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Carcass and Meat Quality Characteristics of Native Chicken Reared under Backyard and Farm Setting in Karnataka

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ABSTRACT

Background: The commercial rearing of native chicken has been gaining importance due to higher demand for natural and organic meat. In this context the present study was designed to compare the carcass and meat quality characteristics of native chicken reared under backyard system as compared to native chicken reared under farm setting in Karnataka.

Methods: Sixty (30 backyard and 30 farm reared) native birds were used to evaluate the carcass characteristics *viz*., dressing per cent, yield of cut up parts and meat bone ratio. Breast muscle was used to evaluate physico-chemical (pH, WHC, colour, drip loss and cooking loss), compositional (proximate composition, cholesterol content and collagen content), structural characteristics (muscle fibre diameter, sarcomere length, shear force) and sensory characteristics.

Result: A significant difference ($P<0.05$) in live weight, carcass weight and dressing per centage was evident in backyard native chicken (BNC) and farm reared native chicken with higher weight being recorded in FNC, whereas no significance could be observed in yield of various primal cuts between them. Physico-chemical and compositional characteristics revealed no significant difference, whereas farm reared birds had lower shear force and collagen compared to backyard birds. Sensory evaluation revealed no negative influence on any of the eating quality indicating that commercial rearing of native chicken could be advocated for faster growth of native birds without compromising on the quality of meat.

Key words: Backyard, Carcass characteristics, Farm setting, Meat quality, Native chicken.

INTRODUCTION

Meat and meat products serve as an excellent source of good quality protein with high biological value and essential amino acids, fats, minerals (*e.g*., zinc, iron and phosphorus), vitamins and other valuable or essential nutrients and hence has always been an integral part of human nutrition worldwide (Zhang *et al*., 2010). Meat consumption pattern in majority of the countries are culture dependent and in India, meat consumption pattern is controlled by customs, tradition and religious taboos. Of the various meats consumed in India, poultry meat occupies the major share among various sections because of its versatility, relatively low cost; no social and religious taboo associated with its consumption and is considered to be lean with low fat content. Chicken meat in India is generally obtained from broiler, indigenous chicken and spent hen (Devi *et al*., 2014). The commercial broiler, because of their genetic potential, are fast growing with high feed conversion efficiency compared to native local chicken which are slow growing poor feed converters but often preferred for better flavour. Native chicken are produced under low input and high output system which is mainly confined to backyard rearing (Wattanachant *et al*., 2004). Desi or native chicken meat is preferred by the consumers because of its colour, taste, leanness and its suitability for preparation of special dishes and often fetches higher prices. It is also believed that natural, less intensive management systems provide desi birds with higher welfare levels, resulting in much better product quality (Mir *et al*., 2017). In India there are around nineteen (19) breeds of native chicken that have been recognized and registered as indigenous breeds of chicken in India (NBAGR, 2019).

In recent years, there has been an increase in demand for meat from indigenous and local birds as consumers perceive that birds reared under extensive system are low in antibiotic and toxic residues. However, indigenous birds

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in spite of being disease resistant and their meat having unique flavor and taste are slow growing and have poor feed conversion efficiency as compared to broilers. Hence, the poultry producers to bridge the gap between production efficiency, taste and price line are attempting to grow these indigenous birds under intensive commercial farming system (Singh and Pathak, 2017). Through commercial farming of indigenous birds producers even though have attained the desired live weight of 1.5-1.7 kg in 15-18 weeks as compared to backyard native chicken (1.5-1.7 kg in 25-28 weeks), the quality of meat from such birds in comparison with pure backyard native chicken need to be ascertained. Further, only little information is available about the meat characteristics of backyard native birds in comparison with native birds reared under farm conditions and hence the present study was undertaken to compare the carcass and meat quality characteristics of backyard native chicken and native chicken reared under farm conditions in Karnataka.

MATERIALS AND METHODS

Location of the study

The present study was carried at the Department of Livestock Products Technology, in collaboration with Department of Poultry Science and AICRP on Poultry Breeding, Veterinary College, Hebbal, Bengaluru. Veterinary College is located in Bangalore which is in the Southern part of India positioned between 13°01' N and 77°35' E at a height of 920 m above sea level. The region experiences usually tropical savannah climate with maximum temperatures ranging from 15°C in winter to 38°C in summer.

Experimental birds

In the present study backyard native chicken (BNC) were procured from native breeding population of Tumkur district of Karnataka and Farm reared native chicken (FNC) were native chicken hatched from eggs collected from breeding stock maintained by AICRP on Poultry Breeding. Farm reared native chicken were maintained on ad libitum feeding with maize soya based diets during the experimental period. The birds were vaccinated as per standard protocol and for comparative evaluation of carcass and meat quality characteristics in BNC and FNC birds were selected on the basis of physiological age (approximately equal weight), as the market age is different for these birds. The market age in FNC was 15-18 weeks and 24-28 weeks in backyard native chicken. A total of 60 birds (30 BNC and 30 FNC) were slaughtered in the Experimental Poultry slaughter facility as per standard procedures and evaluated for carcass traits with approval from institutional animal ethics committee. Breast muscle from each bird was excised and utilized for meat quality and sensory evaluation.

Carcass and meat quality characteristics

Pre slaughter weight of the birds was recorded and after slaughter the carcass weight and weight of edible and inedible offals were separately recorded. Breast muscle from the birds was used for evaluation of pH (Naveen *et al*., 2004), water holding capacity (Wardlaw *et al*., 1973), drip loss (Remignon *et al*., 1996) and cooking loss (Babiker *et al*., 1990). The meat colour was evaluated using instrumental colour assessment (Hunter Lab, USA). The proximate composition was evaluated as per AOAC (2005) and structural characteristics *viz*., collagen content (Nueman and Logan, 1950), muscle fibre diameter (Jeremiah and Martin, 1977), sarcomere length (Hostetler *et al*., 1972) and shear force value (Wheeler *et al*., 1997) were evaluated. The sensory characteristic of the meat was evaluated based on 8 point hedonic scale as outlined by Keeton (1983).

The descriptive statistics for the different types of data were determined as per Snedecor and Cochran (1989). One way ANOVA was performed for data on carcass characteristics and meat quality parameters of breast muscles of BNC and FNC using Graph Pad Prism version 5.00.

RESULTS AND DISCUSSION

The carcass characteristics and yield of edible and inedible offals of BNC and FNC are presented in Table 1 and 2. In the present study, a significant difference ($P<0.05$) in live weight, carcass weight and dressing per centage was

Table 1: Carcass Characteristics of Backyard native chicken (BNC), farm reared native chicken (FNC).

Parameter	BNC (n=30)	FNC (n=30)
Live weight (g)	1295±45.00^a	1390±35.00^b
Carcass weight (g)	847.8±24.88^a	940.8±24.89^b
Dressing percentage (%)	65.40±0.98^a	67.41±0.43^b
Breast (%)	24.79±0.49	26.13±0.33
Neck (%)	5.945±0.15^a	5.078±0.13^b
Back (%)	22.91±0.32	22.37±0.39
Wing (%)	10.36±0.29	10.55±0.23
Thigh (%)	17.47±0.33	17.04±0.22^a
Drumstick (%)	16.29±0.33	16.05±0.14
M:B ratio	1.05±0.01^a	1.16±0.01^b

Mean±SE bearing different superscripts between rows are statistically different at $P<0.05$.

Table 2: Weight of edible and inedible offals of Backyard native chicken (BNC) and farm reared native chicken (FNC).

Parameter	BNC (n=30)	FNC (n=30)
Liver	26.47±1.54	26.41±0.46
Heart	6.500±0.39	6.050±0.22
Gizzard	35.70±1.70	32.80±1.13
Edible offals	68.67±2.86	65.26±1.86
Spleen	2.169±0.18	2.367±0.16
Feet	64.77±2.34	65.48±0.77
Head	46.68±1.50	46.60±1.50
Feather	66.61±2.31	66.94±1.68
Inedible offals	180.2±3.34	181.4±2.15

evident between backyard native chicken (BNC) and farm reared native chicken with higher weight being recorded in FNC. The FNC (67.41%) recorded highest dressing percentage as compared to BNC (65.40%). Feeding of commercial diet was found to significantly improve live weight and dressing per centage in FNC as compared to BNC. Similar to the findings of the present study higher weight and dressing per cent has been recorded by Poltowicz and Doktor (2012) in hybrid birds, Haunshi *et al*. (2013) in Aseel and Kadaknath birds, Patel *et al*. (2014) in Gramapriya birds reared under backyard system and Devatkal *et al*. (2018) in Aseel. Dressing per centage is related to the age of the bird and as age advances there is considerable reduction in dressing per centage due to shrinkage of muscle. In our study lowest dressing per cent was recorded in BNC similar to that reported by Singh and Pathak (2017) who observed that the dressing percentage of broiler strain (Cobb-400) was significantly higher than all indigenous breeds (Aseel, Kadaknath, Vanaraja) studied.

No significant difference in yield of cut up parts could be evidenced between BNC and FNC except in neck yield indicating that changes in feeding practices did not have significant influence of yield of cut up parts in native chicken. Similar to the findings of our study Nielsen *et al*. (2003) reported that slow-growing chickens were characterized by a lower breast, thigh and drumstick yield and higher back and neck yield compared to that of fast-growing chickens. Similarly, Sandercock *et al*. (2009) reported that fast-growing broilers had higher breast and thigh meat as compared with layer or local chickens. A significant difference was observed with meat bone ratio with farm reared birds having higher meat yield compared to backyard native chicken.

The meat quality characteristics of breast muscle of BNC and FNC are presented in Table 3. A significant difference (P<0.05) in pH 45 min of breast muscle was observed between BNC and FNC and ranged from 6.39 to 6.50. The results of the present study indicated that the birds were not under any kind of pre-slaughter stress as the pH at 45 minutes were well within the range of pH of normal rested birds of 6.5-6.8 (Lawrie, 2011). The results were in concurrence with the findings of Devatkal *et al*. (2018). Similar findings have been recorded by Ilavarasan *et al*. (2016) in breast muscle of Aseel, Lakshani *et al*. (2016) in Aseel birds, Kumar *et al*. (2012) in breast meat of chicken, Wattanachant *et al*. (2004) in breast meat of indigenous chicken. In the present study, no significant difference in WHC, drip loss, cooking loss and colour scores was evident in breast muscle from BNC and FNC. Similalrly, Khan *et al*. (2019) and Devatkal *et al*. (2018) did not observe any difference in drip and cooking loss between native chicken and commercial broilers. However, contrary to the findings of our study Fanatico *et al*. (2007) found that chicken raised under free range production system had significantly lower water holding capacity and Wang *et al*. (2009) reported lower WHC in slow growing chicken.

Muscle fibre diameter (MFD) is a function which is related to muscle texture as well as tenderness. In the present study a significant differences (P<0.05) in MFD was observed with higher diameter in BNC (58.52 µm) compared to FNC (50.30 µm). The results of MFD in this study were in agreement with Devatkal *et al*. (2018) in breast muscle of broiler and Aseel and Muthulakshmi *et al*. (2016) in spent layer breast muscle. However, Ilavarasan *et al*. (2016) recorded higher MFD values (75 µm and 94 µm) in breast muscles of 8 week and 40 week old Aseel birds. The differences in MFD reported in various studies might be due to breed and age effect. A significant difference (P<0.05) was observed between BNC and FNC in sarcomere length (SL) with FNC recording higher SL (1.423 µm) compared to BNC (1.289 µm). The range of SL in the present study was in concurrence with Choe and Kim (2020) who observed that the sarcomere length of different chicken genotypes ranged from 1.36 to 1.60 µm.

A significant difference (P<0.05) was observed in collagen content with higher collagen content reported in BNC (489.1) followed by FNC. The higher collagen content in BNC may be attributed to higher physical activity of the birds as compared to FNC and to the age of the birds which significantly influences the collagen content as well as its solubility (Jayasena *et al.,* 2013). The shear-force (kg/cm^2)

Table 3: Meat quality characteristics of breast muscle from Backyard native chicken (BNC) and farm reared native chicken (FNC).

Parameter	BNC (n=30)	FNC (n=30)
pH 45 mins	6.39±0.045^a	6.50±0.025^b
pH 24 hrs	6.01±0.024	6.00±0.031
WHC (%)	13.49±0.365	13.37±0.443
Drip loss (%)	1.53±0.056	1.55±0.050
Cooking loss (%)	9.426±0.584	10.10±0.288
L*	49.57±0.711	50.67±0.821
a*	2.80±0.126	2.61±0.120
b*	10.91±0.183	10.32±0.201
Shear force value (kg/cm^2)	5.89±0.091^b	5.01±0.132^a
Collagen content (mg/100 g)	489.1±7.682^a	403.2±7.781^b
Muscle fibre diameter (µm)	58.52±1.805^a	50.30±1.888^b
Sarcomere length (µm)	1.289±0.044^a	1.423±0.049^b
Moisture (%)	75.88±0.322^a	74.36±0.275^b
Protein (%)	20.02±0.303	20.91±0.188
Fat (%)	0.95±0.037	1.23±0.106
Ash (%)	1.42±0.088^a	2.25±0.129^b
Carbohydrates (g/100 g)	2.09±0.045^a	2.50±0.028^b
Cholesterol (mg/100 g)	35.83±1.648	36.17±1.829
Energy (kCal/100 g)	96.94±1.333^a	105.9±0.786^b
Appearance	6.81±0.046	6.78±0.050
Flavor	6.98 0.069	6.95±0.056
Juiciness	6.46±0.051	6.58±0.049
Tenderness	6.08±0.067	6.17±0.067
Overall acceptability	6.53±0.083	6.51±0.055

Mean±SE bearing different superscripts are statistically different at P<0.05.

revealed a significant difference (P<0.05) with BNC having higher shear force value (5.89) as compared to FNC (5.01). The lowest shear force value in FNC in the present study could be attributed to lower collagen and sarcomere length. It has been reported that shear force value and sarcomere length had negative correlation in duck and chicken breast meat and that sarcomere shortening was a major contributor to the toughness of meat and higher sarcomere length resulted in lower shear force values (Dunn *et al*., 2000). The higher shear force values in backyard native birds might also be due to lower collagen solubility as heat stable crosslink in collagen increases with the age of the birds (Singh and Pathak, 2017).

A significant difference (P<0.05) in proximate composition was evident in moisture, ash, carbohydrate and energy content between BNC and FNC, whereas no significant difference was observed in protein, fat and cholesterol content between the groups. Similar observations have been documented by Wattanachant *et al.* (2004) and Valavan *et al*. (2016) who opined that indigenous chicken muscles contained lower fat and cholesterol. The lower cholesterol content in backyard native birds may be attributed to higher metabolic activity under free range condition and in FNC might be due to genetic influences (Rajkumar *et al.,* 2017). However, Gnanaraj *et al*. (2020) observed no significant difference in proximate composition between three Indian native chicken breeds.

Sensory characteristics and functional properties of poultry meat are critical not only for consumer's initial selection but also for final product satisfaction and the most important quality attributes are appearance and texture. In the present study, no significant difference in appearance, tenderness, flavour, juiciness and overall acceptability could be appreciated between the two groups, indicating that rearing of native birds with commercial feed had no negative influence on sensory meat characteristics but had similar sensory attributes as comparable to backyard native birds.

CONCLUSION

The results of the present study indicated that commercial rearing of native chicken under farm conditions has significantly improved the live weight and carcass yield as compared to backyard native chicken. The native birds reared under farm setting had better scores in terms of lower shear force values, higher sarcomere length and lower collagen content. Farm rearing of native chicken did not have any negative influence on sensory characteristics and were similar to that of meat from backyard native chicken indicating that commercial rearing of native chicken can be an effective alternative for improving the productivity of native birds and thereby improving the profitability without compromising on the quality of the meat.

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