



Evaluation of dry bakery waste as replacement of maize in quail diet

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ABSTRACT

The objective of the study was to compare the effect of replacing maize in quail (*Coturnix japonica*) diet with bakery waste (BaW) @ 0% (T₀), 5% (T₁), 10% (T₂), 15% (T₃) and 20% (T₄) on growth, carcass traits, blood and sensory attributes. A day old, 300 commercial straight run quail chicks were randomly allocated to five different treatment groups (n=60 birds/group) for a period of 6 weeks. Eight birds per group were slaughtered at 42 days of age to evaluate carcass and sensory attributes. Result signifies that birds of all groups performed similar in terms of body weight gain, feed conversion and protein efficiency ratio. Also, estimated blood biochemical parameters showed no difference at all replacement levels. Similarly, carcass trait yields, small intestine micrometry and sensory attributes were also statistically similar. It was concluded that maize flakes in quail diet can be safely replaced by BaW up to 20%, without any negative impact.

Keywords: Bakery waste, Diet, Maize replacement, Quail

Quail is an excellent source for eggs and meat of high biological value and has low calorie content (Qi *et al.* 2018). It is a hardy bird having shorter life span, earlier returns (ICAR 2013) and may bridge up the animal protein demand shortage (Khan *et al.* 2022). Now-a-days, consumer interest in quail meat is escalating due to its delicious taste/nutritional benefits (Babangida and Ubosi 2021).

Major threat to poultry industry, is the escalating cost of feed ingredients particularly maize, which results in inflated product pricing (Edache *et al.* 2017). Thus, there has been a lot of interest in exploring alternative energy sources so that the feed costs remains within permissible limits (Gupta *et al.* 2021). Alternative feed ingredients if fulfils the criteria of being good quality and price, can be selected by nutritionists and may replace conventional feed ingredients (Epao *et al.* 2017, Truong *et al.* 2019, Adegbenro *et al.* 2020)

Amongst different unconventional feeds, bakery waste (BaW) is available in large amounts at throw away prices and can be used for substituting maize grains in poultry diet (Adeyemo *et al.* 2013). BaW comprises of unsold and outdated bakery products, stale dough, and other items which can be dried/dehydrated. These dried products can in turn be used as maize substitute (Epao *et al.* 2017, Penkov and Chobanova 2020). The dried bakery products were not used for human consumption (Ayanrinda *et al.* 2014) and is comparatively economical than maize (Yadav *et al.* 2014, Truong *et al.* 2019).

When the source is unknown, BaW should be examined every time as a requirement. (Mahmoud 2017). Earlier researchers recommended that BaW can be utilised in poultry diets without compromising growth, feed intake, or feed efficiency (Olafadehan *et al.* 2010, Edache *et al.* 2017), and may replace maize at various levels (Al-Ruqaie *et al.* 2011, Shittu *et al.* 2016a, Edache *et al.* 2017). There is paucity of information in terms of evaluation of nutritional composition of BaW of Jammu region. Moreover, its usage as maize substitute in quail diet is also scanty, thus present study was proposed to evaluate BaW containing diet on quail performance.

MATERIALS AND METHODS

The present experiment was conducted upon 300 quail chicks at Faculty of Veterinary Sciences and Animal Husbandry, Sher-e-Kashmir University of Agricultural Sciences and Technology of Jammu, where they were randomly assigned to five equal groups (n=60), having 4 replicates of 15 birds each. The ingredient composition of basal diet of quail starter (0-21 days) and quail finisher (22-42 days) diet was prepared as per standards of ICAR (2013) (Supplementary Table 1). Birds of control group (T₀) were offered mash diet made up of maize and soybean as principle ingredients whereas in T₁, T₂, T₃ and T₄ groups, maize was swapped with bakery waste at 5%, 10%, 15% and 20%, respectively in such a way that all the diets remained isonitrogenous. The experimental trial lasted for 42 days.

Bakery waste (BaW) source: Bakery waste was collected from Bonn bread factory, positioned at Paloura in Jammu region of Jammu and Kashmir Union Territory.

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The lot so collected was cleaned and dried in sun followed by its grinding before its incorporation in quail diet. Crude protein, organic matter, crude fibre of BaW realised in the current study was 11.90%, 98.03%, 2.79%, respectively and is comparable to maize, but ether extract in BaW was 12.94% which is higher than maize (4.08%).

Biochemical parameters: Eight birds per group, i.e. two birds per replicate were slaughtered on 42nd day and blood samples were collected for estimating glucose, total protein and albumin in plasma whereas cholesterol, triglycerides, alanine aminotransferase (ALT)/serum glutamate pyruvate transaminase (SGPT) and aspartate aminotransferase (AST)/serum glutamate oxaloacetate transaminase (SGOT) were estimated in serum by using standard diagnostic kits.

Carcass traits: Different carcass traits, viz. live weight, bled weight (weight of bird after severing the jugular vein), carcass weight, viscera weight (weight of internal organs of body; giblet weight) were recorded in grams. They were also expressed as % of live weight. However, dressing % was calculated by dividing eviscerated plus giblet weight by live weight and is then expressed in yields. The specimens/tissues of small intestine's sections were also collected and fixed in 10% neutral buffered formalin solution (Luna 1968). After dehydration with graded concentration of ethyl alcohol, samples were cleared in xylene and embedded in paraffin. In next step, paraffin blocks were cut by using microtome to prepare slides. These slides were then stained with Hematoxylin and Eosin (H and E) to record micrometrical observations by using ocular micrometry which is appropriately calibrated with stage micrometer.

Sensory evaluations: The dressed meat obtained after slaughter (eight birds per group) was washed thoroughly

and boiled in hot water for 10 min for organoleptic evaluation. The evaluation was done by means of eight-point descriptive scale (Seman *et al.* 1987) by 5 panellists (Professors), where eight signified extremely desirable whereas one represented extremely poor. The sensory attributes evaluated were appearance, flavor, juiciness, texture and overall acceptability.

Statistical analysis: The data related to different parameters was analyzed by using one way analysis of variance (ANOVA) as per the method described by Snedecor and Cochran (2004). Also, means of different treatments was subjected to Duncan's multiple range test (1955).

RESULTS AND DISCUSSION

Growth performance: The data for the overall feed intake and body weight gain value varied in between 665.66 g to 685.05 g and 165.41 g to 182.47 g, respectively (Table 1). Also, FCR and protein efficiency ratio (PER) values of all the treatment groups were statistically similar, indicating no adverse effect of BaW substitution as maize replacer up to 20% on appetite and feed utilization. Previous studies on BaW inclusion as maize substitute revealed no difference in above mentioned growth traits in quails (Edache *et al.* 2017, Lukanov *et al.* 2021) or in other poultry birds (Epaio *et al.* 2017, Al-Sagan *et al.* 2021).

Blood parameters: Plasma glucose, serum cholesterol and serum triglyceride values were found within the physiological ranges and showed no statistical difference (Table 2). Elevated cholesterol levels are associated with hepatic lipidosis, high fat diets, hypothyroidism, starvation and its blood measurement even dictates the fat metabolism

Table 1. Effect of inclusion of bakery waste on growth traits of quail

Attribute	Group					SEM	P-value
	T ₀	T ₁	T ₂	T ₃	T ₄		
AFI (g/bird)	665.66	682.67	683.38	680.54	685.05	6.41	0.90
AWG (g/bird)	182.47	183.94	177.69	175.06	165.41	3.47	0.50
FCR	3.67	3.73	3.86	3.92	4.17	0.08	0.35
PER	1.22	1.19	1.15	1.14	1.07	0.02	0.38

AFI, average feed intake; AWG, average body weight gain; FCR, feed conversion ratio; PER, protein conversion ratio. T₁, T₂, T₃ and T₄ groups- maize was replaced with bakery waste @ 5, 10, 15 and 20% BaW, respectively. SEM, standard error of mean.

Table 2. Effect of inclusion of bakery waste on blood biochemical parameters of quail

Particular	Group					SEM	P-value
	T ₀	T ₁	T ₂	T ₃	T ₄		
Glucose (mg/dl)	183.25	188.75	191.00	193.25	193.00	4.74	0.97
Cholesterol (mg/dl)	187.17	180.52	176.99	182.73	186.24	4.27	0.96
Triglyceride (mg/dl)	77.71	78.21	75.87	77.47	80.86	2.18	0.98
Total protein (g/dl)	3.92	3.95	3.93	4.04	4.01	0.08	0.99
Albumin (g/dl)	2.62	2.61	2.57	2.62	2.56	0.06	1.00
Globulin (g/dl)	1.31	1.34	1.37	1.42	1.45	0.05	0.92
A/G ratio	2.01	1.99	1.96	1.91	1.82	0.09	0.97
SGOT (IU/L)	42.92	43.67	46.94	48.51	49.61	1.52	0.60
SGPT (IU/L)	20.53	19.28	19.20	20.43	20.25	0.59	0.93

T₁, T₂, T₃ and T₄ groups- maize was replaced with bakery waste @ 5, 10, 15 and 20% BaW, respectively. SEM, standard error of mean.

Table 3. Effect of inclusion of bakery waste on carcass characteristics of meat quail

Attribute	Group					SEM	P-value
	T ₀	T ₁	T ₂	T ₃	T ₄		
Live weight (g)	183.69	185.69	181.63	180.95	178.27	1.40	0.55
Bled weight (g)	176.85	178.51	174.33	173.35	170.54	1.37	0.42
% of live weight	96.28	96.14	95.98	95.82	95.65	0.14	0.68
De-feathered weight without skin (g)	142.71	144.40	140.66	139.33	136.83	1.51	0.58
% of live weight	77.66	77.73	77.40	76.96	76.71	0.30	0.81
Eviscerated weight (g)	121.63	123.19	121.05	120.64	117.99	1.53	0.89
% of live weight	66.17	66.34	66.58	66.57	66.12	0.43	1.00
Viscera weight (g)	21.08	21.21	19.61	18.69	18.84	0.47	0.28
% of live weight	11.50	11.39	10.82	10.38	10.59	0.26	0.62
Dressing %	71.81	72.01	72.24	72.28	71.95	0.47	1.00
Giblet weight (g)	10.39	10.57	10.30	10.37	10.42	0.21	1.00
% of live weight	5.64	5.68	5.66	5.71	5.83	0.08	0.96
Heart weight (g)	1.13	1.20	1.21	1.18	1.19	0.02	0.75
% of giblet weight	0.61	0.65	0.66	0.65	0.67	0.01	0.37
Liver weight (g)	4.06	4.18	4.04	4.16	4.16	0.09	0.99
% of giblet weight	2.21	2.25	2.22	2.29	2.33	0.04	0.86
Gizzard weight (g)	5.20	5.19	5.06	5.03	5.07	0.12	0.99
% of giblet weight	2.82	2.79	2.79	2.77	2.84	0.05	0.99
Drumstick weight (g)	5.15	5.29	5.10	5.06	5.15	0.09	0.96
% of live weight	2.80	2.84	2.80	2.79	2.88	0.03	0.92

T₁, T₂, T₃ and T₄ groups- maize was replaced with bakery waste @ 5, 10, 15 and 20% BaW, respectively. SEM, standard error of mean.

assessment. The normal and non significant above mentioned blood parameters indicates the normal health of quail birds. Similarly, different protein parameters, viz. total protein, albumin, globulin and Albumin:Globulin (A:G ratio) showed no noticeable difference ($P>0.05$). The synthesis of serum protein and albumin depends upon the availability and intake of protein (Ahaotu *et al.* 2018). The intake of isonitrogenous diets by quail birds in the present trial resulted in similar protein parameters. Liver function tests conducted in serum of adult quails also presented similar values for both SGOT/AST and SGPT/ALT. All these blood biochemical parameters strongly supports that it is safe to replace maize by BaW up to 20% level in quail diet and there is no adverse effect on vital organs. It also suggests that diets framed by maize substitution with BaW meal were of good quality and free from anti-nutrients. The results of this trial are in agreement with the findings of some researchers (Shittu *et al.* 2016, Epao *et al.* 2017, Chauhan 2021).

Carcass traits: The different carcass traits of mature quail broilers measured after slaughtering is given in Table 3. Live weight, bled weight, defeathered weight without skin, eviscerated weight, viscera weight as well as weight of different visceral organs, viz. giblet weight, heart weight, liver weight, gizzard weight and drumstick weight measured in grams and articulated as % live weight remained unaffected on substituting maize with BaW up to 20% level ($P>0.05$). The dressing percentage varies from 71.81-72.28 % in present study and no significant effect was observed, however, it was calculated by using

de-skinned birds, which resulted in lower dressing percentage. Similar to current results, several authors reported alike carcass traits while replacing maize with different inclusion levels of BaW in broiler diet (Al-Ruqaie *et al.* 2011, Ayanrinde *et al.* 2014, Shittu *et al.* 2016a, Epao *et al.* 2017 and Al-Sagan *et al.* 2021). Contrary to the current findings, Edache *et al.* (2017) reported higher BW, slaughter weight and plucked weight of Japanese quail birds on replacing 100% maize with BaW, but up to 75% replacement no difference was observed. The similar carcass traits also revealed that muscle turnover was not affected negatively on substituting maize with BaW meal (up to 20%) in quail diet.

Different micrometrical parameters, viz. villi length, base of villi width, luminal epithelial height, crypt depth, diameter of glands and gland epithelial height were measured in duodenum, jejunum and ileum of adult quail birds (Table 4). Alimentary tract particularly gut converts feed into nutrients and acts as absorption site also. The current study revealed similar micrometrical values in all the segments of small intestine. The identical values of intestinal micrometry signify that BaW does not tamper intestinal integrity and suggests that maize can be efficiently substituted by BaW meal up to 20% in the quail ration. The above results matches with the findings of Chauhan (2021) who replaced maize flakes with 0, 5, 10, 15 and 20% BrW meal in Cobb broiler ration and reported comparable micrometrical parameters in small intestine. On the other hand, Shittu *et al.* (2016b) observed considerable difference ($P<0.05$) in villus height and crypt

Table 4. Effect of inclusion of bakery waste on micrometry of different components of small intestine of meat quail

Attribute	Group					SEM	P-value
	T ₀	T ₁	T ₂	T ₃	T ₄		
<i>Duodenum</i>							
Length of villi (µm)	612.55	614.32	615.92	620.18	611.95	7.13	1.00
Width at base of villi (µm)	118.40	126.63	122.91	124.23	116.41	4.39	0.96
Luminal epithelial height (µm)	31.22	29.56	28.90	30.07	29.37	0.67	0.86
Crypt depth (µm)	80.35	83.86	81.39	82.18	79.63	1.75	0.96
Diameter of glands (µm)	57.61	55.08	55.44	57.19	56.70	0.66	0.73
Gland epithelial height (µm)	23.27	22.94	23.05	22.61	21.96	0.36	0.83
Villi length/crypt depth	7.69	7.47	7.67	7.66	7.81	0.20	0.99
<i>Jejunum</i>							
Length of villi (µm)	435.74	437.68	434.32	431.83	426.61	7.03	0.99
Width at base of villi (µm)	82.95	88.34	86.85	84.63	79.15	2.62	0.85
Luminal epithelial height (µm)	26.62	26.33	25.68	24.71	25.77	0.53	0.84
Crypt depth (µm)	69.06	71.64	70.33	70.75	69.56	0.63	0.75
Diameter of glands (µm)	45.65	45.18	44.71	43.50	42.93	0.66	0.70
Gland epithelial height (µm)	20.75	21.04	19.97	20.88	20.12	0.32	0.80
Villi length/crypt depth	6.33	6.11	6.20	6.13	6.17	0.13	0.99
<i>Ileum</i>							
Length of villi (µm)	297.65	298.91	309.00	305.12	303.64	4.33	0.93
Width at base of villi (µm)	70.42	72.50	68.82	70.76	69.96	2.84	1.00
Luminal epithelial height (µm)	22.67	22.00	22.12	21.87	21.26	0.35	0.82
Crypt depth (µm)	59.59	60.40	59.08	60.82	58.75	0.77	0.92
Diameter of glands (µm)	39.48	39.72	40.63	40.86	40.02	0.36	0.75
Gland epithelial height (µm)	20.12	19.87	20.27	19.55	19.68	0.32	0.96
Villi length/crypt depth	5.03	4.97	5.25	5.07	5.22	0.11	0.94

T₁, T₂, T₃ and T₄ groups- maize was replaced with bakery waste @ 5, 10, 15 and 20% BaW, respectively. SEM, standard error of mean.

depth on feeding biscuit dough (BD) to broiler birds as maize substitute. Dissimilar feed composition, diverse experimental poultry birds and different type, composition, source of BaW might be responsible for the differences realized in these two above studies.

Sensory parameters: The result of different sensory parameters of quail meat, viz. appearance, flavour, juiciness, texture and overall acceptability (Supplementary Table 2). The related values of different sensory attributes depicts that control (fed maize-soya based basal diet) and treatment quail birds (fed 5, 10, 15 and 20 % BaW meal as maize replacer in the diet) were alike. Similar sensory evaluation results of broiler meat were reported by Oke (2013) on including BrW meal @ 0, 10, 20 and 30% as maize substitute.

In other words, 20% inclusion of bread waste (BaW) as maize substitute does not affect the meat delicacy, growth and carcass traits.

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