J. Meat Sci. 2018, 13 (1): 60-63 Research paper

Comparison of Chicken Varieties: Muscle Fiber Diameter, pH, Color, Tenderness in *Pectoralis major* Muscle

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ABSTRACT

This study was undertaken to compare two varieties (Srinidhi and Vanaraja) at three age groups (16, 20, 24 weeks) in terms of muscle fiber diameter, pH, color and tenderness qualities. A total of 210 birds reared up to age group 16, 20 and 24 weeks and slaughtered by following standard procedure. Samples for muscle fiber diameter were taken from the middle parts of breast meat cut i.e. Pectoralis major muscle. Muscle fiber diameter measured by calibrated micrometer under light microscope. Results of present study indicated variety, age and sex significantly influence muscle fiber diameter, pH, tenderness and color. Vanaraja chicken observed significantly higher muscle fiber diameter (µm) 43.43±3.98 than Srinidhi chicken 42.29±4.07. Vanaraja chicken recorded significantly ($p \leq 0.05$) higher pH 5.64±0.16, (color coordinate) L* 54.98±1.09, a* 6.56±0.91, b* 35.17±1.97, shear force value (N) 12.40±0.71 than Srinidhi chicken pH 5.60±0.15, L* 53.49±2.01, a* 7.24±0.9, b* 35.05±1.09, shear force value 11.29±0.87. Male observed significantly higher pH, color coordinate L*a*b*, shear force value than female. With age increased shear force values were associated with increased muscle fiber diameter. Results indicated that variety significantly affected physicochemical qualities of chicken.

Keywords: *Srinidhi, Vanaraja, Color coordinate, Shear force value*

Received: 25-08-2018 Accepted: 11-12-2018

INTRODUCTION

Directorate on Poultry Research, Hyderabad has developed improved chicken varieties which are tailor-made for better production and adaptability under diversified regions in rural and tribal backyard conditions. Vanaraja and Srinidhi are among the various dual purpose varieties developed by Directorate on Poultry Research, Hyderabad which have successfully been reared by farmers inseveral parts of country. Many reports (Sharma *et*

2004; Niranjan *et al.* 2008; Pathak *et al.* 2009; Kalita *et al.* 2012; Jha and Prasad 2012) indicated Vanaraja as an example of superior stock, dual purpose colored bird which has significantly contributed to rural poultry in terms of meat and eggs. Vanaraja was developed using a low performing colored Cornish population as a male parent and a synthetic random bred meat as a female parent. The meat control line was originally established at University of Agricultural Sciences, Bangalore and subsequently transferred to the Directorate. Naked neck phenotypes were allowed to segregate in the female parent population (Ayyagari 2008). However, Srinidhi chicken is developed from six test crosses.

Srinidhi complements the body weight gain of Vanaraja and egg production of Gramapriya and well suited for rural areas because of its long shanks (75.63 mm at 6 weeks of age) and multiple colored plumages (Project Report Directorate on Poultry Research, Hyderabad 2012-13).

According to Kumar (2008) for the formulation of proper breeding plans and for the improvement of poultry production the carcass characteristics, meat quality and amount of variation present in different breeds and their crosses must be assessed accurately. However, Berri (2001) study observed significant effect of selection for breast muscle development on the glycolytic potential and early postmortem metabolism (24 hrs post mortem pH decline) and suggested more studies should be conducted under industrial condition to evaluate the possible effect of interactions between genotype and the slaughter or processing conditions on the quality of broiler meat. The scientific data on comparative performance of these chicken varieties in terms of muscle fiber diameter, physicochemical qualities are unavailable. An endeavor to elicit varieties variation on different parameters was the objective of given study.

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DOI : 10.5958/2581-6616.2018.00009.9

MATERIALS AND METHODS

Day old Srinidhi (105) and Vanaraja (105) chicks were procured from Directorate on Poultry Research, Rajendranagar, Hyderabad and were grown under actual farm conditions with identical management practices for all the two different varieties throughout the five trials. Each trial comprised of 36 birds of each variety divided into three slaughter groups (12 birds in each group) were subjected for slaughter after completion of 16, 20, 24 weeks of age with equal distribution of sexes.

Slaughter and Dressing of Birds: Birds were off feed overnight and slaughtered by adopting standard procedure followed in the Department of Livestock Products Technology, College of Veterinary Sciences, Hyderabad. The Pectoralis major muscle collected from breast meat cut and stored in refrigerator (4±1°C) for 24 hrs.

Physicochemical qualities: Muscle fiber diameter (µm) was measured as per method recommended by Jeremiah and Martin (1977). Five grams of muscles homogenized twice for 15 seconds at low speed, interspaced with a five seconds resting in a solution containing 0.25 M sucrose and 1.0 mM EDTA. The suspension was examined directly under light microscope equipped with low object and 8×eyepiece containing a calibrated micrometer. Muscle fiber diameter was measured as the mean cross sectional distance in micrometer between the exterior surfaces of the sarcolemma of 20 randomly selected muscle fibers. Average counted divisions of ocular micrometer multiplied by 13 to give value for muscle fiber diameter. pH of samples was measured by adopting the procedures

laid down by AOAC using digital pH meter (Elico model L1-10T). Instrumental color measured by using color Tec PCM + (Color Tec Associates Inc., Clinton, NJ, USA) and shear force value of cooked sample measured by Texturometer (Model H1KF; Tinius Olsen, Redhill, England). 1.25 cm cores were taken using a tissue borer parallel to the direction of muscle fibers.

Statistical Analysis: The data were subjected to ANOVA as per Snedecor and Cochran (1989) to study the influence of sex, variety, age etc. The significant differences between means were obtained by using Duncan's Multiple Range Test.

RESULTS AND DISCUSSION

The overall mean values (Table 2 and Table 1) for muscle fiber diameter (μm) in Srinidhi chicken was 41.85±4.40, 42.16±4.90, 42.87±3.79 at 16, 20 and 24 weeks of age, respectively wherein Vanaraja chicken was 42.93±2.06, 43.22±4.00, 44.13±2.98 at 16, 20 and 24 weeks of age, respectively. Vanaraja recorded significantly (p≤0.05) higher muscle fiber diameter than Srinidhi chicken in all three age groups (Table 1). Guan *et al.* (2013) study suggested fast growing genotype had significantly (p≤0.05) larger fiber diameter of breast muscle than slow-growing chicken genotypes. They further reported fiber diameter of AAB (commercial broiler Arbor Acres Broiler) was larger than indigenous chicken. As age advanced from 16 week to 24 week muscle fiber diameter increased in Srinidhi and Vanaraja chicken. Results can be correlated with earlier study of Muthukumar *et al.* (2011) in broilers and Anitha (2015) in Rajashri chicken. Male 42.20±3.45 recorded significantly (p≤0.05) higher muscle fiber diameter than female 36.53±3.56. The study can be corroborated with study of Scheuermann *et al.* (2004) recorded male broiler chicken had higher muscle fiber density than female. Similarly, Anitha (2015) recorded significantly higher muscle fiber diameter in Rajasri male than its female. These differences might be due to the genetic factors, method of breeding and feeding of animals. Study observedSrinidhi chicken meat tendered than Vanaraja chicken (Table 1). The effects of variety, sex and age were also significant (p≤0.05) (Table 2) on shear force value of chicken. Shear force value of Vanaraja chicken was significantly (p≤0.05) higher than Srinidhi chicken. As age advanced shear force value increased and male recorded significantly (p≤0.05) higher shear force value than female. Lonergan *et al.* (2003) recorded significant

Table 1: Physicochemical qualities of Vanaraja and Srinidhi chicken (Mean±SE)

Parameters	Sex	16 weeks		20 weeks		24 weeks	
		Vanaraja	Srinidhi	Vanaraja	Srinidhi	Vanaraja	Srinidhi
Muscle fiber diameter	Male	48.84^{a}±3.9	48.70^{b}±5.0	48.99^{a}±5.6	48.88^{b}±5.3	50.08^{a}±3.6	49.75^{b}±6.0
	Female	37.01^{a}±4.4	35.01^{b}±4.8	37.45^{a}±3.4	35.45^{b}±5.7	38.18^{a}±3.0	35.99^{b}±4.0
pH	Male	5.70^{a}±0.50	5.59^{b}±0.04	5.50^{a}±0.11	5.42^{b}±0.45	6.08^{a}±0.82	5.90^{b}±0.33
	Female	5.51^{a}±0.06	5.25^{b}±1.20	5.48^{a}±0.09	5.39^{b}±0.23	6.02^{a}±0.03	5.80^{b}±0.21
Shear force value (N)	Male	13.47^{a}±.17	11.04^{b}±1.0	14.06^{a}±0.1	12.77^{b}±1.3	15.63^{a}±1.8	15.01^{b}±0.5
	Female	9.78^{a}±0.97	9.14^{b}±0.98	10.02^{a}±1.1	9.80^{b}±1.00	11.47^{a}±1.2	10.02^{b}±1.9

Means with different superscripts in each class differ significantly (p≤0.05)

Table 2: Effect of age, sex and variety on physicochemical qualities of chicken

Parameters			16 weeks	20 weeks	24 weeks	Overall mean
Muscle fiber diameter	Variety	Vanaraja	42.93±2.06	42.22±4.00	44.13±2.98	43.43^{a}±3.98
		Srinidhi	41.85±4.40	42.16±4.90	42.87±3.79	42.29^{b}±4.07
	Sex	Male	48.77±1.89	48.93±5.43	49.91±4.09	42.20^{m}±3.45
		Female	36.05±4.01	36.45±2.95	37.08±5.01	36.53^{n}±3.56
	Age		42.39^{r}±4.08	42.69^{q}±3.98	43.50^{p}±3.01	42.36±2.07
pH	Variety	Vanaraja	5.55±0.92	5.49±0.12	5.85±0.41	5.64^{a}±0.16
		Srinidhi	5.47±1.10	5.40±0.60	6.05±0.90	5.60^{b}±0.15
	Sex	Male	5.64±0.08	5.44±0.23	5.91±0.42	5.66^{m}±0.13
		Female	5.38±0.11	5.45±0.19	5.99±0.61	5.60^{n}±0.12
	Age		5.51^{q}±0.90	5.45^{r}±0.21	5.95^{p}±0.34	5.63±0.15
Shear force value (N)	Variety	Vanaraja	11.62±0.87	12.04±0.78	13.55±0.98	12.40^{a}±0.71
		Srinidhi	10.09±1.03	11.28±0.98	12.52±1.09	11.29^{b}±0.87
	Sex	Male	12.25±1.01	13.42±0.98	15.32±0.81	13.78^{m}±0.65
		Female	9.46±0.98	9.91±1.01	10.74±1.05	10.03^{n}±0.45
	Age		10.85^{r}±0.91	11.66^{q}±1.87	13.03^{p}±0.76	11.91±0.43

Means with different superscripts in each class differ significantly (p≤0.05)

(p≤0.05) difference in shear force value in the genotypes (Broiler, F5-Leghorn, F5-Fayoumi, Leghorn and Fayoumi) where were highest shear force value recorded in Broiler than indigenous genotypes. Study of Jaturasitha *et al.* (2008) also observed significant (p≤0.05) effect of breeds and their crosses in shear force value. Tang *et al.* (2009) recorded significantly (p≤0.05) higher shear force value in fast growing broiler than LNH broiler cross. However, effect of age and sex can be compared with study of Anitha (2015) in Rajasri chicken and Muthukumar *et al.* (2011) in broilers reported male chicken meat significantly tough than female chicken and with age shear force value increased. Shear force values were associated with muscle fiber diameter.

The mean pH of chickens at 24 hrs of post slaughter, for the two varieties studied, sex and age wise effect are presented in (Table 2). Between two varieties pH was significantly (p≤0.05) different (Table1). The findings indicated that genotypes could affect the declining rate of pH. These findings are in agreement with Jaturasitha *et al.* (2008), Liu and Niu (2008), Lichovnikova *et al.* (2009). Keshri (1991) stated that the pH of muscles is affected by intrinsic factors such as species of poultry and the type of muscle. The overall pH value of male was significantly (p≤0.05) higher than female and with age pH of chicken meat increased significantly (p≤0.05) (Table 2). The results can be corroborated with study of Anitha (2015) in Rajasri chicken. The color co-ordinates (Table 3, Fig 4) L* (lightness) and a* (redness) values indicated decrease and increase, respectively with the increase in age of chicken of both varieties. Difference in L* value (Fig 1) between two varieties was significant (p≤0.05) and female also difference were significant (p≤0.05).

CONCLUSION

Muscle fiber diameter recorded significantly higher in Vanaraja than Srinidhi. Tenderness recorded more in Srinidhi than Vanaraja chicken. Female was more tendered than male. With age tenderness decreased but color coordinate (L*, a*, b*) values increased. Male chicken was darker in color coordinate (a*) value than female chicken. Certainly chicken varieties were different in physicochemical qualities but are comparable to each other.

Table 3: Color co-ordinate (L* a*b* values) of Vanaraja and Srinidhi chicken (Mean±SE)

		16 weeks		20 weeks		24 weeks	
Parameters	**Sex**	**Vanaraja**	**Srinidhi**	**Vanaraja**	**Srinidhi**	**Vanaraja**	**Srinidhi**
L*	Male	59.09^{a}±4.45	57.21^{b}±2.50	56.94^{a}±2.13	54.34^{b}±4.51	56.28^{a}±4.35	53.64^{b}±3.24
	Female	58.51^{a}±3.51	51.81^{b}±2.19	54.97^{a}±2.13	51.11^{b}±3.43	52.58^{a}±3.01	51.35^{b}±3.24
a*	Male	3.70b±0.89	3.85^{a}±0.56	4.65^{b}±0.29	5.00^{a}±0.34	7.67^{b}±1.23	10.30^{a}±1.32
	Female	5.50b±0.98	8.37^{a}±0.78	8.94^{b}±0.35	9.38^{a}±0.30	8.94^{b}±.35	9.55^{a}±0.99
b*	Male	28.19^{b}±2.01	29.16^{a}±1.81	30.35^{a}±2.47	27.73^{b}±1.77	30.60^{b}±1.89	30.74^{a}±1.53
	Female	30.46^{b}±2.48	33.55^{a}±2.20	32.25^{b}±1.92	39.36^{a}±1.54	39.36±1.61	39.36±1.62

Means with different superscripts in each class differ significantly (p≤0.05)

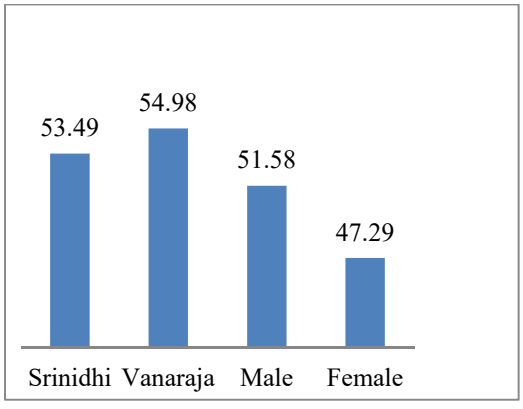

Figure 1: L value difference in variety and sex

Increase in a* value with age can be attributed to increase in myoglobin content with age. When the a* (redness) value (Figure 2) was compared for two varieties, it was found that Srinidhi chicken had significantly (p≤0.05) higher a* value than Vanaraja chicken.

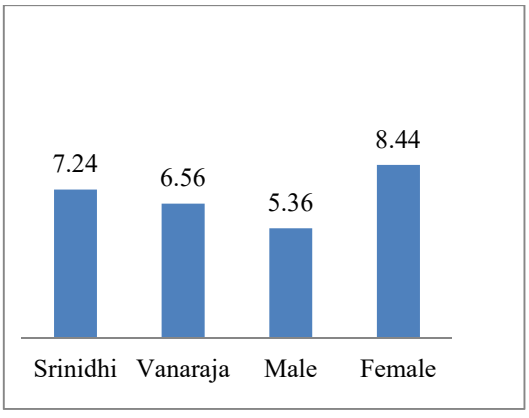

Figure 2: a* value difference in variety and sex

However, there was significant (p>0.05) influence of variety and sex for b* value (Figure 3). Significant increase in b* value was observed as age advanced (Fig 4). Gaun *et al.* (2013) and Kokoszynski *et al.* (2013) recorded significant effect of genetic lines on color characteristics of breast meat. Muthukumar *et al.* (2011) reported that with age (from 35 days to 45 days) a* (chroma) increased in broilers and Anitha (2015) in Rajasri chicken.

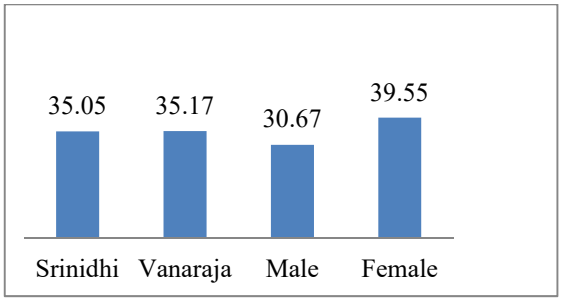

Figure 3: b* value difference in variety and sex

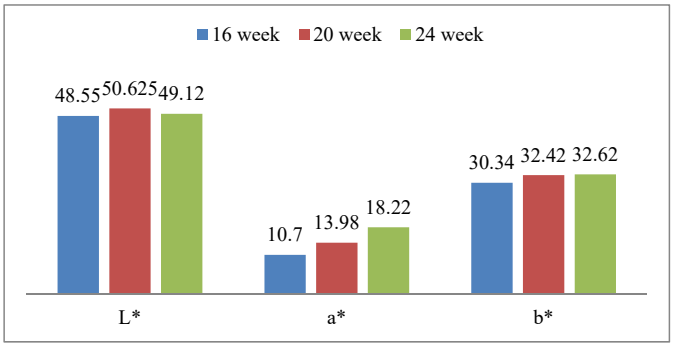

Figure 4: Effect of age on Lab colour coordinate

CONFLICT OF INTEREST: The authors declare that they have no competing interests.

ETHICS STATEMENT: Not Applicable

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