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Studies on carcass and meat quality characteristics of Rajasri chicken

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Abstract
The present investigation was carried out for comparing the carcass and meat quality attributes of improved chicken variety ie) rajasri male chicken and broilers meat to assess the extent of suitability for preparing the processed/value added chicken meat products. Rajasri chicken recorded significantly (P<0.05) lower pre slaughter weight, dressing per cent, giblet yeild and cut up parts yield compare to broilers. Broilers meat recorded significantly (P<0.05) lower drip loss, pH, muscle fibre diameter, collagen content, cooking loss, total protein and total fat content and significantly (P<0.05) higher water-holding capacity, total protein extractability and collagen solubility than rajasri chicken meat. Broiler meat recorded significantly (P<0.05) superior sensory scores compared to rajasri chicken meat. From these results, it can be concluded that rajasri meat is lower carcass and meat quality attributes compared to broiler meat but this can also be utilized for preparation of processed and value added chicken meat products without adverse affect on quality of finished processed meat product.

Keywords: Rajasri birds, carcass characteristics, meat quality, broilers, value addition

Introduction
A huge demand is there from the meat consumers for local chicken meat and eggs compared to the broilers and layer eggs due to their better taste, texture and flavor as perceived by the local population (Bhaskar Reddy *et al.*, 2016) [1]. Rajasri birds are very good in meat and egg production. The average number of eggs produced by the desi bird per annum will be around 60-80, but by the "Rajasri" birds, it will be around 150-160. The weight at maturity stage for egg production of desi bird is around 1.0 -1.1 kgs whereas as "Rajasri" birds is around 1.1-1.2 kgs. They can be reared simply just like desi birds in the backyard without any difficulty. They have less in weight with good long legs and can easily escape from the predators. They are bright red in colour with medium stature similarly looks like desi birds. Just like desi birds, they eat the locally available feed, insects and other food available in the home premises and gives good delicious meat and more eggs. They have high immunity power and can easily be reared in the village conditions (Devi *et al.*, 2012) [3]. Compared to desi birds, they will be ready in a short time for marketing and also fetches a good price in the market.
The comparison of the meat quality characteristics of rajasri birds with commercial broiler birds has limitedly reported. Therefore, the objective of this study was to compare the carcass and meat quality characteristics of rajasri birds with broiler birds to suit the rajasri birds meat for preparation of various processed/value added meat products.

Materials and Methods
A total of eight broiler (6 weeks old) and eight male rajasri birds (24 weeks old) each were procured from Department of Poultry Science, College of Veterinary Science, Tirupati reared under deep litter system under actual farm conditions with identical management practices. Birds were off fed overnight and slaughtered as per the standard procedure. All the internal organs were taken out by inserting the fingers inside, when the body was completely devoid of internal organs, the eviscerated weight was recorded as weight of carcass. The liver (without gall bladder), gizzard (without mucous membrane) and the heart (after removal of blood clot) constitute the giblet. All these portions were taken out properly, carefully and weighed individually to obtain respective individual weights and weighed together and recorded as giblet weight. Both the legs were cut with the help of a sharp knife at the hip joint. Leg was divided into thigh and drumstick by cutting at the femorotibial joint and respective weights were recorded.

Wings were removed by cutting through the shoulder joint at the proximal end of the humerus and weighed and recorded as wing weight. The breast was then separated from the bone by cutting down on both the sides between the collar bone and back bone towards the tail leaving the pelvic bone and neck intact and breast weight was obtained. The neck and back portions were separated by cutting close to the clavicle as possible and respective weights were recorded.

Meat from breast portion was obtained from all carcasses and analysed immediately for various physico-chemical and sensory characteristics. Cooking loss was determined the weight difference before and after cooking of muscle and expressed in percentage. The pH was measured using a standardized electrode attached to a digital pH meter after 24 hours of keeping the samples at refrigerated temperature. Muscle samples was individually weighed, packed and suspended in plastic bags at 4 °C for 24 h, and percentage weight loss during storage expressed as drip loss. Shear force value (SFV) was estimated by using Warner-Brazler shear force apparatus and SFV was recorded in kg/cm^2. Muscle fibre diameter and sarcomere length was calculated with the help of calibrated eye piece micrometer. The following methods are adopted by estimation of water-holding capacity (WHC) (Wardlaw *et al.,* 1973) [4], total myoglobin (Warris, 1979) [5], collagen content and solubility (Nueman and Logan, 1950) [6], total protein extractability (Joo *et al.,* 1999)[7], proximate composition (AOAC, 2002) [8] and sensory evaluation conducted by cooking the muscle pieces attained to 75°C and add salt and spice mix to taste then evaluated according to Keeton (1983) [9]. The data generated for different carcass and meat quality characteristics were compiled and analysed by using SPSS Ver.16.

Results and Discussion

Carcass characteristics

The comparative carcass characteristics between rajasri and broiler birds has presented in Table 01. Broilers had significantly (P<0.05) higher pre slaughter weight than rajasri birds. Higher pre slaughter weight of the broilers over rajasri birds might be due to the genetic potential available with the broilers. Significant differences in pre-slaughter weight among birds indicate the genetic differences between varieties. This is in accordance with Debata *et al.,* (2012) [10] and Haunshi *et al.,* (2013) [11], who also reported significant differences among different brids with regard to pre-slaughter weight.

The carcass weight and dressing percent of broilers was significantly higher than rajasri birds. The range of carcass weight of broilers are 1.57 kg and rajasri birds are 1.09 kg and dressing percentis 67.28 and 71.04 respectively for rajasri chicken and broilers. This might be due to carcass weight depends on pre-slaughter weight and pre slaughter weight of broilers was higher than rajasri chicken. Higher carcass weight tends increased the dressing percentof broilers. Breed differences affect the carcass characteristics and birds belonging to heavy breeds tend to produce higher carcass weight and lower inedible offals (Pal *et al.,* 2011) [12]. These results are in agreement with Rajakumar *et al.,* (2013) [13] who observed significant effect of genetic lines on carcass weight of chickens.

The mean percent giblet yield in broilers are 3.97 and rajasri birds are 3.24 and a significant (P<0.05) higher giblet yield was observed in broilers. Debata *et al.,* (2012) [10] and Haunshi *et al.,* (2013) [11] found similar results in Vanaraja, Black Rock and Red Cornish chicken and Aseel and Kadaknath, respectively. The inedible offals constitutes weights of feathers, blood, head, shank, total viscera and calculated as percent yield on the basis of pre slaughter weight. Rajasri chicken recorded significantly (P<0.05) higher inedible offals yield than broilers. Usually birds belonging to heavy breeds tend to produce higher carcass weight and lower inedible offals. Pal *et al.,* (2011) [12] found significant effect of breed on inedible offal by-products percentage in White Leghorn and White Cornish. The percent cut up parts includes neck, wing, breast, back, thigh and drumstick. Broilers had recorded significantly (P<0.05) higher wing, breast, back, thigh and drumstick yield and significantly (P<0.05) lower neck

Table 1: Mean ±S.E values of carcass characteristics (%) of rajasri birds and broilers*

Carcass characteristics	Rajasri birds	Broilers
Pre slaughter weight (kg)	1.52±0.12^b	2.21±0.19^a
Carcass weight (kg)	1.09±0.32^b	1.57±0.17^a
Dressing percent	67.28±0.07^b	71.04±0.24^a
Giblet yield (%)	3.24±0.13^b	3.97±0.21^a
Inedible offal yield (%)	30.17±0.09^a	26.17±0.11^b
Cut up parts yield (%)		
Neck	7.02±0.17^a	6.21±0.12^b
Wing	12.96±0.10^b	15.71 ±0.22^a
Breast	23.11±0.21^b	29.11±0.28^a
Back	21.10±0.37^b	23.92±0.19^a
Thigh	16.93±0.11^b	18.14±0.33^a
Drumstick	13.87±0.25^b	15.71±0.18^a
Meat: Bone ratio	1.62±0.11^b	2.09±0.17^a

Note: Mean values within row bearing different superscripts are differ significantly (P<0.05). *n=8

yield than rajasri chicken. It was observed that the mean values for cut up parts (wing, breast, back, thigh and drumstick) weight increased in higher pre slaughter birds. This might be attributed that more growth of muscular tissue as the birds mature is the reason for the higher yields of muscular cuts in broilers. Similar trend in the yield of cut up parts were reported by Haunshi *et al.,* (2013) [11] in improved chicken varieties vanaraja and red cornish and Rajakumar *et al.,* (2013) [13] in backyard chickens. Broilers had significantly (P<0.05) recorded higher meat bone ratio than rajasri chicken. The higher meat bone ratio for broilers indicated its better performance over the Rajasri chicken. Compared to broilers, rajasri chicken bone size was small proportionately. Higher meat bone ratio in broilrs might be due to more proportionate growth of muscles than bones. The present results are in congruent with Sogunle *et al.,* (2013) [14] in Vanaraja chicken.

Physico-chemical characteristics

Mean ±S.E values of meat quality characteristics of broilers and rajasri chicken are presented in Table 2. The drip loss (%) was significantly (P<0.05) higher in rajasri chicken meat compared to broiler meat. Drip is a dilute solution of sarcoplasmic proteins. Immediately after slaughter, depending on age of birds, protein degradation causes reduce water reservation among myofibrils, which increase juice loss of meat (Elisabath and Stevan, 2005) [15]. The results are in agreement with Bhaskar Reddy *et al.,* (2016) [1] in spent breeder, layer and broiler birds.

Table 2: Mean ±S.E values of meat quality characteristics of Rajasri birds and broilers*

Meat quality characteristics	Rajasri birds meat	Broilers meat
Drip loss (%)	2.42±0.11[a]	1.21±0.17[b]
pH (24 hrs)	6.03±0.14[a]	5.72±0.20[b]
WHC (%)	24.10±0.12[b]	32.51±0.11[a]
SFV (kg/cm^2)	11.23±0.09[a]	08.57±0.08[b]
Muscle fibre diameter (µm)	35.17±0.27[b]	33.10±0.39[a]
Sarcomere length (µm)	1.21±0.21[b]	1.47±0.11[a]
Myoglobin content (mg/g)	0.89±0.07[a]	0.41±0.27[b]
Total protein extractability (%)	10.28±0.08[b]	14.86±0.34[a]
Collagen content (mg/g)	2.17±0.11[a]	1.39 ±0.18[b]
Collagen solubility (%)	27.08±0.14[b]	39.11±0.21[a]
Cooking loss (%)	27.57±0.32[a]	15.69±0.07[b]
Moisture (%)	74.55±0.24[b]	75.50±0.11[a]
Protein (%)	21.55±0.19	21.61±0.08
Fat (%)	2.56±0.31[b]	3.92±0.20[a]
Total ash (%)	1.62±0.11	1.59±0.24

Note: Mean values within row bearing different superscripts are differ significantly (P<0.05). *n=8

A significant (P<0.05) difference was observed in pH of both broilers and rajasri chicken meat. The findings indicated that genotypes could affect the declining rate of post-mortem muscle pH. In addition to this, the difference in pH indicates that the rate or pattern, of pH decline immediately after post-mortem is vary and pH fall will result from denaturation of proteins, increase in actomyosin shortening and internal structural changes (Bhaskar Reddy *et al.,* 2016) [1]. In the present study, significant effect of variety was influenced on water holding capacity of meat. A significant (P<0.05) higher WHC was noted in broiler meat compared to rajasri chicken meat which is highly correlated with less drip loss. The differences in the WHC might be due to differences in ultimate pH, ionic balance and compositional changes in meat from broilers and rajasri chicken meat. Kokoszynski *et al.,* (2013) [16] and Bhaskar Reddy *et al.,* (2016) [1] found significant effect of genotypes on WHC of chicken meat. The overall shear force value of muscle differed significantly between broilers and rajasri chicken meat and higher shear force value recorded in broilers meat. The difference in shear force value can be due to meat type chicken genotype in broilers. Shear force values decreased with the increasing body weight of the birds which might be due to more collagen cross linking which increases with more muscular growth and is often associated with increased shear values (Bhaskar Reddy *et al.,* 2016) [1]. These results are in agreement with the earlier findings of Petracci *et al.,* (2013) [17].

Effect of variety was significantly (P<0.05) affected the muscle fibre diameter of both broilers and rajasri chicken meat. The rajasri chicken meat had significantly (P<0.05) higher muscle fibre diameter than broiler meat. The differences in muscle fibre diameter might be due to the differences in the genotype, age, production systems, diets etc. Broiler meat had significnalty (P<0.05) higher sarcomere length than rajasri chicken meat. The sarcomere lengths of muscles from different breeds were in the range reported by Young *et al.,* (1990) [18]. Muscle fibres from fast growing lines of chickens have larger fibre diameters than slow-growing lines and larger fibre diameters are often associated with meat toughening (Guan *et al.,* 2013) [19]. The results are in congruent with Bhaskar Reddy *et al.,* (2016) [1] in spent breeders, layers and broilers.

The overall mean values of myoglobin content differed significantly between broilers and rajasri chicken meat, wherein rajasri chicken recorded significantly (P<0.05) higher myoglobin content than broilers meat. The difference in myoglobin content between two varieties can be compared with the earlier findings of Bhaskar Reddy *et al.,* (2016) [1] in spent breeders, layers and broilers. Total protein extractability significantly (P<0.05) higher broilers meat compared to the rajasri chicken meat. Higher body weight birds recorded highest protein extractability. The differences might be due to differences in pH of meat samples and the protein extraction increases with pH and salt concentration. Naveena and Mendiretta, (2004) [20] reported higher water holding capacity, lower salt soluble protein and myoglobin content for spent hen meat. The results are in accordance with Bhaskar Reddy *et al.,* (2016) [1] in spent breeders, layers and broilers.

A significant (P<0.05) differences in both collagen content and collagen solubility was observed in broilers and rajasri chicken meat. Greater collagen content was found in rajasri chicken meat than broiler meat. There was a significant (P<0.05) difference observed between collagen solubility and broilers meat collagen was more soluble than rajasri chicken meat. The difference in collagen solubility is might be due to differences in live weights and ages are the main factors (Bhaskar Reddy *et al.,* 2016) [1].

Rajasri chicken meat recorded significantly (P<0.05) higher cooking loss compared to broilers meat. Cooking loss decreased significantly with increasing the live weight of the birds. Higher cook loss in rajasri chicken meat might be due to higher proportion of oxidative fibre which in turn related to water holding capacity of meat causing more moisture loss during cooking compared to broiler meat. The results are in accordance with Petracci *et al.,* (2013) [17], who also observed significant difference in cooking loss of different genotypes and Bhaskar Reddy *et al.,* (2016) [1] in spent breeders, layers and broilers.

Broilers meat had significantly (P<0.05) higher moisture and fat content than rajasri chicken meat. Both protein and total ash content of meat did not significantly (P>0.05) affected by different varieties of birds. The range of moisture percentis 75.50 and 74.55 respectively for broilers and rajasri chicken meat and the range of fat percentis 3.92 and 2.56 respectively for broilers and rajasri chicken meat. The differences might be due to different of environmental conditions, feeding, birds maturity and rearing systems. According to Xiong *et al.,* (1993) [1], the chemical composition of chicken meat was affected by breed, sex, age, feeding regime, meat yield, composition, part of meat as well as carcass processing. Haunshi *et al.,* (2013) [11] and Ni Wayan Suriani *et al.,* (2014) [22] who also observed significant effect of genotype on proximate composition of meat. On the contrary, Debata *et al.,* (2012) [10] noticed no significant effect of breed on proximate composition.

Mean ±S.E values of sensory characteristics of broiler and rajasri chicken meat are presented in Table 3. Meat obtained from rajasri chicken recorded significantly (P<0.05) higher colour and flavour scores and broilers meat had significantly (P<0.05) higher juiciness, tenderness and overall acceptability scores. Higher colour scores in rajasri chicken meat might be due to higher myoglobin content than broilers meat and also differences in the genotype of birds. These results are in agreement with the findings of Rajakumar *et al.,* (2013) [13] who recorded significantly higher color score in Bangalore district chicken and Ramanagar chicken than

Chikkaballapuram chicken meat. The difference in the age of broilers and rajasri birds might be contributory factor for differences in flavour, juiciness and tenderness scores. Gigaud *et al.,* (2008) [23] stated that age was the most significant factor of variation of the sensory characteristics. The differences in juiciness scores between broilers and rajasri chicken meat might be due to differences in cooking losses. In the present study broilers meat recorded significantly higher tender score than rajasri chicken meat which might be due to lower shear force value of broilers meat than rajasri chicken meat. Similar to these results Bhaskar Reddy *et al.,* (2016) [1] found differences in sensory scores of spent breeders, layers and broilers meat. The flavor score obtained in the present study can be compared with the study of Rajakumar *et al.,* (2013) [13] who also observed significant effect of genotypes on flavor score of different rural chicken of Bangalore district. Kokoszynski *et al.,* (2013) [16] found significant effect of genotypes on juiciness and tenderness score of chicken meat.

Table 3: Mean ±S.E values of sensory characteristics of rajasri birds and broilers meat*

Sensory characteristics	Rajasri birds meat	Broilers meat
Colour	6.86±0.17^{a}	6.51±0.43^{b}
Flavour	6.47±0.31^{a}	6.19±0.10^{b}
Juiciness	5.68±0.25^{b}	6.96±0.12^{a}
Tenderness	5.87±0.21^{b}	7.21±0.13^{a}
Overall acceptability	6.11±0.18^{b}	6.67±0.28^{a}

Note: Mean values within row bearing different superscripts are differ significantly ($P<0.05$). *n=24

The overall acceptability of meat obtained from broilers and rajasri birds was influenced by variety. Significant difference of age of the birds and other sensory characteristics like colour, flaovur, juiciness and tenderness tremendously influence the overall acceptability score of meat obtrained from broilers and rajasri chicken. The results are in congruent with Kokoszynski *et al.,* (2013) [16] in different commercial broilers.

Conclusion

Based on the above results it can be concluded that many carcass and physico-chemical characteristics and proximate composition is comparable between meat obtained from rajasri chicken and broilers. The sensory scores also comparable between broilers and rajasri chicken meat thus rajasri chicken meat can be conveniently utilized for production of various processed chicken meat products without affecting the quality.

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