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Physico-chemical and Instrumental Colour Properties of Emu Meat

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ABSTRACT

The present study was conducted to analyze the physico-chemical and colour properties of emu meat. The leg, back and breast portion along with a uniform mix of these three cuts were taken for evaluation of emu meat quality in respect to various physico-chemical parameters. The pH of breast meat was found significantly ($P<0.05$) lower than meat from leg and back portion. Water holding capacity of leg meat was significantly ($P<0.05$) higher than back and breast meat. The breast meat had significantly ($P<0.05$) higher shear press value (98.99 N) than other portions meat. Myoglobin and metmyoglobin were found from 7.02 to 8.95 mg/g and 28.39 to 45.70 % respectively. The lightness value of breast meat was higher than leg and back meat. Thus, results showed the good acceptability of emu meat in category of red meat and can be an alternative to other meat.

Keywords: Emu meat, water holding capacity, myoglobin, colour

Non-vegetarian diet loving people in India have a craving for the variety of meat and meat products. Sometimes, available products from mutton, chevon and broiler meat are not able to satisfy their palate. In this regard, emu meat can be a better option for an alternative source of meat. Emu (*Dromaius novaehollandiae*), a native bird of Australia was traditionally farmed for the production of feathers, high quality leather and fat. But recently, it has been adopted in many countries for meat. Emu meat is recognized as a healthy alternative to other red meats due to its leanness, low cholesterol and favourable fatty acids (Sales and Horbanczuk, 1998). Intramuscular lipids of emu drumstick contain higher level of linoleic, arachidonic, alpha linolenic and decosahexaenoic acids than those of chicken drumsticks and beef steak. The ratio of unsaturated fatty acids (USFA) to saturated fatty acids (SFA) in emu meat has been reported to be higher than chicken meat and beef (Wang *et al.,* 2000). It is a better source of heam iron than beef and its consumption is recommended by American Heart Association because of its low fat and cholesterol content (Pegg *et al*., 2006). In spite of its healthy composition, emu farmers are finding it difficult to market the new source of meat (Daniel *et al*., 2000). Therefore, popularization and marketing of emu meat products are essential for the sustainability of emu based industry. Buffalo meat and mutton are the red meats of choice for various communities in India. So, emu meat can be a suitable alternative to these red meats. Moreover, it can provide some special delicacy to consumers demanding a variety of meat. Hence the present study was conducted to analyze the quality of emu meat from the leg, back and breast portion with respect to physico-chemical and colour properties.

MATERIALS AND METHODS

Emu meat

Emu male birds of around 14 months of age and weighing approximately 35 kg were procured from emu farm in Hisar. They were slaughtered and dressed as per standard procedure in the slaughterhouse of Department of Livestock Products Technology, Lala Lajpat Rai University of Veterinary and Animal Sciences. Carcasses were washed thoroughly and separated into the leg, back and breast portion. Cut up parts deboned manually after trimming of visible fat. Along with the cut parts, a uniform mix of these three deboned cuts was also made to represent the whole meat. All meat samples were frozen and stored in a freezer (−18 °C) for further studies.

Physico-chemical properties

The pH was determined according to method of Trout *et al*. (1992) by using Eutech pH meter after homogenizing 10 g sample with 50 ml distilled water by using IKA T10 Basic Ultra Turrax homogenizer. Water holding capacity (WHC) was estimated as per the method prescribed by Wardlaw *et al*. (1973) using centrifuge (Eltek refrigerated centrifuge, model MP 400 R) at 5000 rpm for 10 minutes at -9 ºC. Shear press value of meat samples was measured using Texture Analyzer (TA.HD plus model, Stable Micro Systems Ltd., England). Meat samples of 15×15×15 mm size were cut by Warner-Bratzler cutting blade. A cross-head speed of 2 mm/s and 50 kg load cell was used to obtain the force time cutting curves. The maximum force required to cut the sample was taken as shear press value and expressed in Newton (Yadav *et al.,* 2016). The TBA value was determined according to the method of Witte *et al*. (1970). Cholesterol of extracted fat samples was estimated by method of Zak (1957) and was later converted to mg/100 g meat sample. For the estimation of unsaturated and saturated fatty acids, methyl esters were prepared by the method of Luddy *et al*. (1968). Methyl esters of fatty acids were separated in a Nucon-5765 gas chromatograph equipped with flame ionization detector. The ratio of unsaturated to saturated fatty acids (USFA/SFA) was calculated from the fatty acid composition of sample by addition of all unsaturated and saturated fatty acids separately. The method of Warris (1979) was adopted to estimate myoglobin in meat samples. The metmyoglobin (%) was calculated according to Trout (1989).

Instrumental colour properties

Colour was measured using a chroma meter CR-400 (Konica Minolta Sensing, Inc., Japan) with 8 mm aperture and D65 illuminant. The instrument was calibrated with a white standard plate. Meat samples of 20×20×20 mm size were evaluated for colour at room temperature. Colour scores were expressed as CIE Lab i.e. L* (lightness), a* (redness) and b* (yellowness).

Statistical analysis

The analysis was carried out in triplicates and repeated two times for each parameter. Data obtained (n=6) were subjected to analysis of variance followed by Duncan's multiple range test at 5 % significance level (Snedecor and Cochran, 1989) and results were expressed as mean ± standard deviation.

RESULTS AND DISCUSSION

Physico-chemical properties

The pH of breast muscle was significantly ($P<0.05$) lower than back and leg meat (Table 1). It was probably due to the predominant glycolytic metabolism of white fibres of breast meat and due to their high inherent glycogen content. In general, glycolysis and onset of rigor mortis are faster in white than in red fibres. White fibres mainly carry out the glycolytic pathway and their metabolism contributes to a fast pH decline (Ryu and Kim, 2005). Therefore, lower pH was observed in the breast meat. Similarly, Sulcerova *et al*. (2011) documented the lower breast meat pH than thigh meat of chicken broiler and Lesiak *et al*. (1996) also reported that the initial and ultimate pH values of leg meat were about 0.2 units higher than breast meat.

The WHC of leg meat was significantly ($P<0.05$) higher than back and breast meat, however, the whole carcass revealed intermediate WHC (9.72 %). The WHC values are indirectly related to the irrespective pH as the ultimate pH influences the structure of myofibrils and consequently, the water holding capacity of meat (Castellini *et al*., 2002; Dyubele *et al*., 2010). The decline in pH at faster rates in white fibres causes a decrease in water holding capacity (Schutte, 2008).

Shear press value of emu breast meat was the significantly highest ($P<0.05$) than shear press value of leg, back and whole meat samples (Table 1). Fitzgerald *et al*. (1999) reported shear press values from 35.4 to 61.0 N in flat fillet

Table 1: Physico-chemical properties of emu meat

Components	Leg	Back	Breast	Whole carcass
pH	6.31^{b} ±0.26	6.24^{b} ±0.09	6.01^{a}±0.12	6.19^{ab} ±0.13
WHC (%)	14.17^{b} ±4.92	8.33^{a}±4.08	6.67^{a}±2.58	9.72^{ab}±2.87
Shear press value (N)	45.10^{a}±22.13	33.99^{a}±24.95	98.99^{b} ±36.31	59.36^{a}±15.59
TBA value (mg malonaldehyde/kg)	0.22^{b} ±0.01	0.25^{b} ±0.02	0.17^{a}±0.02	0.22^{b} ±0.01
Cholesterol (mg/100 g)	170.47^{a}±35.12	143.30^{a}±87.92	107.26^{a}±28.80	140.34^{a}±34.80
USFA/SFA ratio	2.27:1	2.21:1	2.19:1	2.22:1
Myoglobin (mg/g)	8.16^{a}±1.85	8.95^{a}±3.32	7.02^{a}±1.60	8.05^{a}±1.35
Metmyoglobin (%)	37.47^{a}±18.91	45.70^{a}±8.87	28.39^{a}±16.14	37.19^{a}±10.91

(Mean ± SD, n=6)

Means with different superscript in a row differ significantly ($P<0.05$)

Table 2: Instrumental colour properties of emu meat

Colour	Leg	Back	Breast	Whole carcass
L*	31.73^{ab}±3.70	30.06^{a}±4.21	35.35^{b}± 2.54	32.38^{ab}±1.19
a*	9.33^{a}±2.53	8.92^{a}±1.50	8.85^{a}±0.79	9.03^{a}±1.47
b*	6.20^{a}±1.10	7.75^{a}±0.91	8.01^{a}±2.32	7.32^{a}±0.70

(Mean ± SD, n=6)

Means with different superscript in a row differ significantly ($P<0.05$)

and round of emu meat. Shear press values of less than 39.0 N are reported as tender cuts (Naveena *et al.,* 2013). Hence, emu meat from back portion in this study can be regarded as tender cut. However, the meat fibers in different cuts have their different inherent nature due to the variation in the physiological or functional requirements, hence had different shear press values.

The TBA value of breast meat was significantly ($P<0.05$) lower than TBA value of other cut up parts. The lower TBA value of breast meat was probably due to comparative lower fat content than leg and back cut up parts.

The cholesterol content was found variable in different cut up parts but differ non-significantly (Table 1). In whole emu muscle, 140.34 mg cholesterol/100 g of meat was observed but Naveena *et al*. (2013) reported 82.49 mg cholesterol/100 g of meat. Higher cholesterol content might be due to the higher fat content of meat. Moreover, birds procured from the farm were raised by stall feeding method and were not exposed to any free range activity, probably leading to higher fat and cholesterol accumulation in muscles. Guttman (1996) also reported higher cholesterol content in dark muscles of thigh/leg as compared to breast or white meat. Wang and Sampugna (1983) also observed that chicken dark meat showed higher cholesterol content than breast meat and visible fat.

The ratio of USFA to SFA was 2.22:1 in whole emu meat. Results are in accordance with that of Wang *et al*. (2000) who indicated the ratio of 2.22:1, 1.84:1 and 1.44:1 for emu, chicken and beef fat. Mann and miller (1999) also reported the ratio of USFA to SFA as 2.47:1. Results obtained were agreement with Ahn *et al.* (1995) who reported more unsaturation in the leg than breast meat of chicken.

Myoglobin content of breast meat was found non-significantly lowest among different cut up parts (Table 1). Pearson and Young (1989) stated that white fibres in breast muscle have lower myoglobin content and lower blood supply in comparison to red muscle fibres. However, highest myoglobin content has been reported in emu meat compared with the beef, buffalo meat, mutton, pork and chicken (Naveena *et al*., 2014).

The metmyoglobin content which is an indicator of colour deterioration was 37.19 % in whole emu meat. Naveena *et al*. (2013) indicated the metmyoglobin content of 33.03 % in frozen thawed emu meat. Berge *et al*. (1997) also reported metmyoglobin content ranging from 25 to 35 % for different emu muscles during aerobic storage. The highest metmyoglobin content of back cut up part indicated less colour stability of emu back meat than leg and breast.

Instrumental colour properties

The lightness (*L**) and yellowness (*b**) values of breast meat were recorded highest among cut up parts (Table 2). The highest lightness of breast meat was due to lower myoglobin pigment in the breast meat. Higher myoglobin content of meat resulted in more redness value of meat (Naveena *et al*., 2014). Similar results were observed by Menon *et al.* (2014) in adult emu meat. Higher myoglobin content gives emu meat a dark cherry red colour and its content has been reported to vary between species, sex, age and muscle etc. (Suman *et al.,* 2010). Ali *et al.* (2007) also observed higher *L** value and lower *a** value in duck breast meat in comparison to leg meat.

CONCLUSION

The present study concluded that meat from breast portion had lower water holding capacity and higher shear press value than meat from leg and back portion. The cholesterol, myoglobin and metmyoglobin content were observed in the range of 107.26 to 170.47 mg/100 g, 7.02 to 8.95 mg/g and 28.39 to 45.70 % respectively. The emu meat has a good potential to be used as an alternative source of meat. There is also a need to popularize the quality of emu meat.

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