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## Quality attributes of country chicken and commercial broiler chicken preserved under super chilled conditions

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### Abstract

The present study was conducted for comparing meat quality attributes of different varieties of chicken viz., Rajasri and Commercial broilers at super chilling (0 to -2 °C storage conditions). In this study, a total of 120 birds, 60 birds from each group i.e. Rajasri (18 weeks old) and Commercial broilers (38 days old) were selected for evaluation. Meat samples stored at super chilled (30 days) condition were evaluated for various meat quality traits during storage period. The results of meat quality parameters revealed significantly ( $p < 0.05$ ) higher water holding capacity (%) and pH values in Commercial broilers compared with Rajasri group. The values of pH as well as water holding capacity (%) showed a decreasing trend for both the groups of birds as the storage period of super chilling advanced. Evaluation of sensory scores revealed higher scores for appearance, texture, flavour, juiciness and overall acceptability for cooked breast meat samples of Rajasri than Commercial broilers. Also sensory scores showed a decreasing trend as the period of storage advanced for two groups of birds. TBARS and shear force values showed a higher significant ( $p < 0.05$ ) values for Rajasri than Commercial broilers. A trend of increase in TBARS and decrease in shear force values (SFV) were observed as the storage period advanced. The results of study indicated that the quality attributes of meat of Rajasri birds are better and they have the potential to form a good source of chicken as they have shown better sensory attributes. Also, the study indicated super chilling could a good way to preserve freshness of meat with improved quality characteristics.

**Keywords:** commercial broiler, rajasri, super chilling

### Introduction

As the growth of world population increasing, leading to the increased in the demand for animal proteins. Meat from poultry as well as eggs are a good source of high quality animal proteins sustaining the nutrition and health of human beings (Shahzad *et al.*, 2011) [18]. The chicken meat which is processed comprises about only 5% of total production (Poultry and Poultry Products Annual report in India-2016). The requirement for meat with guaranteed sensory attributes especially firm texture and juiciness, led to the development of improved varieties of dual purpose birds like Rajasri, Vanaraja, Giriraja, Gramapriya, Kalinga brown, Krishi bro etc. by various organizations/agencies. These birds resemble to indigenous 'desi' birds in their physical characteristics, hardiness and colour, but with higher genetic potential, they perform better than indigenous poultry in attaining higher body weight under low input systems. It is reported that the meat from the country chicken is more firm and juicier than meat from commercial broiler chicken breeds. Some studies reported that the meat from slow growing country chicken had higher shear force value and protein content and lower saturated acid content (Devatkal *et al.*, 2019) [6].

With increasing awareness among consumers about the importance of safe and hygienic meat production, the perceptible change in the retailing landscape from wet markets to professionally managed centrally processing plants and entry of e-commerce online retailers, led to the retailing of chicken in chilled and frozen condition. Though several works have been carried out on the chilled and frozen broiler chicken quality, the information on impact of super chilling on the quality attributes of country chicken are scanty. This demands a thorough investigation on the impact of preservation methods like super chilling on meat quality traits and shelf life of country chicken.

### Materials and Methods source of raw material

Chicken of slaughter age i.e., Rajasri (18 weeks old) and Commercial broilers (38 days) were

procured from Directorate of Poultry Research and local markets of Hyderabad, respectively. Before slaughter, birds were adequately rested, and ante mortem examination was carried out. Hygienic slaughtering and dressing were carried out at primary poultry processing plant of ICAR – NRCM. Slaughtering was done by severing the carotid artery and jugular vein. After bleeding, the carcasses were then scalded at 55 to 58<sup>o</sup> C for 90 seconds and then defeathered, thoroughly washed with potable. Evisceration was performed in a hygienic manner by giving a transverse incision and the abdominal cavity was opened, inedible organs, vent, spleen, lungs, testis, all portions of intestinal tract, and gallbladder were removed, the dressed meat was collected and stored.

### Storage of meat sample

Meat samples (breasts and thighs) from individual bird were collected and packed in trays and sealed. The packed samples were preserved at storage conditions i.e. super chilled (0 to -20 C) for analysis of different parameters at regular intervals. Analysis of super chilled samples was carried out on 6th, 12th, 18th, 24th and 30th day of storage.

### Physico-Chemical Parameters

#### pH

The pH for the meat sample estimated by following the method given by Trout *et al.* (1992) [20]. Five grams of meat sample was blended with 45 ml of distilled water using Ultra Turrax Tissue Homogenizer (IKA digital ULTRA-TURRAX, Model T- 25, Germany) for one minute. The pH recorded by digital pH meter by immersing the glass electrode (Eutech Instrument, Cyberscan, Singapore Model) into the homogenate of sample. The pH of the sample was measured with the pH meter, pH 4, 7 and 14 as per user manual instructions.

#### Thiobarbituric Acid Reactive Substances (TBARS)

Thiobarbituric acid reactive substances (TBARS) value will measure the lipid oxidation in the chicken meat sample which is estimated as per the procedure given by Tarladgis *et al.* (1960) [19]. Meat sample about 4g along with 20 ml of 20% trichloroacetic acid was blended for 3min. The blended sample kept for centrifugation at 5000 rpm for 15 minutes. Filtering of supernatant through Whatman No.1 filter paper. The filtrate i.e. TCA extract was used in the estimation of thiobarbituric acid number (TBA). The test solution was prepared by mixing 3 ml of 0.1% thiobarbituric acid to the 3 ml of TCA filtrate. After mixing the contents, tubes were kept in boiling water bath (100 °C) for 30 minutes along with blank. Blank was prepared by mixing 5 ml of 20% trichloroacetic acid with a 5ml of 0.1% thiobarbituric acid reagent mixed properly and was run simultaneously to check the experimental error. After cooling, the optical density (O.D) was measured in a UV-VIS spectrophotometer (SHIMADZU, UV-1700, Japan) at 532 nm. TBARS expressed in terms of mg malonaldehyde per kg of meat sample.

#### Water Holding Capacity (WHC)

The WHC of meat estimated by the process given by Wardlaw *et al.* (1973) [22]. Thoroughly minced meat sample weighing about 10g was stirred with 0.6M sodium chloride (NaCl) about 15ml in a so called centrifuge tube. The tubes were then kept for 15 minutes at a temperature of 4±1 °C, the meat sample stirred again and centrifuged (REMI-R-24) for

25 minutes at a speed of 5000 rpm. The supernatant obtained after centrifugation was measured and the difference between volumes i.e. initial (15ml NaCl) and the supernatant left over, used for calculation of WHC and is expressed in percentage of meat sample (i.e.10g) weight to calculate WHC.

#### Shear force value (SFV)

For estimating the Warner Bratzler shear force value the meat sample packed in low density polyethylene bags and sealed properly to avoid entry of water then the packed sample cooked in water bath for 10 to 20 minutes at 80 °C. After cooking, the cooked meat samples were made into cores and the cores from each sample were sheared across the length of the meat sample. These sample cores so prepared were placed under the V- notched shear blade of the Texture analyzer (Tinius Olsen, HIKF, United Kingdom). Cores were sheared perpendicular to the fiber orientation to measure the shear force. The peak shear force was recorded in newtons (N) and the average value from the three cores was recorded.

#### Sensory Evaluation

The sensory evaluation includes such as appearance, overall acceptability flavor, texture and juiciness of the meat samples evaluated using a descriptive scale (8 point) (Keeton, 1983) [11]. In the 8 point scale, highest quality of components characteristic given as 8 whereas scores were considered acceptable from 5 to 8 and scores from 1 to 5 were considered unacceptable. Minimum of 6 trained and experienced members of the institute were there in the panel, who were well familiar with all the characteristics of the meat. The meat samples were cooked in water bath for 20 minutes at 80 °C by adding salt (0.5% by weight of sample). After cooking, the cooked samples were cut into small equal sized pieces (square shape). At room temperature these coded samples are served in plates in separate sensory evaluation cabins, in between to avoid mixing of sensory attributes of different meat samples water served for cleansing the mouth.

#### Statistical analysis

The data which is obtained in the study for different meat quality traits were compiled and analyzed by SPSS (version 13 for Windows, SPSS, USA). The entire data was subjected to analysis of variance, (one-way ANOVA) for both groups, and (Two-way ANOVA) for both groups and storage days during super chilling. The least significant difference (LSD) and Duncan's multiple range tests are so applied to compare the means to find difference between both the groups and storage days. The smallest difference of about (5%) for two means was reported as different significantly.

#### Results and Discussion PH

The mean ± SE values of pH, TBARS, WHC, Shear force & sensory scores for Rajasri and Commercial broilers meat preserved at super-chilling (6, 12, 18, 24 and 30 days storage condition) were presented in Table 1. Among the birds group, Commercial broilers had higher significant ( $p < 0.05$ ) pH values in the entire storage period. The pH values of meat of both the group of birds decreased gradually with storage time. The meat samples (breast and thighs) of the group of birds preserved under the super chilling condition spoiled on 24 days of storage shown in figure 1. The pH changes are might be due to differences in type of muscles and content of glycogen. The results of present study are coinciding with the Khan *et al.* (2019) [12]; Xiong *et al.* (1993) [23]; Fernandez *et al.*

(2002) <sup>[9]</sup>, who reported significant differences in the pH among different genotypes of chicken. Debut *et al.* (2003) <sup>[5]</sup> stated that the rate of pH decrease of chicken which are growing slowly is faster than in chicken varieties which are growing fast. The lower pH values of meat obtained from Rajasri birds might be because of higher stress during slaughter resulting in depletion of glycogen and rapid acidification of breast muscle due to lactic acid production, resulting in lower pH (Debut *et al.*, 2005; Berri *et al.*, 2007; Fanatico *et al.*, 2007) <sup>[4,3,8]</sup>. In heavier birds the struggle is not much and the pH decline is also very low (Sarsenbek *et al.*, 2013) <sup>[16]</sup>, which is correlated with present study.

#### Thiobarbituric Acid Reactive Substances (TBARS)

There is increase significantly ( $p < 0.05$ ) in mean  $\pm$  SE values of TBARS for meat of both group of birds with storage time. The Rajasri bird showed a higher significant ( $p < 0.05$ ) TBARS values on day 6th, 12th and 18th day of super chilling. Daming Ding *et al.* (2020) <sup>[7]</sup> stated that substantial increase in TBARS values of pork meat stored in super chilling storage at different degrees i.e. -1 °C, -2 °C, -3 °C which is similar with the current study.



**Fig 1:** Slime formation indicating the spoilage of breast meat samples of Commercial broiler at 24 days of super chilled storage (0 to -2 °c).

#### Water Holding Capacity (WHC)

There was a decrease in mean  $\pm$  SE values significantly ( $p < 0.05$ ) for WHC for meat of birds of both groups with storage time. Studies of Fanatico *et al.* (2007) <sup>[8]</sup> stated that the slow growing birds having more drip loss (low WHC) when compared to fast growing birds, which is similar with the findings of present study where Commercial broilers showed higher WHC compared with Rajasri group.

#### Shear Force Value (SFV)

The mean  $\pm$  SE values of SFV for both group of birds decreased gradually with storage time. Tenderness of meat sample determined by shear force value, an important factor relating to palatability as well as quality of meat (An *et al.*, 2010) <sup>[1]</sup>. In this study the SFV's decreased when the storage period advanced, whereas with in birds group the SFV was higher for meat of Rajasri than Commercial broilers.

#### Sensory Evaluation

**Appearance:** The mean appearance scores on 12 and 18 days of super chilling not differed for both the birds groups

significantly ( $p > 0.05$ ). The mean appearance scores for meat of Commercial broilers showed lower scores for appearance. Comparatively Commercial broilers showed lower scores for appearance during entire storage period. Findings of Ullengala *et al.* (2020) <sup>[21]</sup>, who observed no significant differences for appearance scores among Aseel crosses.

#### Flavour

The mean flavour scores for meat of Rajasri on 6 12 and 18 days of super chilling significantly ( $p < 0.05$ ) not differed, whereas significantly ( $p < 0.05$ ) lower scores for Commercial broilers were observed compared with Rajasri group. Results also correlated with findings of Rajkumar *et al.* (2016) <sup>[15]</sup> observed no significant differences for flavour scores among Aseel and Broilers and also there is no significant differences observed with in groups with different weights.

#### Juiciness

No significant ( $p > 0.05$ ) difference observed in the mean juiciness scores for meat of Rajasri on 12 and 18 days of super chilling, whereas significantly ( $p < 0.05$ ) lower scores for meat of Commercial broilers were noticed when compared with Rajasri group. The mean juiciness scores for meat of Rajasri and Commercial broilers on 6 days of super chilling differed significantly ( $p < 0.05$ ). According to (Savell and Cross, 1988; Hopkins *et al.*, 2006) there are many factors which will influence the juiciness of meat like the fat content in the intramuscular areas. Pandey *et al.* (2018) <sup>[13]</sup> observed lower Juiciness scores in slow growing Native x CSFL crossbred chicken compared to Commercial broilers.

#### Texture

No significant ( $p > 0.05$ ) differences were observed in mean texture scores on 6, and 12 days of super chilling with both groups. Significantly ( $p < 0.05$ ) higher texture scores for meat sample of Rajasri bird was observed comparing with the meat of Commercial broiler group. Baracho *et al.* (2006) <sup>[2]</sup> stated that the palatability of meat is connected with texture and is affected by many factors like species, nutritional condition, genetic factors, age, and so on.

#### Overall acceptability

The mean overall acceptability scores significantly ( $p > 0.05$ ) not differed for meat of Rajasri on 12 days of super chilling, whereas significantly ( $p < 0.05$ ) lower scores for meat of Commercial broilers were observed when compared with Rajasri group. Significant ( $p < 0.05$ ) difference observed in mean overall acceptability scores for meat of Rajasri on 6 and 18 days of super chilling, whereas no significant ( $p > 0.05$ ) difference observed between both the groups. Present results coinciding with Rajkumar *et al.* (2016) <sup>[15]</sup>, who also noticed lower overall acceptability scores in Commercial broilers meat than Aseel meat. Ullengala *et al.* (2020) <sup>[21]</sup> observed no significant differences in scores among Aseel crosses. Devatkal *et al.* (2019) <sup>[6]</sup> reported that Indbro breast meat scores were higher when compared to Commercial broiler breast meat.

**Table 1:** PH, TBARS, WHC, Shear force values and, sensory evaluation scores of Rajasri and Commercial broiler chicken preserved at super chilled storage conditions (Mean  $\pm$  SE).

Parameter	Storage period (days)	Rajasri (R)	Commercial broilers (C.B)
PH	6	5.83 $\pm$ 0.02 <sup>ab</sup>	5.95 $\pm$ 0.02 <sup>bc</sup>
	12	5.74 $\pm$ 0.01 <sup>ba</sup>	5.77 $\pm$ 0.01 <sup>cb</sup>
	18	5.72 $\pm$ 0.00 <sup>aA</sup>	5.79 $\pm$ 0.01 <sup>ba</sup>
TBARS (mgMDA/Kg)	6	0.08 $\pm$ 0.002 <sup>ba</sup>	0.06 $\pm$ 0.001 <sup>aA</sup>
	12	0.09 $\pm$ 0.001 <sup>bb</sup>	0.09 $\pm$ 0.001 <sup>aB</sup>
	18	0.14 $\pm$ 0.005 <sup>bc</sup>	0.12 $\pm$ 0.001 <sup>aC</sup>
WHC (%)	6	26.66 $\pm$ 0.24 <sup>aC</sup>	37.91 $\pm$ 0.45 <sup>cC</sup>
	12	24.41 $\pm$ 0.20 <sup>aB</sup>	33.91 $\pm$ 0.30 <sup>cB</sup>
	18	21.90 $\pm$ 0.18 <sup>aA</sup>	31.85 $\pm$ 0.18 <sup>cA</sup>
Shear force (N)	6	11.77 $\pm$ 0.21 <sup>cb</sup>	6.85 $\pm$ 0.06 <sup>aC</sup>
	12	10.13 $\pm$ 0.04 <sup>cA</sup>	6.15 $\pm$ 0.04 <sup>aB</sup>
	18	9.90 $\pm$ 0.040 <sup>cA</sup>	5.58 $\pm$ 0.07 <sup>aA</sup>
Appearance	6	6.72 $\pm$ 0.00 <sup>bb</sup>	6.68 $\pm$ 0.00 <sup>aB</sup>
	12	6.60 $\pm$ 0.04 <sup>aB</sup>	6.60 $\pm$ 0.03 <sup>aB</sup>
	18	6.56 $\pm$ 0.02 <sup>aA</sup>	6.48 $\pm$ 0.03 <sup>aA</sup>
Flavour	6	6.89 $\pm$ 0.02 <sup>bc</sup>	6.81 $\pm$ 0.02 <sup>aC</sup>
	12	6.70 $\pm$ 0.01 <sup>bb</sup>	6.58 $\pm$ 0.01 <sup>aB</sup>
	18	6.51 $\pm$ 0.03 <sup>ba</sup>	6.29 $\pm$ 0.04 <sup>aA</sup>
Juiciness	6	6.76 $\pm$ 0.02 <sup>bb</sup>	6.69 $\pm$ 0.02 <sup>aC</sup>
	12	6.63 $\pm$ 0.01 <sup>bb</sup>	6.54 $\pm$ 0.04 <sup>aB</sup>
	18	6.54 $\pm$ 0.02 <sup>ba</sup>	6.06 $\pm$ 0.08 <sup>aA</sup>
Texture	6	6.68 $\pm$ 0.01 <sup>aC</sup>	6.52 $\pm$ 0.10 <sup>aB</sup>
	12	6.53 $\pm$ 0.02 <sup>aB</sup>	6.54 $\pm$ 0.01 <sup>aB</sup>
	18	6.17 $\pm$ 0.02 <sup>ba</sup>	5.91 $\pm$ 0.08 <sup>aA</sup>
Overall Acceptability	6	6.83 $\pm$ 0.04 <sup>bc</sup>	6.71 $\pm$ 0.01 <sup>aC</sup>
	12	6.63 $\pm$ 0.01 <sup>bb</sup>	6.50 $\pm$ 0.03 <sup>aB</sup>
	18	6.08 $\pm$ 0.08 <sup>ba</sup>	5.90 $\pm$ 0.03 <sup>aA</sup>

Different superscripts for the means i.e. lower alphabets - a, b, c in the each row, whereas in the columns i.e. A, B, C - alphabets of uppercase are different significantly ( $p \leq 0.05$ ).

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