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Comparison of meat yield and quality characteristics between indigenous chicken and commercial broiler

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Abstract

Yield and quality of meats from commercial broiler and indigenous chickens weighing one kg each were studied during different periods of refrigeration. The chicken carcasses were stored at -20°C for 30 days and were analyzed on 0, 15 and 30 days. Carcass weight (%), shank weight (%), dressing (%), breast meat yield (%) were higher ($P<0.05$) in commercial broilers, but head (%), neck (%), thigh meat (%), drumstick meat (%) were higher ($P<0.01$) in indigenous chickens. Shank weight (%) decreased with storage time. Higher ($P<0.01$) percentage of dry matter (DM) and crude protein (CP) were found in indigenous chicken breast meat, while ether extract (EE) and total ash content were higher ($P<0.01$) in commercial broiler breast meat. Cooking loss (%) was higher in commercial broiler breast meat. The pH and CP (%) decreased, while DM (%), EE (%), Ash (%), Thiobarbituric acid reactive substance (TBARS) value, free fatty acid (FFA) value, and Peroxide value (POV) increased with storage time in both types of chicken. Sensory evaluation showed more juiciness in commercial broiler meat. (*Bangl. vet*. 2017. Vol. 34, No. 2, 61 – 70)

Introduction

Genetic selection for rapid growth rate has engineered the commercial broiler chickens to the extent that they may have several undesirable characteristics such as excess deposition of adipose tissue, and inability to tolerate the stress of climatic insults and mismanagement. Broiler carcasses contain high fat, less protein and higher cholesterol (Mendes *et al*., 1994), while indigenous chickens are widely preferred by consumers because of their lean meat, less fat and cholesterol with more protein, taste, pigmentation and suitability for special dishes (Islam and Nishibori, 2009). Poultry meat quality is affected by lipid oxidation during storage. Delaying lipid oxidation is relevant to the poultry processors as well as consumers. Oxidative processes in meat lead to the degradation of lipids and proteins which, in turn, contribute to the deterioration in flavor, texture and color of meat products (Decker *et al*., 1995).

The present study was carried out to compare the meat yield characteristics, physicochemical, biochemical and sensory properties of meat from native and commercial broiler chicken of similar body weight at different storage times.

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Materials and Methods

Commercial broilers at 1000 ± 50g live weight were purchased from Bangladesh Agricultural University Poultry Farm, while the indigenous chicken at similar weight were bought from local market. All birds were weighed before and after slaughtering, bled, plucked and eviscerated. The carcasses were stored at -20°C for 30 days and breast meat was analysed at 0, 15 and 30 days.

Proximate compositions

Proximate composition of DM, EE, CP and Ash were carried out with standard procedures (AOAC, 2005) in triplicate, and the mean values were calculated.

pH determination

The pH of raw breast meat homogenate was determined by blending 10g of sample with 50 mL of distilled water using an Ultra Turrax T25 tissue homogenizer (Janke and Kunkel, IKA Labortechnik, Staufen, Germany) at 8,000 rpm for one min. The pH of the suspension was recorded by dipping combined glass electrode of Elico digital pH meter, Model LI 127 (Elico Limited, Hyderabad, India).

Cooking loss

To determine cooking loss, weighed 5 ± 1 gm samples were wrapped in a heat-stable foil paper and kept in water bath at 80°C for 30 min. Samples were surface-dried and weighed. Cooking loss was calculated after draining the drip coming from the cooked meat as the percentage loss of weight of the cooked sample (Symeon *et al*., 2010).

Cook loss (%) = [(w2-w3)_w2] x 100;
where, w2 = meat weight before cooking and w3 = meat weight after cooking.

Thiobarbituric acid reactive substance (TBARS) analysis

Lipid oxidation was assessed in triplicate using the 2-thiobarbituric acid (TBA) method as described by Schmedes and Holmer (1989). Chicken breast meat samples (5g) were blended with 25 mL of 20% trichloro acetic acid solution (200 g/L of trichloro acetic acid in 135 mL/L phosphoric acid solution) in a homogenizer (IKA) for 30 sec. The homogenized sample was filtered with Whatman filter paper number 4, and 2 mL of the filtrate was added to 2 mL of 0.02 M aqueous TBA solution (3 g/L) in a test tube. The test tubes were incubated at 100°C for 30 min and cooled with tap water. The absorbance was measured at 532 nm using a UV-VIS spectrophotometer (UV-1200, Shimadzu, Japan). The amounts of TBARS were expressed as milligrams of malonaldehyde per kilogram of meat.

Free fatty acid analysis

Free fatty acid value (FFA) was determined according to Rukunudin *et al*. (1998). Five gm of sample was dissolved in30 mL chloroform using a homogenizer (IKA T25 digital Ultra-Turrax, Germany) at 10000 rpm for one min. The sample was filtered

under vacuum through Whatman filter paper number 1 to remove meat particles. Five drops of 1% ethanolicphenolphthalein were added as indicator to filtrate, and the solution was titrated with 0.01 N ethanolicpotassium hydroxide.

FFA (%) = mL titration × Normality of KOH × 28.2/gm of sample

Peroxide value (POV)

Peroxide values of the samples were determined according to AOAC (2005). One gm of sample was accurately weighed into 250 mL conical flask. Thirty mL of a mixture of glacial acetic acid and chloroform (3 : 2) were added to the conical flask. One gm of saturated solution of potassium iodide was added and the flask was vigorously shaken for one min. and kept away from the light for exactly 5 min., then titrated with accurately standardized solution of 0.01N sodium thiosulphate. Titration continued until the yellow colour almost disappeared. A 0.05 mL of starch indicator solution was added. Titration was performed with continuous shaking till the end point. Drops of thiosulphate were added until the blue colour disappeared. POV was calculated from POV % = {(A-B) × N × 100}/S.

Where; B = reading of blank in ml, A = reading of sample in ml, S = weight of oil sample, N = normality of sodium thiosulphate.

Sensory evaluation

The carcasses were cut into pieces and cooked with similar time, temperature and ingredients at day one of the experimental period. The cooked commercial broiler and indigenous chicken meat products were evaluated by six highly trained personnel. Sensory scores were nine for like extremely, eight for like very much, seven for like moderately, six for like slightly, five for neither like nor dislike, four for dislike slightly, three for dislike moderately, two for dislike very much, one for dislike extremely.

Statistical analysis

Data were analysed using analysis of variance procedure of 2 × 3 factorial design of two different sources of meat and three different storage times. The sensory evaluation data were analysed by *t*-test (SAS, 2002).

Results and Discussion

Effects of 30 days cold storage (-20°C) on meat yield parameters of commercial broiler and indigenous chicken meat at one kg standard live weight is shown in Table 1. Carcass weight, dressing and breast meat yield as a percentage of live weight were significantly ($P<0.05$) higher in commercial broiler, however head, neck, thigh meat and drumstick meat as a percentage of live weight were significantly ($P<0.01$) higher in indigenous chicken. Our result agrees with Sandercock *et al.* (2009) that fast-growing broiler has more breast meat than traditional chickens. The carcass yield of

four breeds of local chicken was slightly lower than that reported for Italian local chickens (Marchi *et al.,* 2005) and Benin local chickens (Youssao *et al.,* 2012), and markedly lower than that reported for commercial broilers (Zhang *et al.,* 2010; Panda *et al.,* 2010). Nielsen *et al.* (2003) reported that slow-growing chickens were characterized by a lower breast yield, but higher yield of thigh and drumstick meatthan fast-growing chickens. These results are similar to this present study.

Table 1: Effects of 30 days cold storage period on meat yield parameters of commercial broiler and indigenous chicken meat at 1 kg live weight

Meat yield parameters	Commercial broiler			Indigenous chicken		
	0 day	**15 days**	**30 days**	**0 day**	**15 days**	**30 days**
Carcass weight %	63.7 ± 1.3	61.4 ± 1.3	60.4 ± 1.0	59.3 ± 0.6	56.6 ± 1.2	55.7 ± 0.4
Dressing %	60.8 ± 1.1	59.6 ± 1.0	58.5 ± 1.0	57.2 ± 0.6	53.4 ± 1.1	52.5 ± 0.3
Head weight%	3.2 ± 0.2	3.1 ± 0.1	2.9 ± 0.1	3.7 ± 0.1	3.6 ± 0.1	3.4 ± 0.1
Neck weight%	2.3 ± 0.1	2.2 ± 0.1	2.1 ± 0.1	3.2 ± 0.2	3.0 ± 0.1	2.8 ± 0.1
Breast meat (2)%	10.2 ± 1.0	10.0 ± 1.0	9.8 ± 1.1	7.6 ± 0.1	7.4 ± 0.2	7.2 ± 0.1
Shank weight (2)%	4.5 ± 0.1	4.4 ± 0.1	4.2 ± 0.1	3.1 ± 0.1	3.0 ± 0.1	2.8 ± 0.1
Thigh meat (2)%	5.7 ± 0.3	5.6 ± 0.4	5.4 ± 0.4	7.4 ± 0.3	7.2 ± 0.40	7.0 ± 0.4
Drumstick meat (2)%	4.4 ± 0.5	4.3 ± 0.5	4.2 ± 0.5	5.7 ± 0.2	5.5 ± 0.22	5.3 ± 0.2

Level of significance	Meat type	Storage period	Meat type* Storage period
Carcass weight	0.0236	0.2070	0.9684
Dressing	0.0144	0.5215	0.9026
Head weight	0.0004	0.0744	0.9917
Neck weight	<.0001	0.0925	0.8918
Breast meat	0.0009	0.8725	0.9999
Shank weight	<.0001	0.0065	0.9481
Thigh meat	<.0001	0.5973	0.9852
Drumstick meat	0.0025	0.7163	0.9738

The pH of meat decreased with increased storage time (P<0.0096).

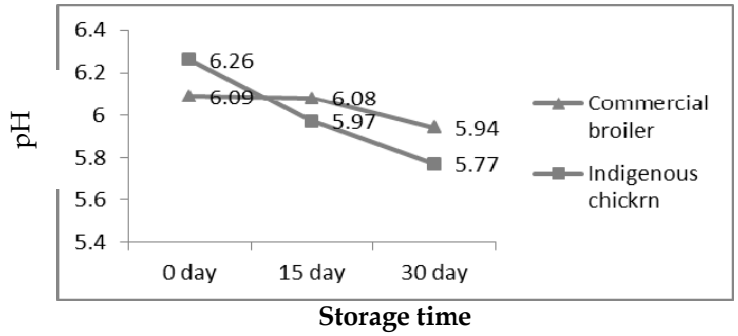

Fig. 1: The pH of commercial broiler and Indigenous chicken breast meat.

Dry matter content was higher in indigenous chicken breast meat than in commercial broiler breast meat (P<0.0001, Table 2). The dry matter content increased significantly (P<0.001) with time of storage. Indigenous chicken breast meat had significantly higher CP (P<0.0004) than commercial broiler breast meat (Table 2). The CP content decreased significantly (P<0.0001) with storage time. According to Fletcher (2002), differences in DM content and juiciness of meat, may be due to greater activity of free-range birds thanindoor chickens. The CP values were within the range 22.5 to 22.6% reported in broilers by Suchy *et al.* (2002) and 23.6 to 24.8%in indigenous Thai chickens by Jaturasitha *et al.* (2008). Sirri *et al.* (2010) reported that the protein content of slow-growing chickens was 24.6%. Fanatico *et al.* (2007) found that the slow-growing birds had higher protein content than the fast-growing ones. All these results are consistent with this study.

Table 2: DM and CP (%) of Commercial broiler and indigenous chicken breast meat during 30 days cold storage

Proximate composition (%)						
Source of meat	DM			CP		
	0 day	**15 days**	**30 days**	**0 day**	**15 days**	**30 days**
Commercial broiler	26.7 ± 0.2	26.7 ± 0.3	27.6 ± 0.3	23.2 ± 0.4	22.4 ± 0.3	20.6 ± 0.3
Indigenous chicken	27.2 ± 0.3	27.6 ± 0.4	28.8 ± 0.3	24.4 ± 0.1	23.1 ± 0.3	22.4 ± 0.4
Level of significance	Meat type		Storage period		Meat type* Storage period	
DM	<.0001		0.0018		0.1678	
CP	0.0004		<.0001		0.2008	

EE and total ash percentage were significantly (P<0.01) higher in commercial broiler breast meat than indigenous chicken breast meat (Table 3). Longeran *et al.* (2003) found higher lipid content of breast meat without skin from fast-growing broilers than slow-growing ones. Thai-indigenous breed meat contained lower fat and ash contents when compared to broiler meat (Wattanachant *et al.,* 2004). These results are in agreement with the present study.

Table 3: EE and ash (%) of commercial broiler and Indigenous chicken breast meat during 30 days cold storage

Proximate composition (%)						
Source of meat	EE			Ash		
	0 day	**15 days**	**30 days**	**0 day**	**15 days**	**30 days**
Commercial broiler	1.5 ± 0.1	2.5 ± 0.1	3.0 ± 0.1	1.3 ± 0.0	1.3 ± 0.0	1.6 ± 0.0
Indigenous chicken	1.1 ± 0.1	1.3 ± 0.0	1.4 ± 0.0	1.2 ± 0.0	1.3 ± 0.0	1.4 ± 0.0
Level of significance	Meat type		Storage period		Meat type* Storage period	
EE	<.0001		<.0001		<.0001	
Ash	0.0004		<.0001		0.0011	

Cooking loss was significantly higher in broiler meat than indigenous chicken meat (P<0.001 Table 4). With increasing storage time, cooking loss of both types of chicken meat decreased significantly (P<0.001). Jaturasitha *et al.* (2002) found that the cooking loss of Thai native chicken was lower than commercial broiler chicken.

Table 4: The cooking loss (%) characteristics of commercial broiler and Indigenous chicken breast meat during 30 days cold storage

Cooking loss %			
Source of meat	Storage period		
	0 day	**15 days**	**30 days**
Commercial broiler	1.5 ± 0.1	2.5 ± 0.1	3.0 ± 0.1
Indigenous chicken	1.1 ± 0.1	1.3 ± 0.0	1.4 ± 0.0
Level of significance	Meat type	Storage period	Meat type* Storage period
Cooking loss	<.0001	0.0011	0.7640

The TBARS value (mg malonaldehyde/kg sample) increased with increasing storage time in both commercial broiler and indigenous chicken breast meat (Fig. 2) The TBARS values were significantly (P<0.0009) higher in commercial broiler breast than indigenous chicken breast over the whole storage time. It is normally accepted that with increasing storage time TBARS value increases. TBARS valued increased with increased storage period (P<0.0001).

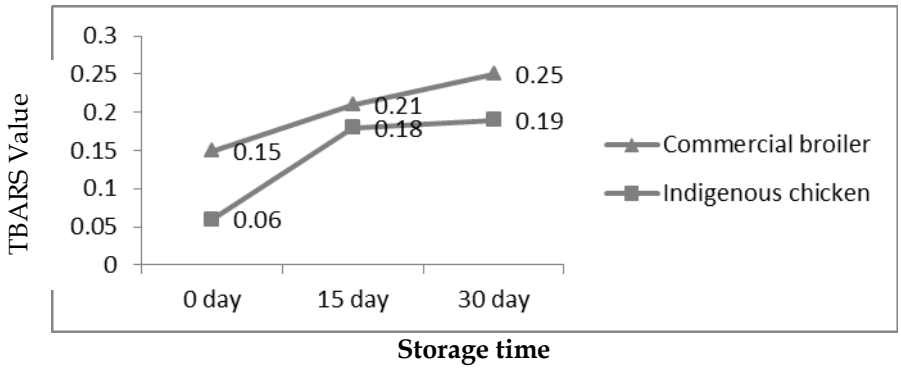

Fig. 2: The TBARS values of commercial broiler and Indigenous chicken breast meat.

The oxidative status of breast meat evaluated as TBARS level was different in different genetic strains and a higher TBARS value was recorded with storage time in broilers (Castellini *et al.,* 2006). Russell *et al.* (2003) found a higher TBARS value in duck breast meat with increasing storage time. Pettersen *et al.* (2004) found that TBARS value increased up to six months in refrigerated turkey breast meat and then declined.

The FFA value increased significantly (P<0.05 from 0 to 30 days. The FFA values were significantly (P<0.0002) higher in commercial broiler breast than indigenous chicken breast over the whole storage time.

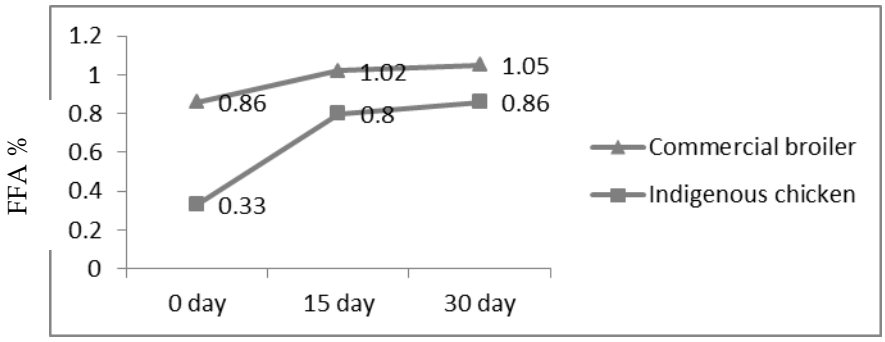

Fig. 3: The FFA (%) values of commercial broiler and Indigenous chicken breast meat.

Lipid peroxidation reflects the interaction between oxygen and polyunsaturated fatty acids (Verma *et al.*, 2009). It occurs during processing and storage when meat is exposed to oxygen, heat, and light (Fasseas *et al.*, 2007).

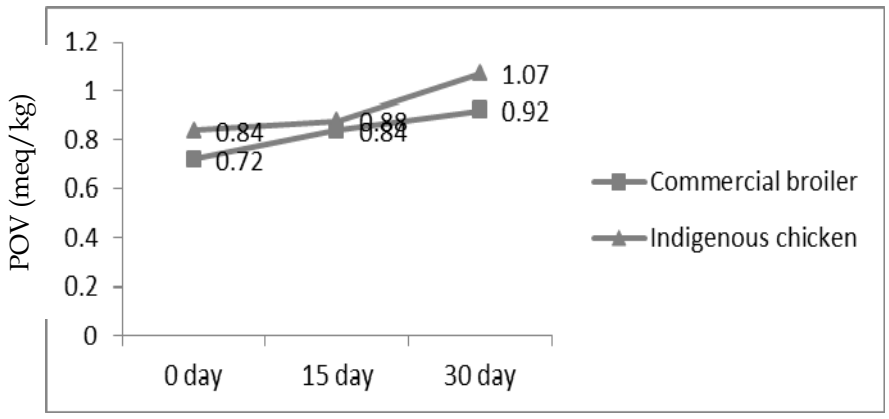

Fig. 4: The POV values of commercial broiler and indigenous chicken breast meat.

POV (meq/kg) values (Fig. 4). were significantly higher (P<0.0075) in indigenous chicken meats than commercial chicken meat. The POV (meq/kg) value increased significantly (P<0.0004) with storage period. Rhee and Myers (2003) reported a similar trend in peroxide value in meat loaf made from ground goat meat during storage.

Colour, flavour and overall acceptability were not different between commercial broiler chicken and indigenous chicken; however, tenderness and juiciness were significantly (P<0.0219) higher in commercial broiler meat.

Table 5: Sensory evaluation of commercial broiler and indigenous chicken meat product at 30th day of cold storage

Parameters	Treatments		Level of significance
	Commercial broiler	Indigenous chicken	
Colour	7.3 ± 0.2	7.7 ± 0.2	0.2897
Flavour	7.2 ± 0.2	7.6 ± 0.2	0.2897
Tenderness	7.8 ± 0.24	7.2 ± 0.3	0.0394
Juiciness	7.5 ± 0.3	6.7 ± 0.2	0.0219
Overall acceptability	7.5 ± 0.3	7.7 ± 0.2	0.5995

Conclusions

Carcass weight, shank weight, dressing, breast meat yield were higher relative to live weight in commercial broiler, but head, neck, thigh meat, drumstick meat were higher in indigenous chicken, during 30 days of refrigeration. The higher TBARS value in commercial broiler breast meat indicates higher oxidative metabolism. It might be concluded that indigenous chicken meat has a lower rate of deterioration than that of broiler when refrigerated.

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