), who observed higher feed intake and increased preference of broiler chickens when the broilers fed on all-vegetable

Table 3: Live weight (LW), feed intake (FI), feed conversion ratio (FCR) or feed gain ratio, performance index (PI), and mortality of broiler chickens fed on all-vegetable or conventional diets from d1-35 days

	Age (days)	Dietary Treatments (T)					SEM	P-values
		T_1	T_2	T_3	T_4	T_5		
LW (g/b)	1-14	411.0^{b}	408.8^{b}	487.22^{a}	477.5^{a}	392.44^{b}	4.959	0.001
	1-28	1334.7	1438.5	1424.7	1522.1	1337.7	23.014	0.077
	1-35	2083.50^{b}	2156.40^{b}	2264.30^{a}	2274.70^{a}	1916.80^{c}	36.024	0.02
FI (g/b)	1-14	504.3^{d}	538.6^{c}	607.7^{a}	597.70^{a}	527.9^{bc}	6.590	0.004
	1-28	2117.9^{c}	2318.0^{ab}	2352.9^{a}	2323.5^{ab}	2161.5^{bc}	21.521	0.003
	1-35	3677.7^{b}	3879.4^{a}	3856.6^{a}	3840.6^{a}	3413.6^{c}	39.68	0.003
Feed:gain ratio or FCR	1-14	1.38^{c}	1.48^{ab}	1.37^{c}	1.39^{bc}	1.53^{a}	0.0152	0.008
	1-28	1.80	1.84	1.74	1.72	1.91	0.033	0.389
	1-35	1.80	1.84	1.73	1.72	1.91	0.033	0.38
PI	1-14	29.81^{b}	27.592^{bc}	35.49^{a}	34.55^{a}	25.91^{c}	0.558	0.01
	1-28	81.54	83.72	86.71	97.01	80.52	2.217	0.151
	1-35	115.87	117.48	130.68	132.16	109.4	3.738	0.255
Mortality (%)	1-35	10.94	6.25	10.94	12.50	7.81	0.920	0.21

Data represent mean values of eight replicate groups consisting of eight broiler chickens per replicates during 1-21 days, and five birds per replicates during 21 to 35 days of ages; [a,b,c,d]Means within a row bearing unlike superscripts are significantly different at *P<0.05, **P<0.01, and *** P<0.001; T_1 and T_2 denote all-vegetable diets, T_3 and T_4 diets are animal protein diets or conventional diets; and T_5 diet is treated as Control diet; SEM= Standard Error of mean

Table 4: Meat yield traits (%) of broiler chickens

	Dietary Treatments (T)					Pooled SEM	P-values
	T_1	T_2	T_3	T_4	T_5		
Dressing (%)	74.69	74.53	74.03	73.93	73.04	0.360	0.625
Breast weight (%)	25.06	22.52	23.44	23.01	23.66	0.283	0.08
Drumstick weight (%)	9.00	8.65	8.66	8.76	8.65	0.625	0.625
Thigh weight (%)	10.58	10.19	9.86	10.71	9.56	0.145	0.256
Abdominal fat weight (%)	0.72^{c}	0.83^{b}	0.92^{a}	1.10^{a}	0.72^{c}	0.0313	0.006
Giblet weight (%)	5.67	5.19	5.36	5.26	5.65	0.089	0.322
Shank weight (%)	2.56	2.34	2.43	2.51	2.45	0.045	0.620
Neck weight (%)	2.83	2.71	2.77	2.78	2.73	0.031	0.743

Data represent mean values of two chickens of eight replicate groups during 35 days of age; [a,b,c] Means within a row bearing unlike superscripts are significantly different at **P<0.01.

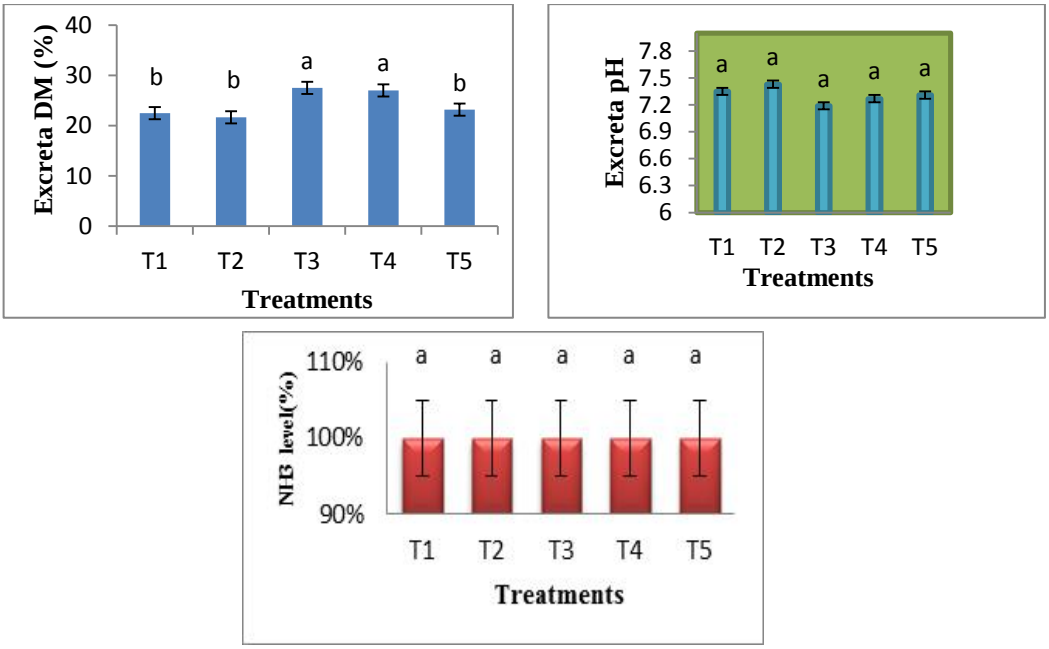

Figure 1: Excreta DM (%), pH and ammonia (NH_3) of broiler chicken; bars with different letters are significantly different at **P<0.01

or animal protein diets. Apart from this, the higher nutrient digestibility (protein), improved feed efficiency and efficient energy utilization of these diets by broiler chickens may be another reasons, to contribute better growth of broiler chickens fed on conventional or animal protein diets. Moreover, the better performance of broilers fed conventional diets might be due to the combination of animal and plant protein sources which would better amino acid balance. Our results agreed with the findings of previous researchers (Radhakrishnan *et al.,* 2001; Alali *et al*., 2011; Hossain *et al*., 2012 a,b; 2013; 2015).

The results further suggested that conventional diets formulated with fish meal responded positively through utilizing higher feed intake more efficiently, and gave rise to better growth performances than the diets based on plant-based or control diets. In addition, results of the current study indicated that the beneficial effect of conventional diets on broiler performance became more pronounced during the mid-point of the growth period, with the greatest benefit manifesting between 1-28d, mainly via stimulation of higher feed intake at 1-35 d of age. Several researchers have concluded that some feedstuffs such as fish meal contain an unidentified growth factor, which is known to improve the palatability of these feedstuffs which, when fed to broilers, results in an improvement in growth (Barlow and Windsor, 1984; EI Boushy and van der Poel, 1994). In addition, the higher growth responses of conventional diets might be the synergistic effects of animal and vegetable proteins and, dietary amino acids balance because of addition of fish meal with these rations, which is supported by several researchers (Woodham and Deans, 1977; Pike, 1976; 1979). Besides, animal protein, for example, fish meal is basically devoid of anti-nutritive factors, is balanced in amino acids, and have higher biological value with well-balanced amino acid than the vegetable proteins (Dublecz, 2003). These traits of fishmeal might influence broilers to grow more rapidly through efficient utilization of feed than on diets without fishmeal. Furthermore, fish meal is considered as a standard ingredient in pig and poultry rations to make up for deficiencies of essential amino acids (NRC, 1994; Pike, 1999). These differences in characteristics of individual protein sources in the practical diets might influence the productivity of broiler chickens. It is axiomatic that no two protein sources are alike in their characteristics in the nature (Singh and Panda, 1992). The physical or chemical properties, mode of digestibility, quality, biological efficacy, fibre contents, amino acid balance, nutrient availability etc., of individual protein sources might vary widely when they are used for diet formulation, and thereby influence broiler performance to a greater extend (Singh and Panda, 1992; Hossain *et al.*, 2014).

However, bird performances fed on plant-based diets were poorer than conventional diets entire the trial period. The reasons behind this might be due to presence of anti-nutritive factors, limiting amino acids, low biological value, poor feed efficiency, and poor nutrient digestibility of plant-based diets as compared to conventional diets. The performance index (PI) and feed conversion ratio (FCR) were also poorer in the birds when they fed on plant-based diets. The impaired growth of broilers fed on plant-based diets may be an outcome of poor feed utilization as evinced from our current study. The PI or FCR were improved on the conventional diets compared to the plant-based or control diet group in this study. The improved FCR of birds might be due to better protein digestibility of the animal protein diets as well as increased efficiency in utilization of energy, as recently reported by Hossain *et al.*, (2013; 2012 a,b) in a trial on similar diets. Our findings are in agreement with Solangi *et al*., (2002) and Alali *et al*., (2011), who reported that fishmeal and or other animal protein meal increase feed intake and also enhance the feed efficiency of the broilers. Singh and Panda (1990) reported that fishmeal contains all indispensible amino acids in adequate amounts, particularly lysine and methionine needed for poultry, and is considered as an ideal ingredient for monogastric animal diets (NRC, 1994; Pike, 1999). However, our results contradict with the findings of previous researchers (Al-Masri, 2003; Cancherini *et al.,* 2004; Vieira and Lima, 2005; Bellaver *et al.,* 2005), who conducted their researches on broiler chickens with all-vegetable and conventional diets. The performance of birds fed vegetable protein diets was better than those birds fed diets containing animal proteins as reported by Bellaver *et al.*, (2005) and Cancherini *et al.*, (2004), respectively. Al-Masri (2003; 2006) and Vieira

and Lima (2005) found no significant effects on the productivity of broiler chickens when they fed all-vegetable or conventional containing animal proteins. The differences in productivity of broiler chickens by different experiments may have been due to multiple factors, amongst those different protein sources, dietary composition, protein quality, strain, anti-nutritive effects, essential amino acids, fibre level and so on, might play a common role to affect the performance of broiler chickens. Most of the meat yield parameters of broiler chickens fed on plant-based or conventional diets containing animal protein had no difference as observed in our current study. This results agreed with the previous researchers (Al-Masri, 2003; 2006; Xavier *et al.*, 2011; 2012; Hossain *et al*., 2013), who observed similar growth of organs and meat yield traits of broilers on all-vegetable or conventional diets. However, higher abdominal fat deposition was found in the birds when they fed conventional diets containing animal protein. Birds showed less fat accumulation in their carcass when they had access on plant-based diets. Our results are in agreement with the previous researchers (Jensen *et al.*, 1980; Mendonca and Jensen, 1989; Hossain *et al.*, 2015), who observed increased abdominal fat content when broiler fed conventional diets containing animal protein. The probable reason of variable abdominal fat accumulation in the test diets might have resulted from an imbalance between energy intake and energy expenditure or reduced protein uptake by the birds. Skrivan *et al*., (1990) reported that the accumulation of fat in the abdomen may have been generally due to an imbalance between energy intake and energy expenditure. Moreover, the increased fat accumulation of broiler chickens fed conventional or animal protein diets might have been due to rapid growth, leading to precocious maturation of the birds (Hossain *et al*., 2013). However, slightly improved breast meat (%) was observed in the birds when they offered plant-based diets (T_1). Similar response was also found by Al-Ostwani *et al*., (2000), who reported improved relative weight of breast muscle in broilers fed plant-based diets containing corn, barley, soybean and cotton seed meal.

The excreta of broilers fed the conventional diets contained significantly higher dry matter than that of the plant-based or control diets. It implies that the moisture levels of the excreta of broiler chickens fed the plant-based or control diets were higher than levels in conventional or animal protein diet group. Many dietary factors such as protein level, electrolytic balance, ionophores, cereal contents, fibre content, legumes and NSPs are associated with regulation of excreta moisture and quality (Smith *et al*., 2000; Murakami *et al*., 2001; Francesch and Brufau, 2004). The current findings supported the results of previous researchers (Takahashi *et al*. 2004; Vieira and Lima, 2005; Eichner *et al*., 2007), who reported that broilers fed plant-based diets had a lower amount of dry matter or higher moisture level in their excreta. Any dietary change that increases water intake of birds will lead to an increase in excreta moisture level. The NSP contents of VP diets arising from soybean and canola meals can affect digestion of other nutrients by attracting water and contributing to higher litter moisture (Francessch and Brufau, 2004).

CONCLUSIONS

Broilers fed conventional diets grew better than those fed only plant-based diets. However, broilers on former diets tended to reduce litter quality and were more fatty than those on plant-based diets. Although growth responses were poorer in the birds fed plant-based diets, reduced abdominal fat accumulation assures better quality of meat than those on conventional diets. Meat chickens with low fat content can be produced successfully with all-vegetable diets, and has potential to reduce production cost if cheaper ingredients like plant feedstuffs are used in diet formulation.

ACKNOWLEDGEMENTS

The authors are greatly acknowledged to the research grant and facility of UNE, Australia for conducting this experiment.

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