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Research Paper

Comparison of Meat Quality Characteristics of Vigova Super M and Kuttanad Ducks

Animal Science

KEYWORDS : Duck, Vigova, Kuttanad, Meat, characteristics, Comparison

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ABSTRACT

A study was conducted to compare the meat quality characteristics of Vigova Super M duck, a broiler duck strain and Kuttanad duck, a dual purpose duck indigenous to Kerala. Meat quality characteristics, viz., pH, Water Holding Capacity (WHC), Myofibrillar Fragmentation Index (MFI), fibre diameter, colour, cooking loss, chemical composition including proximate composition, cholesterol and mineral composition and sensory attributes of breast and thigh muscles of the two groups of ducks were studied. The values of pH, WHC and MFI were higher in Kuttanad ducks and these values in thigh meat were higher compared to those in breast meat. Kuttanad duck meat had higher fibre diameter values than Vigova duck meat. L value was highest in Vigova breast meat whereas redness value (a*) was highest in Kuttanad thigh meat. Kuttanad duck meat showed a significantly lower (P<0.05) mean cooking loss, the loss being comparatively higher for thigh meat. Vigova thigh meat showed significantly higher (P<0.05) moisture content while Kuttanad thigh meat showed significantly higher (P<0.05) fat content. Higher mean protein, ash, cholesterol, sodium and potassium values were observed in Kuttanad duck meat, values being higher for thigh meat than breast meat. On sensory evaluation, highest flavour and juiciness scores were observed in Kuttanad thigh meat, while highest overall tenderness and overall acceptability scores were obtained for Vigova breast meat. It was concluded that Vigova duck could be used for broiler purpose and Kuttanad duck could be used for processing meat products after its economic laying period.*

Poultry meat is of high nutritional value and is a good source of protein. Though majority of poultry meat in India is constituted by chicken, duck meat is slowly gaining popularity due to its nutritional value (Kanagaraju et al., 2012). Duck meat production in India was 37700 tonnes in 2010 (FAOSTAT, 2010). Duck meat has combined characteristics of red meat - contains high levels of phospholipids, precursors of aromas and the dietetic characteristics of poultry meat - contains high levels of mono unsaturated fatty acids, especially oleic and linoleic acids which constitutes about 60 % of total fatty acids. With recommendations for the reduction of red meat intake due to its association with cardiovascular pathologies, the consumption of white meats and duck meat is gaining more attention. Kerala with its extensive network of inland water bodies is highly suitable for rearing of ducks. Vigova Super M (Super Meat) is a broiler strain of duck which is a cross of White Pekin and Aylesbury and has its origin in Vietnam. They have high disease resistance, faster growth rate and good feed conversion efficiency. These are ideally suited for the Indian climate and are gaining popularity in India. Kuttanad duck, the most popular duck of Kerala is native to the state and includes both Chara and Chemballi varieties. They are reared in large flocks in the paddy fields of Kuttanad area in Kerala and are mainly kept for egg production, but are dual purpose in nature with high disease resistance and good adaptability.

It would be beneficial if the quality characteristics of meat of these two ducks are studied and compared. Only very few works had been so far conducted in this area. Hence a study was envisaged with the objectives of evaluating and comparing the meat quality characteristics of Vigova and Kuttanad ducks.

MATERIALS AND METHODS

Comparative studies on quality characteristics of Vigova Super M and Kuttanad duck meat were conducted at the Department of Livestock Products Technology, College of Veterinary and Animal Sciences, Mannuthy. Twenty each of Vigova Super M ducks (aged six to eight weeks) and Kuttanad ducks (aged 5 to 6 months) of either sex selected at random were used for the study. Vigova Super M ducks were purchased from local farmers and Kuttanad ducks from the University Poultry and Duck Farm (UPDF), Mannuthy. Ducks were humanely slaughtered and hygienically processed in the Department. Breast and thigh meat of each duck without skin and subcutaneous fat were salvaged and kept chilled at 0 to 4°C for the evaluation of meat quality characteristics. The meat quality characteristics assessed were pH, water holding capacity, myofibril fragmentation index, fibre diameter, sarcomere length, colour, cooking loss, chemical composition including proximate composition, cholesterol and mineral composition and sensory attributes.

The pH of the meat samples were estimated at 30 min, 6 h and 24 h by using a digital pH meter (μ pH system- Systronics, India) as described by O'Halloran et al. (1997). Water holding capacity of meat sample was estimated at 30 min, 6 h and 24 h using filter paper press method of Grau and Hamm (1957). Fragmentation index values of meat samples at prescribed intervals (30 min, 6 h and 24 h) were determined by procedure outlined by Davis et al. (1980). Fibre diameter was measured as per method outlined by Jeremiah and Martin (1997). Sarcomere length of myofibrils was measured as per the method outlined by Hostetler et al. (1972). Colour of the samples was determined objectively using Mini Scan XE Plus Spectrophotometer (Hunter Lab, Virginia, USA) with diffuse illumination (Page et al., 2001).

Cooking loss of meat was assessed as per the procedure of Boccard et al. (1981). Duck meat was analyzed for its proximate principles, viz., moisture, fat, protein and ash, on the day of slaughter. The composition of proximate principles was expressed as per cent of the duck meat on wet matter basis as per AOAC (1990). The method of Folch et al. (1957) was used to extract lipids from samples of the duck meat. Tschugaeff reaction as modified by Hanel and Dam (1955) was used for the estimation of total, free and esterified cholesterol. Mineral contents of duck meat were determined according to the methods of AOAC (1990). The sodium and potassium contents were estimated using a Flame Photometer (Systronics flame photometer 128, Ahmadabad, India) and calcium content was determined using Atomic Absorption Spectrophotometer (Perkin Elmer, 3110, US Instrument division, Norwalk, USA) at a wavelength of 422.7 nm. Phosphorous was determined by ANSA method (Fiske and Subbarow, 1925). The sensory evaluation of duck meat was conducted by a semi trained panel consisting of seven panelists from the Department of Livestock Products Technology, College of Veterinary and Animal Sciences, Mannuthy using the score card (AMSA, 1983) in an eight point Hedonic scale for colour, flavour, juiciness, ease of fragmentation, mouth coating, overall tenderness and overall acceptability. The cooked samples were

cooled to room temperature and served to the panellist with code number and score card, and asked to rate in the eight point Hedonic scale (Cross, 1987).

The data obtained were statistically analyzed by Independent t-test, Paired t-test, Mann-Whitney-U test and Wilcoxon Signed Ranks test using SPSS soft ware as per Snedecor and Cochran (1994).

RESULTS AND DISCUSSION

The meat quality characteristics of breast and thigh meat of Vigova and Kuttanad ducks are shown in Table 1 and Table 2 respectively.

pH

pH was higher in meat of Kuttanad ducks, which was significant (P<0.05) in the breast and thigh meat at 24 h. This might be due to reduced glycogen store in Kuttanad meat when compared to Vigova meat. The results were in agreement with the findings of Kisiel and Ksiazkiewicz (2004) and Jassim et al. (2011). In both groups of ducks, thigh meat showed a significantly higher (P<0.05) pH when compared to breast meat. This could be attributed to the type IIB muscle fibres in breast meat of poultry which had higher glycogen levels and hence resulted in more lactic acid production.

Water Holding Capacity (WHC)

Highest WHC was observed for Kuttanad thigh meat and lowest for Vigova breast meat and they differed significantly (P<0.05). In the study Kuttanad ducks showed higher WHC values at all time periods which might be due to higher pH. It was in accordance with findings reported by Van Laack and Smulders (1992) and Karakaya et al. (2006). From the result it could be inferred that WHC increased with increasing slaughter age. Between breast and thigh meat in both groups of ducks, thigh meat showed a higher WHC at all time periods, which might be due to significantly higher (P<0.05) pH values.

Myofibril Fragmentation Index (MFI)

The results of MFI showed a similar trend as the results of pH and WHC values. Between the two groups of ducks, Kuttanad ducks had significantly higher (P<0.05) MFI values in meat than Vigova ducks. Highest MFI value was observed in Kuttanad thigh and lowest in Vigova breast. Significantly lower (P<0.05) value in Vigova might be due to the increased tenderness of meat when compared to Kuttanad ducks due to less collagen cross linking. As age advanced, collagen cross linking increased. It was in accordance with findings of Kavitha (2006). These results reflected in the sensory evaluation where Vigova duck meat had significantly higher (P<0.05) overall tenderness scores than Kuttanad duck meat. In both groups of ducks, thigh meat showed significantly higher (P<0.05) mean MFI values which might be due to more collagen content in the thigh meat. This was also reflected in the significantly lower (P<0.05) overall tenderness scores of breast meat when compared to thigh meat in both groups.

Fibre Diameter

Kuttanad duck meat had significantly higher (P<0.05) mean muscle fibre diameter values than Vigova duck meat. It might be due to the higher age of Kuttanad ducks that resulted in muscle fibres with more diameters. These findings were in agreement with the results of Baeza et al. (1997) who observed that as slaughter age increased, fibre diameter value increased. In both groups of ducks, breast meat had higher fibre diameter values than thigh meat which might be due to the greater proportion of white fibres in breast meat.

Colour

L* value exhibited was highest for Vigova breast which differed significantly (P<0.05) from all others. It might be due to decreased myoglobin pigment concentration as supported by findings of Qiao et al. (2001). Vigova duck meat had higher L* values which might be due to lower pH values which increased L* values as supported by findings of Page et al. (2001), Qiao et al. (2001) and Jassim et al. (2011). Redness value was significantly higher (P<0.05) for Kuttanad duck meat compared to Vigova duck meat which might be due to an increase in myoglobin concentration in muscles due to higher age. This was in agreement with the findings of Ali et al. (2007) and Jassim et al. (2011). a* value was highest for thigh meat compared to breast meat in both groups of ducks and might be due to higher proportion of red muscle fibres in thigh meat than in breast meat.

Cooking Loss

Kuttanad duck meat showed a significantly lower (P<0.05) mean cooking loss and might be due to significantly higher (P<0.05) WHC values of that meat. It could also be attributed to the differences in species resulting from structural differences in connective tissues, muscle fibres, fatty tissues and other chemical composition as observed by Woloszyn et al. (2011). Thigh meat showed significantly higher (P<0.05) cooking loss when compared to breast meat, though the WHC was higher in thigh meat. This might be due to increased proportion of type IIA fibres in thigh and was in accordance with findings as observed by Ali et al. (2007).

Proximate Composition

Between the two groups, the moisture content differed significantly (P<0.05), being higher for Vigova duck meat. This might be due to the higher slaughter age of Kuttanad ducks which might have increased the protein and fat contents as supported by findings of Huda et al. (2011).Mean moisture per cents of breast meat in both groups of ducks showed higher values compared to thigh meat. Higher protein per cent values in Kuttanad ducks might be due to higher slaughter age which increased protein levels in meat. Protein per cent of thigh meat showed higher value compared to breast meat in both groups of ducks. Between the two groups, mean fat per cent value of meat differed significantly (P<0.05), being higher for Kuttanad ducks. This might be due to the higher slaughter age of Kuttanad ducks which resulted in more fat deposition. Thigh meat showed higher fat per cent values compared to breast meat in both groups of ducks which was in agreement with findings of by Witak (2008) and Huda et al. (2011). Between the two groups, ash content differed significantly (P<0.05), being higher for Kuttanad ducks and might be due to the higher slaughter age of Kuttanad ducks.

Cholesterol

Significantly higher (P<0.05) mean cholesterol values in Kuttanad duck meat might be due to higher level of fat in the meat, mainly due to higher slaughter age. In both groups of ducks, thigh meat had significantly higher cholesterol values. This might be because of higher fat content in thigh meat due to greater proportion of red muscle fibres.

Mineral Composition

Highest mean sodium value was observed for Kuttanad thigh meat and lowest for Vigova breast meat and the difference was significant (P<0.05). Highest potassium value was observed for Kuttanad thigh meat. In both groups of ducks, significantly higher (P<0.05) levels of calcium and phosphorus were seen in breast meat when compared to thigh meat. Similar phosphorus levels were observed in breast and thigh meat of both groups of ducks. Stadelman et al. (1988) studied mineral composition of meat of broiler ducks with skin and observed similar phosphorus values in breast and thigh meat.

Sensory Evaluation

Colour

A lower colour score on sensory evaluation was obtained for Kuttanad duck meat and might be due to darker colour of meat. This might be due to more red fibres in their muscles and results were in agreement with findings of Forrest et al. (1975). Breast meat showed higher colour scores compared to thigh meats in both groups of duck, however, the difference was significant (P<0.05) only in Vigova ducks.

Flavour

Scores were more for Kuttanad duck meat compared to Vigova for both breast and thigh meat. This might be due to the higher lipid and haematinic pigment contents which would have con-

tributed to the increased flavour. Also, higher slaughter age of Kuttanad ducks might have contributed to more flavour scores, since flavour compounds in meat increased as animal aged which were supported by findings of Aberle et al. (2001) and Warriss (2000).Thigh meat showed higher flavour scores compared to breast meat in both groups of ducks. Highest flavour score was in Kuttanad thigh meat and lowest in Vigova breast meat. Thigh meat with higher lipid content and along with the increased phospholipid level might have contributed to the increased flavour.

Juiciness

Highest juiciness score was obtained for Kuttanad thigh meat and lowest for Vigova breast meat. Higher WHC along with higher intramuscular lipid levels of Kuttanad duck meat, especially of thigh meat might have contributed to increased juiciness scores which agreed with the findings of Forrest et al. (1975). There was significant difference (P<0.05) in juiciness scores between breast and thigh meat in both groups of ducks which might be due to higher intramuscular lipid levels of thigh meat in the study.

Ease of Fragmentation

Value was lower for Kuttaand meat which might be due to the increased connective tissue content in Kuttanad duck meat due to higher slaughter age and was in agreement with Forrest et al. (1975). Breast meat showed higher scores compared to thigh meat in both groups of birds. It might be due to increased connective tissue content in thigh meat (Forrest et al., 1975 and Aberle et al., 2001).

Mouth Coating

Highest score (least mouth coating) was obtained for Vigova breast meat and lowest for Kuttand thigh meat. Scores were more for Vigova compared to Kuttanad, in both breast and thigh meat. It might be due to increased connective tissue content in Kuttanad duck meat due to higher slaughter age (Forrest et al., 1975 and Aberle et al., 2001). In both groups, scores were significantly higher (P<0.05) for breast meat which might be due to less connective tissue content in breast meat when compared to thigh meat.

Overall Tenderness

Highest score was obtained for Vigova breast meat and lowest for Kuttand thigh meat and might be due to small muscle fibre size of Vigova duck meat.This might also have contributed to increased tenderness score on sensory evaluation. Breast and thigh meat in both groups of ducks also showed significant difference (P<0.05) in overall tenderness scores with breast meat showing higher scores. This might be due to lower connective tissue content in breast meat.

Overall Acceptability

Scores were more for Vigova breast and thigh meat compared to those of Kuttanad ducks. This might be due to increased overall tenderness scores for Vigova meat, though flavour and juiciness scores were higher for Kuttanad duck meat. In both groups of ducks, breast meat had significantly higher (P<0.05) overall acceptability scores when compared to thigh meat. This might also be due to increased tenderness of breast meat. Similar findings were reported by Joseph et al. (1997) on frozen duck meat and Omojola (2007) in Rouen, Pekin and Muscovy duck.

Table 1: Physico-chemical characteristics of Vigova Super M and Kuttanad duck meat

Parameters	Treatment mean values			
	Vigova breast	Vigova thigh	Kuttanad breast	Kuttanad thigh
pH, 30 min	6.23 ± 0.01^{ab3}	6.30 ± 0.01^{c3}	6.22 ± 0.03^{a2}	6.29 ± 0.04^{bc2}
pH, 6 h	5.96 ± 0.02^{a2}	6.05 ± 0.02^{b2}	5.98 ± 0.01^{a1}	6.13 ± 0.02^{c1}
pH, 24 h	5.83 ± 0.03^{a1}	5.98 ± 0.02^{a1}	5.95 ± 0.02^{b1}	6.11 ± 0.02^{c1}
WHC, 30 min (M/T)	0.22 ± 0.02^{a1}	0.26 ± 0.02^{b1}	0.37 ± 0.04^{c1}	0.44 ± 0.04^{c1}
WHC, 6 h (M/T)	0.24 ± 0.02^{a1}	0.29 ± 0.03^{a1}	0.34 ± 0.04^{b1}	0.42 ± 0.03^{c1}
WHC, 24 h (M/T)	0.23 ± 0.03^{a1}	0.28 ± 0.04^{b1}	0.30 ± 0.34^{b1}	0.40 ± 0.03^{c1}
MFI#, 30 min	714.64 ± 6.00^{a3}	746.76 ± 9.58^{b3}	827.20 ± 5.06^{c3}	840.62 ± 6.44^{d3}
MFI, 6 h	632.55 ± 8.80^{a2}	676.38 ± 9.80^{b2}	762.11 ± 11.82^{c2}	774.10 ± 12.63^{c2}
MFI, 24 h	566.71 ± 8.00^{a1}	619.88 ± 9.57^{b1}	664.62 ± 18.45^{c1}	676.57 ± 24.32^{c1}
Fibre diameter (µm)	40.81 ± 0.31^{b}	38.10 ± 0.61^{a}	57.04 ± 2.05^{d}	52.57 ± 2.09^{c}
Sarcomere length (µm)	1.73 ± 0.14^{a}	1.81 ± 0.01^{b}	1.81 ± 0.02^{b}	1.89 ± 0.05^{b}
L*	47.43 ± 0.26^{c}	45.22 ± 0.37^{b}	41.35 ± 0.63^{a}	43.91 ± 0.55^{b}
a*	11.68 ± 0.30^{a}	13.44 ± 0.17^{b}	12.50 ± 0.35^{a}	15.45 ± 0.38^{c}
b*	10.12 ± 0.44^{a}	12.07 ± 0.44^{c}	9.63 ± 0.85^{a}	11.15 ± 0.86^{ac}
Cooking loss (%)	33.25 ± 0.37^{c}	35.52 ± 0.34^{d}	27.12 ± 0.60^{a}	29.44 ± 0.92^{b}
Moisture	76.82 ± 0.26^{c}	75.76 ± 0.22^{b}	74.26 ± 0.32^{a}	73.66 ± 0.26^{a}
Protein	19.46 ± 0.19^{a}	20.32 ± 0.19^{bc}	20.27 ± 0.24^{b}	20.83 ± 0.20^{c}
Fat	1.26 ± 0.03^{a}	1.48 ± 0.03^{b}	3.05 ± 0.07^{c}	3.12 ± 0.10^{c}
Ash	0.92 ± 0.01^{a}	0.95 ± 0.02^{a}	1.11 ± 0.03^{b}	1.30 ± 0.62^{c}
Carbohydrate	1.53 ± 0.19^{ab}	1.48 ± 0.08^{b}	1.32 ± 0.11^{ab}	1.10 ± 0.10^{a}
Cholesterol	57.90 ± 0.49^{a}	61.66 ± 0.67^{b}	65.57 ± 0.62^{c}	67.88 ± 0.83^{d}
Sodium	67.15 ± 0.88^{a}	69.71 ± 1.52^{a}	79.9 ± 1.0^{b}	80.93 ± 1.10^{b}
Potassium	222.77 ± 4.42^{a}	232.29 ± 8.27^{ab}	239.58 ± 4.08^{b}	253.18 ± 3.62^{c}
Calcium	19.96 ± 0.40^{b}	15.33 ± 0.40^{a}	18.87 ± 0.77^{b}	14.87 ± 0.32^{a}
Phosphorus	223.78 ± 4.84^{a}	213.66 ± 6.15^{a}	220.39 ± 5.16^{a}	216.55 ± 4.83^{a}

Means bearing identical alphabets in the rows and numbers in the column do not differ significantly (P<0.05).

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Table 2. Sensory attributes of Vigova and Kuttanad duck meat

Parameters	Treatment mean values			
	Vigova breast	Vigova thigh	Kuttanad breast	Kuttanad thigh
Colour	7.28±0.14^{c}	6.59±0.07^{b}	5.61±0.15^{a}	5.59±0.20^{a}
Flavour	5.87±0.13^{a}	5.99±0.11^{a}	6.49±0.14^{b}	6.99±0.88^{c}
Juiciness	6.18±0.12^{a}	6.52±0.18^{c}	7.02±0.09^{b}	7.08±0.15^{c}
Ease of Fragmentation	6.77±0.14^{c}	6.45±0.08^{c}	5.79±0.10^{b}	5.27±0.20^{a}
Mouth Coating	6.96±0.15^{d}	6.54±0.10^{c}	5.59±0.13^{b}	5.14±0.17^{a}
Overall Tenderness	7.06±0.13^{d}	6.48±0.10^{c}	5.67±0.16^{b}	5.23±0.16^{a}
Overall Acceptability	7.34±0.10^{d}	6.43±0.11^{c}	6.01±0.12^{b}	5.23±0.20^{a}

Means bearing identical superscripts in the rows do not differ significantly (P<0.05).

Comparison of meat quality characteristics revealed lower MFI and fibre diameter values and higher scores for tenderness and overall acceptability on sensory evaluation, for Vigova duck meat. This could be due to the younger age and broiler characteristics of these ducks. Kuttanad duck meat showed comparatively lower value for moisture and higher values for protein, fat, ash, cholesterol and sodium. Meat from Kuttanad ducks had higher flavour and juiciness scores and lower overall tenderness and acceptability scores. It can thus be concluded that Vigova ducks could be used ideally as a broiler bird, mainly suited for grilling or frying due to its tender meat and Kuttanad duck, after its economic egg laying period could be slaughtered for meat production for comminuted meat products.

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