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Evaluation of Dietary Incorporation of Bakery Waste on Nutrient Utilization and Performance of Broiler Chicken

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ABSTRACT

The present study aimed at evaluating the nutritional composition of bakery waste and its impact on growth and nutrient utilization of broiler chickens. A total of 240 day-old broiler chicks were randomly allocated to 5 groups and each group consisted of 4 replicates each having 12 chicks. Each group was given pre-starter (0-14days), starter (15-21 days) and finisher ration (22 day onwards) with control group receiving maize-based basal diet (control) and T1, T2, T3 and T4 groups receiving diet replaced with bakery waste @ 5, 10, 15 and 20 % of maize, respectively in order to meet the nutritional requirements as per ICAR (2013). It was observed that feed intake was comparable among all groups during 1st, 4th and 6th week. However, in week 2, 3 and 5 feed intake was significantly highest ($P<0.05$) in T3, control and T3 respectively. During 1st, 2nd and 6th week, the average body weight (g) was comparable in all five groups while the average body weight was significantly higher ($P<0.05$) in control group during 3rd, 4th and 5th week. Feed conversion ratio (FCR) of all five groups at pre-starter, starter and finisher phases did not vary significantly irrespective of different diets fed to them. Protein efficiency ratio (PER) during week 1 and 5 was significantly highest ($P<0.05$) in control group and comparable among all groups during week 2, 3, 4 and 6. Cumulative feed intake was significantly highest in T3 group during pre-starter and finisher phase and in control group during phase whereas, no significant variation was observed for cumulative body weight, FCR and PER in birds of different treatment groups. It was observed that the DM, OM, CF and NFE intake (g) during the metabolism trial was significantly ($P<0.05$) highest in control group than other groups while that of EE and TA in T4 group.

KEYWORDS: Bakery waste, Broilers, Digestibility, Growth rate

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INTRODUCTION

Poultry one of the most expeditiously expanding sectors in India and the poultry population has increased from 729.21 million to 851.81 million from 2012 to 2019 (20th livestock census, DAHDF) because of its smaller generation interval, no religious taboo and easy availability. India stands 8th in number with respect to broiler production. Poultry rearing has largely been adopted by urban and rural population for income generation as it is an inexpensive source of protein which is also low in cholesterol. In poultry enterprise, feed alone incurs 60-70% of total rearing cost (Kleyn, 1992). Broilers are majorly raised on cereal grains and soybean meal as their energy and protein source, respectively. The commonly used conventional grains for poultry feeding are maize, oats, barley and wheat of which maize is widely used energy-rich component (Summers et al., 1968; Saunders et al., 1969; Moran et al., 1970; Patterson et al., 1988; Vohra, et al., 1991; Cave and Burrows, 1993; Reddy and Quadratullah, 1996; Sharma et al., 2012). However, there has always been curtailment in the production of these cereal grains even for human consumption in developing countries like India and therefore, a constant spike in their price making it unavailable for feeding of poultry as well as livestock. Thus, any attempt to seek for alternative unconventional feed

resources and their efficient utilization by the animal nutritionists and feed industrialists would greatly benefit the poultry raisers by reducing the feed costs and cost per kg live weight. In the past, many studies have been conducted to know the practical possibility of utilizing industrial, animal and agricultural byproducts like bakery waste, tubers, shrub leaves, aquatic plants, insects, fruit etc as poultry feed ingredients which show that these unconventional feedstuffs can be successfully incorporated in ration of poultry to reduce the production cost (Fetuga et al., 1976; El Boushy, 2000a, Yoshida and Morimoto, 1958; Hill et al., 1960; Gerpatio et al., 1978; Ravindran and Rajaguru, 1985; El Boushy, 2000b; Sharma et al., 2013; Sharma et al., 2016). Bakery waste being rich in soluble carbohydrates and easy accessibility forms a great alternative feed source (Arosemena et al., 1995) which may decrease the cost of feeding in poultry. The present research aims at evaluating the nutritive value of bakery waste and its impacts on growth, production performance and nutrient utilization in broilers.

MATERIALS AND METHODS

Feeding and housing

Bakery waste was procured from Bonn bread factory situated at Panduka colony, Paloura, Jammu. Foreign materials present were removed and bakery waste was sun-dried followed by its grinding and packaging. The study was carried out for a period of 6-weeks on a total number of 240 day-old commercial strain cobb-400 chicks collected from a renowned hatchery to scrutinize the effect of bakery waste on their body weight gain, feed intake, feed conversion ratio, protein efficiency ratio, nutrient utilization. The chicks were randomly grouped into five groups- Control, T1, T2, T3 and T4, each group consisting of 48 birds followed by further sub-division of each group into 4 replicates each consisting of 12 chicks. The individual chicks were weighed using electronic digital weighing balance on arrival followed by weighing at 7-days interval. The chicks were fed pre-starter ration from 1 to 14 days, starter ration from 15 to 21days and grower ration from 22 to 42 days. The control group was given the practical type maize-soy based basal feed without bakery waste, however, the treatment groups T1, T2, T3 and T4 were offered feed incorporated with bakery waste @ 5%, 10%, 15% and 20% respectively. Clean and potable water was provided in the waterers all the time. All the diets prepared for each phase were made iso-nitrogenous and iso-caloric and formulated to meet the nutritional requirements of chicks as per ICAR (2013).

The chicks were reared under deep-litter system with an average floor space of approximately 1.3sq.ft per bird. The paddy husk was used as bedding material which was replaced regularly every two weeks.

Feed intake

A known amount of feed was offered to the birds and the feed which was left the next morning was weighed and subtracted from the total feed given and divided by the number of birds in the group which estimated the average feed intake.

Body weight gain

Individual birds were weighed using a digital electronic weighing balance. The previous live weight was deducted from the current live weight of the bird which calculated the body weight gain/bird for the week.

Feed conversion ratio (FCR)

It was determined by dividing the feed consumed (g) by the bird by the body weight gain (g) for a specific period of time.

Protein efficiency ratio (PER)

It was estimated by dividing the protein intake (g) by the bird by live weight gain (g) during a specific period of time.

Nutrient utilization and retention

A metabolism trial of 4-days with an adaptation period of 3-days was carried out during 5th week of trial by housing 2 birds/ replicate into the metabolic cages having trays covered with polythene sheets fitted under the cages for collection of the droppings over a period of 24-hours. The voided droppings

were cleared of any feed particles, feathers and other foreign substances, weighed and dried in hot air oven at 70p C for a period of 4 days. The samples of feed and droppings were pooled, ground and stored in well-labeled airtight containers for the purpose of proximate estimation as per AOAC (2012) and digestibility of nutritional substances in various groups. The amount of feed given, feed left and droppings voided on a daily basis were also recorded.

Statistical analysis

The results obtained from different parameters were subjected to statistical analysis (analysis of variance) as per the methods of Snedecor and Cochran (1994). The significantly different means were subjected to Duncan's multiple range test (DMRT) as per Duncan (1955).

RESULTS AND DISCUSSION

Chemcial composition of feed ingredients

The proximate composition (% DMB) of various feed ingredients as presented in table 1 shows that the greatest content of CP, CF and Total ash was found in meat cum bone meal (MBM) and lowest in maize. Reverse is true for NFE which was found in highest content in maize %) and lowest in MBM %). Calcium and phosphorus content were highest in MBM , however, lowest Ca and P content was found in Bakery waste and maize, respectively.

Table 1. Proximate composition of feed ingredients (on % DMB)

Parti-culars	CP	EE	CF	TA	NFE	Ca	P
Maize	9.25 ± 0.34	4.12 ± 0.14	2.15 ± 0.23	1.52 ± 0.06	82.8 ± 4.51	0.27 ± 0.02	0.31 ± 0.05
Bakery Waste	11.7 ± 0.55	12.5 ± 1.77	2.50 ± 0.35	2.00 ± 0.35	71.3 ± 3.03	0.20 ± 0.07	0.47 ± 0.03

Ingredients and chemical composition of experimental diets

The broiler pre-starter, starter and finisher feeds prepared as per ICAR (2013) for feeding of birds at different phases were prepared using a number of ingredients which included maize, MBM, SBM, soybean oil, salt, sodium bicarbonate, DL-methionine, L-lysine, di-calcium phosphate, limestone powder, vitamin premix and trace mineral mixture are presented in table 2. Maize-soya based diet was given to the control group, however, in treatment groups-T1, T2, T3 and T4 maize was substituted with bakery waste @ 5, 10, 15 and 20% respectively and all the diets prepared were iso-caloric and iso-nitrogenous in nature. The values of proximate components of bakery waste are comparable to the levels as reported by (Shittu et al., 2016 and Epao et al., 2017). However, when compared to results of (Ayanrinde et al., 2014 and Oke, 2013), a subtle difference in the proximate composition was found which might be ascribed to difference in the type of bakery waste (bread, biscuit, cookie, pastry) and compositional difference of bakery products.

Table 2. Ingredient composition (%) of experimental diets of broiler chicks

Attributes	PRE- STARTER PHASE (0-14 DAYS)					STARTER PHASE (15-21 DAYS)					FINISHER PHASE (22-42 DAYS)				
	C	T1	T2	T3	T4	C	T1	T2	T3	T4	C	T1	T2	T3	T4
Maize	60.50	57.47	54.45	51.43	48.40	60.88	57.94	54.89	51.85	48.80	67.50	64.13	60.75	57.38	54.00
Bakery waste	0.00	3.03	6.05	9.07	12.10	0.00	3.04	6.09	9.13	12.18	0.00	3.38	6.75	10.13	13.50
Meat bone meal	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00
Soybean meal	31.08	31.08	31.08	31.08	31.08	30.34	30.34	30.34	30.34	30.34	24.51	24.51	24.51	24.51	24.51
Common salt	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
Sodium bicarbonate	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Soybean oil	2.00	2.00	2.00	2.00	2.00	2.70	2.70	2.70	2.70	2.70	2.20	2.20	2.20	2.20	2.20
DL-Methionine	0.17	0.17	0.17	0.17	0.17	0.13	0.13	0.13	0.13	0.13	0.09	0.09	0.09	0.09	0.09
L-Lysine	0.12	0.12	0.12	0.12	0.12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Dicalcium phosphate	0.13	0.13	0.13	0.13	0.13	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Limestone powder	0.59	0.59	0.59	0.59	0.59	0.54	0.54	0.54	0.54	0.54	0.29	0.29	0.29	0.29	0.29
Vitamin supplement	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
Trace mineral mixture	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10

Feed intake, body weight, body weight gain, feed conversion ratio and protein efficiency ratio of broiler chicken

The cumulative effect of BrW incorporation on feed intake, body weight gain, feed conversion ration and protein efficiency ratio is given in table 3. It was observed that feed intake was statistically comparable among all groups during 1st, 4th and 6th week. However, in week 2, 3 and 5 feed intake was significantly highest ($P<0.05$) in T3 (287.2±7.62), C (706.2±11.02) and T3 (1389.9±34.18) and lowest in T2 (250.3±5.22), T4 (642.1±14.73) and (1260.3±53.34) respectively. It was found that the cumulative feed intake (g) during the pre-starter (0-14 days) and finisher phase (22-42) was significantly highest ($P<0.05$) in T3 group (422.0±10.26 and 3657.4±35.0) whereas during the starter phase (15-21 days) it was significantly highest ($P<0.05$) in control group (706.2±11.02). The average cumulative feed intake (g) during the whole study was highest in T3 (4737.1±35.89) group followed by control group (4509.1±42.77), T1 (4491.6±54.81) and T2 (4527.6±77.00) group however, constantly intermediate in T4 group (4626.8±59.90).

Table 3. Effect of bakery waste inclusion on cumulative feed intake, body weight gain, feed conversion ratio and protein efficiency ratio of broiler chicken

Days	Groups				
	C	T1	T2	T3	T4
			Feed Intake (g)		
0-2 weeks	$392^{ab} \pm 12.3$	$387^{a} \pm 9.14$	$384^{a} \pm 8.06$	$422^{b} \pm 10.2$	$401^{ab} \pm 9.08$
2-3 weeks	$706^{c} \pm 11.0$	$687^{bc} \pm 8.40$	$651^{a} \pm 10.3$	$657^{ab} \pm 10.4$	$642^{a} \pm 14.7$
3-6 weeks	$3410^{a} \pm 44.7$	$3416^{a} \pm 53.2$	$3491^{ab} \pm 75.7$	$3657^{b} \pm 35.0$	$3583^{ab} \pm 49.5$
0-6 weeks	$4509^{a} \pm 42.7$	$4491^{a} \pm 54.8$	$4527^{a} \pm 77.0$	$4737^{b} \pm 35.8$	$4626^{ab} \pm 59.9$
			Body Weight Gain (g)		
0-2 weeks	305 ± 11.10	291 ± 11.5	294 ± 13.6	295 ± 11.9	284 ± 14.3
2-3 weeks	471 ± 12.3	458 ± 17.1	443 ± 24.8	436 ± 23.4	436 ± 23.1
3-6 weeks	1565 ± 21.8	1495 ± 86.1	1473 ± 53.5	1529 ± 69.2	1469 ± 71.6
0-6 weeks	2342 ± 23.3	2245 ± 79.6	2211 ± 41.6	2261 ± 63.2	2190 ± 57.7
			Feed Conversion Ratio		
0-2 weeks	1.29 ± 0.05	1.33 ± 0.02	1.31 ± 0.07	1.43 ± 0.05	1.42 ± 0.04
2-3 weeks	1.50 ± 0.03	1.50 ± 0.04	1.49 ± 0.11	1.52 ± 0.06	1.48 ± 0.05
3-6 weeks	2.18 ± 0.04	2.30 ± 0.12	2.38 ± 0.11	2.41 ± 0.12	2.46 ± 0.12
0-6 weeks	$1.93^{a} \pm 0.03$	$2.01^{ab} \pm 0.06$	$2.05^{ab} \pm 0.05$	$2.10^{ab} \pm 0.06$	$2.12^{b} \pm 0.06$
			Protein Efficiency Ratio		
0-2 weeks	3.62 ± 0.15	3.46 ± 0.06	3.51 ± 0.18	3.21 ± 0.11	3.25 ± 0.10
2-3 weeks	3.13 ± 0.06	3.10 ± 0.09	3.14 ± 0.21	3.05 ± 0.12	3.15 ± 0.10
3-6 weeks	2.37 ± 0.04	2.24 ± 0.10	2.13 ± 0.10	2.11 ± 0.10	2.09 ± 0.10
0-6 weeks	$2.62^{b} \pm 0.04$	$2.49^{ab} \pm 0.06$	$2.41^{a} \pm 0.06$	$2.36^{a} \pm 0.07$	$2.35^{a} \pm 0.07$

[abc]Mean with different superscript within a row and column differ significantly (P<0.05)

The mean BW (g) on weekly basis of all 5 groups at different phases is given in table 4 which depicts that on day 0 and during 1st, 2nd and 6th week, the average body weight (g) was comparable in all five groups. However, the average body weight was significantly higher (P<0.05) in control group, lowest in T4 group and intermediate in T1, T2 and T3 group during 3rd, 4th and 5th week. Similarly, as presented in table 3, the cumulative body weight gain (g) during different phases namely pre-starter (0-2weeks), starter (2-3weeks) and finisher (3-6 weeks) was statistically similar for all five groups regardless of various diets. No significant difference was observed in cumulative body weight gain of in any of the groups.

FCR on cumulative as well as weekly basis as given in table 3 and 4 depicts that feed conversion ration of all five groups at different phases- pre-starter, starter and finisher did not vary significantly irrespective of different diets fed to them. On the contrary, FCR was significantly highest in T4 group (2.12±0.06), intermediate in T1, T2 and T3 group (2.01±0.06, 2.05±0.05 and 2.10±0.06) and lowest in control group (1.93±0.03) respectively for the overall period of time.

Weekly protein efficiency ratio (PER) as presented in table 4 indicates that during week 1, 5 and overall PER was significantly highest (P<0.05) in control group (3.72±0.13, 2.52±0.16 and 2.62±0.04) and lowest in T4 (3.36±0.07), T2 (2.03±0.13) and T4 (2.35±0.07) respectively. On the other hand, cumulative PER and PER during week 2, 3, 4 and 6 did not show any significant variation among all groups. Inconsistent pattern with respect to feed intake by birds was observed during different phases on weekly basis. Feed intake was statistically comparable among all groups during 1st, 4th and 6th week but during week 2, 3 and 5 feed intake was significantly highest (P<0.05) in T3 (287.20±7.62), C (706.23±11.02) and T3 (1389.90±34.18) and lowest in T2 (250.37±5.22), T4 (642.14±14.73) and (1260.36±53.34) respectively. It was found that the cumulative feed intake (g) during the pre-starter (0-14 days) and finisher phase (22-42) was significantly highest (P<0.05) in T3 group (422.02±10.26 and

3657.46±35.0) whereas during the starter phase (15-21 days) it was significantly highest (P<0.05) in control group (706.23±11.02). Our findings were in accordance with the results of (Al-Ruqaie et al., 2011; Ayanrinde et al., 2014, Kumar et al., 2016) who also stated variable patterns of feed intake.

The mean BW (g) during 1st, 2nd and 6th week and cumulative body weight was comparable in all five groups but significantly higher (P<0.05) in control group, lowest in T4 group and intermediate in T1, T2 and T3 group during 3rd, 4th and 5th week. Our findings are similar to the results stated by (Koukhan et al., 2003; Al-Ruqaie et al., 2011; Oke, 2013; Ayanrinde et al., 2014; Kumar et al., 2016 and Epao et al., 2017) who also no major affect on live body weight as a result of substitution of maize with bakery waste in poultry ration.

FCR on cumulative as well as weekly basis during different phases in different dietary groups did not vary significantly however it was significantly highest in T4 group and lowest in control group for the overall period of study which may be attributed to their higher body weight gain and nutrient utilization. This finding is in agreement with the results of (Oke, 2013; Epao et al., 2017 and Kricka et al., 2019) but contradict with those of (Ayanrinde et al., 2014 and Kumar et al., 2016) which may be explained by different source of BrW.

The average Protein efficiency ratio (PER) on weekly basis during week 1, 5 and overall PER was significantly highest (P<0.05) in control group which might be accredited to better protein utilization by them and lowest in T1, T2 and T4 respectively owing to processing of bakery products. These are similar to the results stated by (Oke, 2013) who also reported decreased PER in birds fed with bakery waste. But cumulative PER and PER during week 2, 3, 4 and 6 did not show any significant variation among all groups.

Table 4. Effect of bakery waste inclusion on weekly feed intake (g), body weight (g), feed conversion ratio of broiler chicken

Particulars	Groups				
	Feed Intake (g)				
	C	T1	T2	T3	T4
Week 1	125 ± 3.10	131 ± 3.28	134 ± 5.20	134 ± 3.34	137 ± 3.60
Week 2	266^{ab} ± 11.7	256^{a} ± 8.73	250^{a} ± 5.22	287^{b} ± 7.62	263^{ab} ± 8.75
Week 3	706^{c} ± 11.0	687^{bc} ± 8.40	651^{a} ± 10.3	657^{ab} ± 10.4	642^{a} ± 14.7
Week 4	851 ± 12.9	830 ± 24.5	839 ± 23.6	840 ± 18.5	863± 15.20
Week 5	1277^{ab} ± 26.6	1260^{a} ± 53.3	1268^{ab} ± 34.3	1389^{b} ± 34.1	1360^{ab} ± 38.5
Week 6	1282 ± 65.6	1350 ± 65.4	1383.56± 55.7	1427 ± 48.0	1359 ± 55.0
	Body Weight (g)				
Week 0	49.1 ± 1.05	48.3 ± 1.22	48.6 ± 0.52	48.6 ± 0.34	50.6 ± 0.80
Week 1	149 ± 3.14	152 ± 3.43	152 ± 1.88	149 ± 1.29	151± 2.66
Week 2	354 ± 11.83	340 ± 11.1	343 ± 13.6	344 ± 11.7	334 ± 14.5
Week 3	826^{b} ± 13.20	798^{ab} ± 15.3	786^{ab} ± 18.3	780^{ab} ± 15.1	771^{a} ± 17.6
Week 4	1323^{b} ± 16.8	1288^{ab} ± 54.9	1247^{ab} ± 34.2	1240^{ab} ± 22.1	1202^{a} ± 17.6
Week 5	1899^{b} ± 39.0	1811^{ab} ± 47.2	1781^{a} ± 31.9	1807^{ab} ± 20.6	1769^{a} ± 26.7
Week 6	2391 ± 24.3	2294± 78.4	2260 ± 41.7	2239 ± 77.4	2241 ± 57.0
	Feed Conversion Ratio				
Week 1	1.25 ± 0.04	1.28 ± 0.05	1.29 ± 0.04	1.34 ± 0.02	1.37 ± 0.03
Week 2	1.31 ± 0.07	1.36 ± 0.02	1.33 ± 0.09	1.48 ± 0.08	1.45 ± 0.05
Week 3	1.50 ±0.03	1.50 ± 0.04	1.49 ± 0.11	1.52 ± 0.06	1.48 ± 0.05
Week 4	1.72 ±0.07	1.73 ± 0.12	1.84 ± 0.09	1.84 ± 0.10	2.03 ± 0.14
Week 5	2.07 ± 0.13	2.41 ± 0.08	2.43 ± 0.22	2.49 ± 0.19	2.42± 0.11
Week 6	2.95 ± 0.20	2.89 ± 0.26	2.90 ± 0.08	2.93 ± 0.36	2.94 ± 0.29

	Protein Efficiency Ratio				
Week 1	$3.72^{b} \pm 0.13$	$3.63^{ab} \pm 0.16$	$3.55^{ab} \pm 0.10$	$3.41^{ab} \pm 0.05$	$3.36^{a} \pm 0.07$
Week 2	3.57 ± 0.20	3.38 ± 0.06	3.47 ± 0.22	3.12 ± 0.16	3.19 ± 0.12
Week 3	3.13 ± 0.06	3.10 ± 0.09	3.14 ± 0.21	3.04 ± 0.12	3.15 ± 0.10
Week 4	3.02 ± 0.13	3.02± 0.23	2.75 ± 0.14	2.76 ± 0.14	2.54 ± 0.17
Week 5	$2.52^{b} \pm 0.16$	$2.15^{ab} \pm 0.08$	$2.03^{a} \pm 0.13$	$2.14^{ab} \pm 0.13$	$2.24^{ab} \pm 0.12$
Week 6	1.77 ± 0.11	1.82 ± 0.15	1.68 ± 0.10	1.85 ± 0.46	1.79 ± 0.17

[abc]Mean with different superscript within a row and column differ significantly (P<0.05)

Nutrient utilization and retention

The results of metabolism trial as given in table 5 indicate that the initial, final and average body weight (g) of birds were significantly (P<0.05) highest in control group (1318±17.37, 1815±17.08 and 1567±12.60) among all the groups. It was found that feed, DM, OM, and NFE intake (g) were significantly (P<0.05) highest in control (1095±15.74, 1073±15.35, 1023±14.64 and 701±10.04) and lowest in T4 group (1031±19.36, 1013±19.03, 959.38±18.02 and 637.95±11.95 respectively). The intake of CP (g) was statistically similar among all the dietary groups. The intake of EE and TA was significantly (P<0.05) highest in T4 group (73.28±1.38 and 54.12±1.02) and lowest in T1 group (66.25±0.75 and 48.80±0.56) respectively. The intake of CF (g) was significantly (P<0.05) highest in control group (46.46±0.66) among various dietary groups. The digestibility (%) of various nutrients as presented in table 5 indicate no significant variation in digestibility of DM, OM, CP, EE, CF, TA and NFE among all the groups during the trial. The results of metabolism trial indicate that the initial, final and average body weight (g) of birds were significantly (P<0.05) highest in control group among all the groups. Also feed, DM, OM, CF and NFE intake (g) were significantly (P<0.05) highest in control group which might be due to their higher feed. CPI (g) was statistically similar among all the dietary groups. The intake of EE and TA was significantly (P<0.05) highest in T4 group which can be explained by high EE and TA content of bakery waste when compared to maize. The digestibility (%) of various nutrients presented no significant variation in digestibility of DM, OM, CP, EE, CF, TA and NFE among all the groups during the trial indicating no adverse effects on intestinal integrity and digestive enzymes activity upon dietary inclusion of bakery waste. These results are in accordance with the findings of (Shittu et al., 2016).

Table 5. Effect of bakery waste on body weight (g), nutrient intake (g) and digestibility (%) during metabolism trial of broiler chicken

Attributes	Groups				
	C	T1	T2	T3	T4
Initial body weight	$1318^{b} \pm 17.3$	$1292^{ab} \pm 18.2$	$1291^{ab} \pm 12.7$	$1271^{ab} \pm 11.1$	$1250^{a} \pm 16.2$
Final body weight	$1815^{c} \pm 17.0$	$1779^{bc} \pm 13.5$	$1760^{b} \pm 11.9$	$1741^{ab} \pm 15.9$	$1694^{a} \pm 18.1$
Average body weight	$1567^{c} \pm 12.6$	$1535^{bc} \pm 11.9$	$1526^{bc} \pm 11.4$	$1506^{ab} \pm 13.4$	$1472^{a} \pm 17.1$
			Nutrient intake (g)		
Feed intake	$1095^{b} \pm 15.74$	$1074^{ab} \pm 10.78$	$1046^{ab} \pm 16.22$	$1056^{ab} \pm 14.78$	$1031^{a} \pm 19.36$
DM	$1073^{b} \pm 15.35$	$1045^{ab} \pm 11.90$	$1023^{ab} \pm 15.86$	$1035^{ab} \pm 14.43$	$1013^{a} \pm 19.03$
OM	$1023^{b} \pm 14.64$	$996^{ab} \pm 11.35$	$972^{a} \pm 15.09$	$981^{ab} \pm 13.68$	$959^{a} \pm 18.02$
CP	207 ± 2.97	202 ± 2.31	201 ± 3.12	204 ± 2.86	201 ± 3.78
EE	$67.7^{ab} \pm 0.97$	$66.2^{a} \pm 0.75$	$67^{ab} \pm 1.04$	$70.2^{bc} \pm 0.98$	$73.2^{c} \pm 1.38$
CF	$46.4^{b} \pm 0.66$	$43.5^{a} \pm 0.50$	$43.1^{a} \pm 0.67$	$42.9^{a} \pm 0.60$	$42.9^{a} \pm 0.81$
TA	$49.4^{a} \pm 0.71$	$48.8^{a} \pm 0.56$	$50.0^{a} \pm 0.78$	$53.9^{b} \pm 0.75$	$54.1^{b} \pm 1.02$
NFE	$701.5^{c} \pm 10.04$	$683^{bc} \pm 7.79$	$661^{ab} \pm 10.26$	$663^{ab} \pm 9.25$	$641.7^{a} \pm 12.05$
			Nutrient digestibility (%)		
DM	76.1 ± 1.24	74.9 ± 1.67	74.1 ± 1.01	73.6 ± 2.20	72.8 ± 1.52
OM	75.4 ± 1.51	75.7 ± 1.63	74.0 ± 1.21	74.2 ± 1.10	72.1 ± 1.59
CP	75.8 ± 1.08	75.0 ± 1.36	74.6 ± 1.41	72.8 ± 2.00	71.1 ± 1.58
EE	72.6 ± 1.09	72.9 ± 1.10	73.4 ± 1.14	71.5 ± 1.40	71.8 ± 1.58
CF	56.0 ± 1.02	54.4 ± 1.29	54.4 ± 1.38	53.0 ± 1.45	52.7 ± 1.37
TA	67.1 ± 1.39	66.4 ± 1.79	66.2 ± 1.85	65.1 ± 2.42	65.5 ± 2.24
NFE	74.3 ± 1.28	73.7 ± 1.29	73.8 ± 1.09	72.8 ± 1.10	73.9 ± 1.31

[abc]Mean with different superscript within a row and column differ significantly ($P<0.05$)

CONCLUSION

It can be inferred that the bakery waste can successfully be incorporated as ration of commercial broilers as it does not seem to have any detrimental effect on their body weight, utilization and digestibility of various nutrients. Bakery waste can proficiently be included which can replace maize upto 20% in the ration of broiler chicken.

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