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Growth performance and meat quality of rice fed broiler and native chicken genotypes in Bangladesh

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Abstract

The study was conducted on growth and meat quality attributes of rice fed broiler and native chicken genotypes under intensive rearing. A total 360 DOC from two genotypes were reared in a common brooder house. The diet samples were divided into three treatment groups *viz.* T_1- corn (0% rice), T_2-50% corn replaced by rice and T_3-100% corn replaced by rice. Data were analyzed using 2×3 factorial design. Broiler showed significantly ($p<0.01$) higher growth performance as compared to native chicken. Cooking and drip loss were significantly ($p<0.01$) higher in broiler whearas WHC, ultimate pH and cooked pH were significantly ($p<0.01$) higher in native chicken breast meat. The diet had a significant ($p<0.01$) effect on water holding capacity (WHC) but the highest WHC% was found in T_1 treatment. The CIE L*, a*, b*, was significantly ($p<0.01$) higher in broiler. The interaction between genotype and diet was found significantly ($p<0.05$) different in b* in breast and thigh meat; L*, b* in drumstick meat; a* in liver, respectively. The L* and b* were significantly ($p<0.05$) higher in broiler drumstick meat. The L* and a* values were significantly ($p<0.05$) higher in liver of broilers. Significantly ($p<0.01$) higher tenderness and juiciness were found in broiler breast meat than native chicken. This study provides an important insight on growth performance and meat quality of rice fed broiler and native chicken genotypes. Hence, rice could be used as alternative to corn in chicken ration.

Introduction

Chicken is the cheapest and key contributor of animal protein in the human diet (Rahman et al. 2017). Two major sources of chicken meat are one fast growing commercial hybrid (broiler) and other one slow growing native chicken. Indigenous chicken production is characterized by low productivity due to poor quality and poor management practices (Bidi et al., 2019). The consumers preferred indigenous chicken meat and eggs for decade after decade and consumer‘s attraction towards indigenous chicken will also remain unchanged in future because of their special flavor, taste and texture (Bithi et al., 2020; Islam et al., 2019; Jamaly et al., 2017; Das et al., 2018). Indigenous chicken is always thought to be better in terms of carcass composition than commercial broilers due to its low-fat content (Ganabadi et al., 2009). The world production of poultry meat is based on raising fast-growing broiler chickens intended solely for meat production (Hartcher and Lum, 2019). Consumer interest in the flavor of some meat from slow-growing chickens is increasing in many countries of the world despite its relatively high price. The experience of many countries in which native breeds of slow growing chickens provide good quality meat, which increases the demand (Walley et al., 2015). Corn is the principal cereal grain among major poultry feed stuffs and constitutes about 50-60% in most poultry diets (Anyachor, 2020). Corn price is increasing continuously due to intense competition for its usage by man or livestock species (Bala et al., 2017). Many researchers emphasized the need for utilizing alternative feed ingredients (Alagawany and Attia, 2015) which is suitable alternative sources of energy in poultry feeds that are available. Among cereal grains, rice (*Oryza sativa*) is relatively cheaper promising grains that can be successfully utilized as an ingredient of poultry ration. So, rice may be an alternative to corn due to their availability in addition to presenting similar protein and metabolizable energy contents (Daghir, 2008). In recent years, rice by-products received increased attention as functional foods due to their phenolic base compounds and high amount of vitamins, minerals, fiber, which can help lower cholesterol and support antiatherogenic activity. The inclusion of broken rice in broiler diets has been evaluated and no effects on feed intake, weight gain and feed conversion of birds were observed (Cancherini et al., 2008). When evaluating the replacement of corn by broken rice in broiler diets at the levels of 0, 20 and 40% did not find any significant effects on feed intake, weight gain, or feed conversion ratio (Brum et al., 2007). Swain et al. (2006) concluded that broken rice could substitute the corn only at 5% inclusion level in diets. Nanto et al. (2012) obtained higher final weight in broilers when corn was totally replaced by dehulled paddy rice in the diets. Asian countries contribute approximately 92% of the total world rice production which has been cultivated widely in warm climates. All parts of processed rice are exploited as feed stuffs like rice polish (Rahman, 2005), rice bran (Wang, 1999) and rice grain that is undesirable for human consumption (Alias, 2008). Systematic studies suggest that meat quality traits are highly influenced by dietary compositions (Wood et al., 2008). Recently, some researchers reported that dietary rice improved the growth performance of weaning piglets (Yagami and Takada, 2017)) compared to dietary corn. There were a few reports available on meat yield and quality traits of fast growing broiler and slow growing native chicken fed on rice based commercial diets by varying ingredients and nutrient composition worldwide. The above reviews show a clear gap to investigate the effects of rice inclusion instead of corn based commercial diet of the fast and slow growing chicken genotypes. Therefore, the study was conducted to evaluate the growth response of rice fed broiler and native chicken, examine the meat quality of broiler and native chicken.

Materials and Methods

Experimental birds and management

The experiments were carried out at a local private farm at Alurtol, nearby Sylhet Agricultural University, Sylhet. A total 360 DOC from two genotypes was reared in a common brooder house for the first week separately. The native chicken eggs were collected from Bangladesh Livestock Research Institute, Savar, Dhaka and hatched from a local hatchery. The day-old broiler chicks (Cobb 500 broiler) were purchased from Kazi Farms Limited. All birds were reared on the basis of same age, management, vaccination and feeding having three grouped namely T_1- based on corn (0% rice), T_2-50% corn replaced by rice and T_3-100% corn replaced by rice having 20 birds per treatment. The birds were reared up to marketing age of both genotypes (broiler and native chicken). Three hundred and sixty (180 Native chicken and 180 Cobb 500 broiler) chicks were reared under same house with free access to diet (Commercial broiler grower containing 20% CP and 2950 kcal ME/kg) and water. The day-old chicks were reared in a common brooder house for the first week separately native and broiler chicks. The diet was supplied uniformly for all treated birds. Feed was supplied twice daily; morning and afternoon. Pure drinking water was supplied *ad libitum*. Refusals of feed were measured daily in the morning. Temperature of the house was maintained with the help of an electric brooder and bulb. Temperature and humidity of the house were taken during the farm trial at 6 A.M., 12 noon and 6 P.M. Humidity was measured through a thermo-hygrometer and humidity level was higher than the requirement.

Ration formulation

Corn (CP 9% and ME 3350 kcal), rice (CP 8.5% and ME 3000 kcal), rice polish, soybean meal, protein concentrate, di-calcium phosphate (DCP) and limestone etc. were used for feed formulation (Table 1) considering chemical composition and market price. The DM, CP, EF, and ash were determined by AOAC (2005) method. Calcium and Phosphorus were determined by spectrophotometer.

Table 1. Composition and nutrient content of diet

Ingredients and nutrients (kg)	Diet		
	T_1 (0% Rice)	T_2 (50% Rice)	T_3 (100% Rice)
Corn	550	275	0
Rice	0	275	550
Soybean meal	253	257	160
Protein concentrate	50	60	130
Oil	5	40	55
Di-calcium phosphate	15	15	15
Rice polish	105	60	80
Salt	3	3	3
Lysine	2	2	2
Methionine	2	2	2
Limestone	12	8	5
Vitamin Premix	3	3	3
Total (kg)	1000	1000	1000
CP (%)	20.16	20.11	20.12
Lys (%)	1.2	1.2	0.573
Ca (%)	1.09	1.034	1.22
Met+Cys (%)	0.8	0.796	0.829
ME (kcal/kg)	2950	2950	2950

T_1, T_2 and T_3 provided the following (per 1000 kg of diet): Mn, 100 ng; Zn, 100 ng; Fe, 40 ng; Cu, 15 ng; I, 1mg; Vitamin A, 130 IU; Vitamin D, 35,000 IU; Vitamin E, 80 IU; Vitamin K 4 mg; Thiamine monohydrate 4 mg; riboflavin 9 mg; Vitamin B6 64 mg; Vitamin B12 0.02 mg; pantothenate 15 mg; nicotinamide 60 mg; folic acid 2 mg; biotin15 mg

Litter management

Fresh and dry rice husk was used as litter material with a depth about 5 cm. Litter materials were stirred at a 7 days interval. When the litter materials were found damp, it was replaced by new one.

Sample collection and data recording

The initial body weight (IBW), weekly body weight (WBW), final body weight (FBW), body weight gain (BWG), weekly feed consumption (WFC) and feed consumption ratio (FCR). The weight of blood, skin with feather, dressed weight, breast meat, thigh, drumstick, abdominal fat, liver and gizzard weight were taken by an electrical balance. The mean feed consumption per bird was determined by dividing the total amount of feed consumed per group by the number of birds in each group per day. The FCR was measured by dividing the feed intake by the body weight gain for a given period.

Physicochemical traits of breast meat

Drip loss

Drip loss was measured the following procedure of Rahman et al. (2020) and Disha et al. (2020). For DL measurement approximately 30 g sample was hung with a wire and kept in an air tight plastic container for 24 h. After 24 h the sample was weighed and calculated the difference. It was expressed as percentage.

$$\text{DL }(\%) = \frac{(\text{Weight of sample} - \text{weight after 24 hours chilling})}{\text{Weight of sample}} \times 100$$

Cooking loss

The 30 g meat sample was taken in a poly bag and heated it in water bath until the temperature rises to 71º C inside the sample (Siddiqua et al., 2018). The meat with 71º C was taken out from the water bath and soaked it with tissue paper. Weight loss of the sample was measured during cooking chicken breast meat. CL was calculated using the following formula:

$$\text{CL }(\%) = \frac{(\text{Weight before cooking of sample} - \text{weight after cooking})}{\text{Weight before cooking of sample}} \times 100$$

Ultimate pH measurement

Meat pH value was measured at 24 h after slaughter (ultimate pH) using a pH meter (Boby et al., 2021). The pH was measured by inserting electrodes at three different points of the chicken breast muscle which was calibrated prior to use at pH 4.0 and 7.0 by pH meter (Hanna HI 99163). Triplicate measurements at 1 cm depth on the medial portion of each breast were considered.

Cooked pH

The samples were cooked to an internal temperature of 71°C for 30 minutes (Rima et al., 2019). Then the muscle samples were taken out, after that cooled at room temperature. After cooling, pH was measured the same way as raw sample.

Water holding capacity (WHC)

The WHC was measured according to the methodology of Hossain et al. (2021). Thawed samples (1 g each) were wrapped in absorbent cotton and placed in a 1.5 ml centrifuge tube. The tubes with samples were centrifuged in a centrifuge separator (H1650-W Tabletop high speed micro centrifuge) at 10,000 rpm for 10 min at 4º C temperature, following which the samples were weighed. The WHC% of the sample is expressed as the following formula:

$$\text{WHC }(\%) = \frac{(\text{Weight of sample after centrifugation})}{(\text{Weight of sample before centrifugation})} \times 100$$

Sensory parameters

Different sensory attributes were examined in this study. Each meat sample was evaluated by a trained 8-member panel. The sensory questionnaires measured intensity on a 5- point balanced semantic scale for the attributes viz. color, flavor, tenderness, juiciness, and overall acceptability. Eight training sessions were held to familiarize the judges with the attributes to be evaluated and the scale to be used (Jahan et al. 2018; Saba et al., 2018; Islam et al., 2018). Prior to sample evaluation, all panelists participated in orientation sessions to familiarize with the scale attributes (color, flavor, juiciness, tenderness, overall acceptability) of meat using intensity scale. All samples were served in the petri dishes.

Statistical analysis

Data were analyzed using 2×3 factorial experiments where two genotypes of chicken and three levels of rice were given to the birds. P-value <0.05 was considered statistically significant and a tendency toward significant was considered when the p-value < 0.05.

Results and Discussion

Growth performance

The mean IBW, FBW, BWG, ADG, WFC, FCR and survivality of broiler chicken are presented in Table 2.The IBW, FBW, BWG and ADG were significantly (p<0.001) higher in broiler chicken than native chicken. The FBW at marketing age (five weeks for broiler and twelve weeks for native chicken) were found significantly higher (p>0.001) in T_1, T_2 and T_3 feeding groups in native chicken, respectively. The BWG was significantly (p<0.01) higher in broiler than native chicken. The ADG was found significantly (p<0.001) differed between broiler and native chicken (44.75 vs. 6.47 g). The BGD in native chicken in the study was agreed with the results of Das et al. (2018). Growth is influenced by genotype of the birds reported by Ogunpaimo et al. (2020) and Okyere et al. (2020) mentioned that hormones, tissue specific regulatory factors and other aspects of the bird's environment are contributing factors for growth in chicken. In a stress-free environment, adequate feed supply with essential nutrients, growth will increase until a genetically determined upper limit is reached. There were no significant (p>0.05) differences in growth performance among dietary treatments in current study which was similar to the report of Tariq et al. (2019). Yang et al. (2020) found the using of rice grains instead of corn did not exhibit any negative effects on the rumen fermentation or growth performance which is similar to the present study Present results were agreed with Sittiya et al. (2014) and revealed that rice can totally replace of corn in laying hen diets without hampering egg production performance. The results were in agreement with Korver et al. (2004) who found that genotype influenced by FBG, feed intake and FCR. The broiler groups was significantly higher (p<0.01) feed intake than the native chickens. In general, BWG increased by increasing feed intake, resulting in increased BWG in the broiler group could be attributed to higher feed intake. It is true that heavier strains consume more feed than lighter ones due to their increase maintenance requirements and appetite. Large sized birds tend to require more dietary nutrients than their small counter parts. The FCR significantly (p<0.01) differed between broiler and native chicken. The FCR had significant (p<0.01) differences between two genotypes. The overall mean for FCR of broiler strain was significantly (p<0.01) higher than native chicken. The FCR value obtained from present study was similar with the authors

(Nguyen et al., 2010) reported that genotype influence the FCR. Khan (2006) found that the indigenous grower chick's FCR was 4.08 at 10 weeks after feeding a commercial diet which was slightly higher than the present findings.

Table 2. Performances of broiler and native chicken up to marketing age

Parameters	Genotype	Dietary Treatment				*p-value*		
		0% Rice	50% Rice	100% Rice	Mean	Genotype	Diet	G*D
Initial Body Weight	Broiler	42.67±0.88	43.00±1.53	42.67±0.33	42.70[a]			
	Native	29.67±0.33	31.00±1.53	29.33±0.89	30.00[b]			
	Mean	36.17	37.00	36.00		<0.0001	0.60	0.80
Final Body Weight	Broiler	1613.33±30.87	1615.33±47.83	1598.33±31.67	1609.00[a]	<0.0001	0.19	0.32
	Native	583.00±28.36	684.00±82.78	488.33±18.56	573.11[b]			
	Mean	1098.17	1131.67	1143.33				
Body Weight Gain	Broiler	1570.67±30.18	1572.33±46.32	1555.67±31.45	1566.22[a]	<0.0001	0.18	0.32
	Native	553.33±28.42	617.00±42.21	459.00±19.31	543.11[b]			
	Mean	1062.00	1094.67	1007.33				
Average Daily Gain	Broiler	44.88±0.86	44.93±1.32	44.44±0.90	44.75[a]	<0.0001	0.41	0.72
	Native	6.59±0.34	7.35±0.98	5.47±0.23	6.47[b]			
	Mean	25.73	26.14	24.96				
Feed Consumption	Broiler	2836.33±63.05	2769.67±89.19	2865.67±56.91	2823.9[a]	0.0002	0.33	0.12
	Native	2273.33±80.57	2478.67±0.98	1973.33±46.93	2241.7[b]			
	Mean	2554.80	2624.00	2419.50				
Feed Conversion Ratio	Broiler	1.75±0.07	1.71±0.00	1.75±0.05	1.74[b]	<0.0001	0.20	0.40
	Native	4.11±0.07	4.03±0.60	4.31±0.17	4.15[a]			
	Mean	2.93	2.87	3.03				

Values indicate Mean ± SE, mean in each row having different superscript varies significantly at values** P < 0.01. G*D, Interaction between genotype and diet

Physicochemical traits

Instrumental color values

Physicochemical traits of two genotypes at different level of rice feeding are shown in the Table 3. Genotype had significant (p<0.01) effect in meat quality traits. The cooking loss, drip loss, WHC, ultimate pH and cooked pH were significantly (p<0.01) higher in commercial broiler breast meat. The interaction between genotype and diet had found significant (p<0.05) differences in case of WHC, drip loss and cooked pH. Broiler muscle quality did not affect the quality of animal protein consumption, but also impacts human health (Jin et al., 2019). In the present study meat samples of two genotypes varied significantly (p<0.01) in the WHC, cooking loss and drip loss, ultimate and cooked pH values. The ultimate pH values of native chickens in the study were higher than broiler due to the effect of age of bird. Liu et al. (2020) reported ultimate pH values in breast muscle increased with the growing of age that was similar to the present study where age of native bird was higher than broiler. The ultimate pH values of native chickens in present study were similar to Zhang et al. (2018). Higher ultimate pH was observed compared to present findings (Choo et al., 2014). Lower cooking loss and drip loss in broiler breast meat was found compared to the present findings (Konieczka et al., 2020). Tuoi et al. (2020) observed native chicken pH, cooking loss and drip loss were 5.56, 30.54 and 2.06 respectively which did not agree to the present study. Bungsrisawat et al. (2018) found lower pH and drip loss in broiler which was similar to the present study. A higher drip loss means greater loss of soluble nutrients and flavor substances found by Liu et al. (2020). In this study, the drip loss decreased with increasing free-range days. Exercise stress was regarded as one of the most important factors affecting drip loss of meat reported by Young et al. (2009). The lower drip loss with more free-range days might be ascribed to the increased exercise stress on thigh muscles. Muscle pH reflects the acid and base concentrations, and is closely associated with meat color and WHC.

Table 3. Physicochemical traits of broiler and native chicken at different level of rice

Parameters	Genotype	Dietary Treatment				*p-value*		
		0% Rice	50%Rice	100%Rice	Mean	Genotype	Diet	G*D
WHC	Broiler	90.98±1.69	90.34±1.68	82.15±0.51	87.82 [b]	0.0001	0.0037	0.0107
	Native	93.66±0.87	94.09±0.80	93.19±1.32	93.65 [a]			
	Mean	92.32	92.21	86.67				
Cook Loss	Broiler	28.32.43	26.23±1.96	31.16±1.03	28.28 [a]	0.0077	0.9511	0.0607
	Native	24.28±1.62	26.20±1.73	22.260.39	24.24 [a]			
	Mean	26.3	26.21	26.71				
Drip Loss	Broiler	3.36±0.19	4.26±0.64	4.72±0.33	4.11 [a]	0.0009	0.2600	0.0114
	Native	3.59±0.50	1.94±0.17	2.78±0.12	2.77 [b]			
	Mean	3.48	3.1	3.75				
Raw pH	Broiler	5.84±0.02	5.86±0.06	5.90.278±	5.89 [b]	0.0014	0.7218	0.8024
	Native	6.38±0.13	6.27±0.07	6.36±0.07	6.34 [a]			
	Mean	6.11	6.07	6.17				
Cook pH	Broiler	5.88±0.06	5.83±0.06	5.73±0.06	5.81 [b]	0.0103	0.3990	0.0289
	Native	5.84±0.02	5.98±0.01	5.96±0.3	5.92 [a]			
	Mean	5.86	5.91	5.85				

Values indicate Mean ± SE, mean in each row having different superscript varies significantly at values** P < 0.01. G*D, Interaction between genotype and diet.

Instrumental color values

Breast meat

Instrumental color values *viz.* CIE L*, a*, b* in breast meat of broiler and native chicken are shown in Table 4. Genotype had significant (p<0.01) effect in all instrumental color parameters. The CIE L* and a* were significantly (p<0.01) higher in broiler breast meat whereas b* significantly (p<0.05) higher in native chicken. The interaction between genotype and diet found significant (p<0.01) difference in b* value. Chicken breast meat generally appears to have a pink color, which is a desirable characteristic for the consumers' choice (Choo et al., 2014). Similar research conducted by Jaturasitha et al. (2008). Breast meat of broiler was paler (high L*) and redder (high a*) as compared to native chicken. On the contrary native chicken breast meat was high in yellowness (high b*) than broiler. Bangsrisawat et al. (2018) observed similar L* and higher a* and b* values in native chicken as compared to the current study. Meat color might be influenced by the heme pigments, genetics and feeding (Fanatico et al., 2005). Tuoi et al. (2020) reported lower CIE L*, a* and higher b* value in native chicken compared to present study. The higher myoglobin content may contribute to higher a* value and lower L* value in native chicken (Li et al., 2020). The native chickens showed less color value than broiler genotypes.

Table 4. Instrumental color values in breast meat of broiler and native chicken at different level of rice

Parameter	Genotype	Dietary Treatment				*p-value*		
		0% Rice	50% Rice	100% Rice	Mean	Genotype	Diet	G*D
L*	Broiler	62.08±1.15	61.46±2.69	64.19±1.64	62.58 [a]			
	Native	58.37±1.67	57.22±0.75	60.65±1.11	58.74 [b]	0.005	0.151	0.973
	Mean	60.22	59.34	62.42				
a*	Broiler	4.18±0.66	4.53±0.59	4.94±0.57	4.55 [a]			
	Native	3.58±0.99	1.58±0.58	2.89±0.63	2.69 [b]	0.001	0.375	0.233
	Mean	3.88	3.06	3.92				
b*	Broiler	9.55±0.94	12.31±0.34	10.81±0.51	1.89 [b]			
	Native	8.40±1.63	3.11±0.48	9.16±1.24	6.89 [a]			
	Mean	8.97	7.71	9.99		<0.0001	0.075	<0.0001
	Native	9.30±1.81	3.72±60	9.75±1.27	7.59 [b]			
	Mean	9.91	8.47	10.9				

Values indicate Mean ± SE, mean in each row having different superscript varies significantly at values** p < 0.01. G*D, Interaction between genotype and diet

Thigh meat

The CIE L*, a*, and b* in thigh meat of broiler and native chicken are shown in Table 5. The interaction between genotype and diet observed significant (p< 0.01) differences in CIE b* value in thigh meat. In the present study, the thigh meat of native chicken was higher in CIE L*, a* and b* than broiler chicken. Konieczka et al., (2020) found lower L*, higher a* and b* in broiler compared to present study. Another authors observed inconsistent results compared to present findings (Sarica et al., 2014). This difference in meat color might be due to distinguish the origin of chicken strains (Jeon et al. (2010). The broiler thigh meat had the expected levels of lightness and reduced red color compared to native chicken.

Table 5. Instrumental color values in thigh meat of broiler and native chicken at different level of rice

Parameters	Genotype	Dietary Treatment				Level of Significance		
		0% Rice	50%Rice	100%Rice	Mean	Genotype	Diet	G*D
L*	Broiler	53.79±1.26	55.40±1.79	58.18±1.40	55.79	0.169	0.115	0.169
	Native	56.11±1.75	58.44±1.22	57.66±0.85	57.4			
	Mean	54.95	56.92	57.92				
a*	Broiler	5.59±0.44	7.11±0.60	7.19±0.79	6.63	0.302	0.15	0.204
	Native	7.19±0.40	6.24±0.54	8.31±1.23	7.25			
	Mean	6.39	6.67	7.75				
b*	Broiler	4.27±1.01	6.24±0.03	4.51±0.69	5	0.299	0.362	0.001
	Native	5.98±0.94	1.65±0.43	5.18±1.14	7.27			
	Mean	5.12	3.95	4.84				
	Native	9.63±0.61	6.59±0.51	10.50±1.01	8.91			
	Mean	8.47	8.14	9.7				

Values indicate Mean ± SE, mean in each row having different superscript varies significantly at values** p < 0.01. L* (lightness), a* (redness), b* (yellowness), G*D, Interaction between genotype and diet

Drum stick meat

Instrumental color values CIE L*, a*, and b* in drum stick meat of broiler and native chicken are shown in Table 6. The CIE L* and b* were significantly (*p*< 0.01) higher in commercial broiler compared to native chicken. The a* showed higher in native chicken than broiler quantitatively but did not differ significantly (*p*>0.05). Diet had no effect on instrumental color parameters. However, interaction between genotype and diets found significantly (p<0.05) different in L*, and a* value in drumstick meat. In the present study, CIE L* and b* of the drumstick meat of broiler was higher but a* was lower than native chicken. Similar trends were observed by Wattanachant (2004) who found in Biceps femora's muscle L* 32.53 and 39.32; a* 0.45 and 2.49; b* 2.53 and 0.79 in broiler and native chicken, respectively.

Table 6. Instrumental color values in drum stick meat of broiler and native chicken at different level of rice

Parameter	Genotype	Dietary Treatment				*p-value*		
		0% Rice	50%Rice	100%Rice	Mean	Genotype	Diet	G*D
L*	Broiler	58.62±1.34	61.15±1.92	64.82±1.23	61.53^{a}			
	Native	56.92±1.23	59.09±1.44	55.37±0.99	57.13^{b}	0.0003	0.164	0.011
	Mean	57.77	60.12	60.09				
a*	Broiler	6.25±0.67	8.70±1.00	7.53±0.66	7.49			
	Native	9.30±0.78	6.78±0.61	9.10±0.75	8.39	0.15	0.695	0.006
	Mean	7.78	7.73	8.32				
b*	Broiler	9.16±0.95	10.06±1.25	8.83±1.09	9.35^{a}			
	Native	3.15±0.85	2.00±0.46	4.99±0.88	3.38^{b}			
	Mean	6.16	6.03	6.91		<0.0001	0.607	0.094
	Native	10.05±0.88	7.21±0.56	10.69±0.71	9.32^{b}			
	Mean	10.64	10.36	11.19				

Values indicate Mean ± SE, mean in each row having different superscript varies significantly at values** p < 0.01. L* (lightness), a* (redness), b* (yellowness). G*D, Interaction between genotype and diets

Liver

The CIE L*, a* and b* in liver of broiler and native chicken are shown in Table 7. Genotype had significantly (p<0.01) higher for L* and a* values in broiler compared to native chicken. Diet had no significant (p>0.05) effect on liver instrumental color attributes. The interaction between genotype and diets found significantly (p< 0.05) different in a* in liver. In the present study, higher CIE L*, a* and b* values were found in broiler compared to native chicken. The CIE L* and b* value in liver of broiler are similar and a* value was lower compared to present findings reported by Wattanachant et al. (2004). Abdullah and Buchtova (2016) reported lower liver CIE L*, a* and b* values in broiler compared to the present study.

Table 7. Instrumental color measurement in liver of broiler and native chicken at different level of rice

Parameters	Genotype	Dietary Treatment				*p-value*		
		0% Rice	50%Rice	100%Rice	Mean	Genotype	Diet	G*D
L*	Broiler	48.47±0.69	46.85±0.77	48.85±0.65	48.06^{a}	<0.0001	0.078	0.242
	Native	36.17±1.99	37.53±1.22	40.34±1.10	38.01^{b}			
	Mean	42.32	42.19	44.6				
a*	Broiler	20.39±0.67	19.21±0.56	19.30±0.44	19.63	0.015	0.43	0.042
	Native	17.16±0.72	18.00±.87	19.58±0.74	18.24			
	Mean	18.77	16.61	19.44				
b*	Broiler	10.95±0.55	9.54±0.41	10.88±0.46	10.64	0.936	0.079	0.338
	Native	9.74±.84	9.68±0.60	12.13±1.53	10.51			
	Mean	10.35	9.61	11.5				
	Native	19.80±0.92	20.45±1.02	23.25±1.26	21.17			
	Mean	21.48	20.98	22.72				

Values indicate Mean ± SE, mean in each row having different superscript varies significantly at values** p < 0.01. L* (lightness), a* (redness), b* (yellowness). G*D, Interaction between genotype and diet.

Sensory attributes

The sensory attributes of broiler and native chicken are shown in Table 8. Genotype had significant (p<0.01) effect on tenderness and juiciness in broiler cooked breast meat compared to native chicken. Overall acceptability did not differ significantly (p>0.05) in breast meat between two genotypes, but tenderness and juiciness were higher in broiler. The interaction between genotype and diets had no significant (p>0.05) effect on sensory attributes. A significant (*p*< 0.01) higher tenderness and juiciness were found in broiler breast meat in both genotypes. Flavor score values for native chicken had higher than broiler but did not differ significantly in the present study which was consistent with the findings of Devaktal (2018) who reported the unique flavors of native chicken. Khan et al. (2018) found that flavor of native chicken had lower than broiler which was contradictory to present findings but agreed with tenderness and juiciness to the present study. Higher flavor score values of native chicken compared to broiler might be due to its dark meat (Chartrin et al., 2006). Breast meat tenderness and juiciness showed highly significant (p<0.01) differences in broiler than native chicken. Meat tenderness varies with the rate of glycolysis and vigor onset post-slaughter. The improved tenderness as ultimate pH increases above 6.1 appears to be largely attributable to improvements in WHC and consequent decreases in cooking losses. Tenderness is the most important attribute in consumer's final satisfaction with poultry meat reported by Fletcher (2019). In combination with water melted lipids constitute a broth that, when retained in meat was released upon chewing and this broth might be stimulated saliva flow and thus improve "apparent" juiciness. The lower juiciness of breast meat with native chicken might be related to possible low content of intramuscular fat due to higher physical activity which was in agreement with previous findings (Fanatico et al., 2007).

Table 8. Sensory evaluation of broiler and native chicken meat

Parameters	Genotype	Dietary Treatment 0% Rice	50% Rice	100% Rice	Mean	p-value Genotype	Diet	G*D
Colour	Broiler	7.37±0.09	7.03±0.03	7.13±0.19	7.18	0.82	0.31	0.39
	Native	7.20±0.12	7.17±0.12	7.23±0.09	7.20			
	Mean	7.28	7.10	7.18				
Flavour	Broiler	7.30±0.10	7.13±0.03	7.23±0.09	7.22	0.42	0.65	0.83
	Native	7.30±0.17	7.27±0.12	7.33±0.12	7.30			
	Mean	7.30	7.20	7.28				
Tenderness	Broiler	7.53±0.15	7.43±0.12	7.37±0.09	7.44^{a}	0.0002	0.55	0.90
	Native	7.03±0.07	6.97±0.12	6.97±0.09	6.99^{b}			
	Mean	7.28	7.20	7.17				
Juiciness	Broiler	7.43±0.12	7.37±0.15	7.30±0.15	7.37^{a}	0.0003	0.90	0.52
	Native	6.90±0.0.06	6.87±0.07	7.00±0.0	6.92^{b}			
	Mean	7.17	7.12	7.15				
Overall acceptability	Broiler	7.23±0.09	7.13±0.12	7.10±0.06	7.16	0.68	0.74	0.79
	Native	7.20±0.56	7.17±0.12	7.20±0.12	7.19			
	Mean	7.22	7.15	7.15				

Values indicate Mean ± SE, mean in each row having different superscript varies significantly at values** $p < 0.01$. G*D, Interaction between genotype and diet

Conclusions

In conclusion, rice could be considered as alternative feed ingredients instead of corn in broiler and native chicken diets without detrimental effect on growth performance, carcass and meat quality traits. At marketing age (broiler 5 and native 12 weeks), growth of commercial broiler was 2.7 times higher compared to native chicken. The growth performances in broiler were significantly higher due to their genotype characteristics. The feed was same but FCR was 2.88 times higher in native chicken compared to broiler. Diet had no effect on broiler performance, carcass and meat quality traits except WHC. The WHC was significantly lower at 100% rice based diet. Tenderness and juiciness were significantly higher in broiler breast meat. The overall acceptability was similar in both breast meats of two genotypes during sensory evaluation. These findings could be helpful for poultry industries and rural households who are involved in commercial and native chicken production.

Conflicts of Interest

The authors declare that there are no potential conflicts of interests.

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