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Review Article

Carcass and meat quality attributes of native sheep in Bangladesh: A review

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Abstract

Three native sheep breeds like Jamuna basin, Barind tract and Coastal belt that used to rear in semi-intensive systems in three agro-ecological zones of Bangladesh. The quality of meat is a multifactorial trait dependent on the perspective and goals of the link in the production chain. In this review an attempt has been made to present detail carcass traits and meat quality attributes of native sheep in relation to other sheep breeds. Some factors that influence carcass traits and the quality of lamb meat namely proximate component, physicochemical traits, sensory attributes and instrumental color values were considered in this review.

Introduction

Sheep is an important farm animal in Bangladesh which is a vital source of income and food, as well as the socio-economic status of poor farmers (Hossain et al., 2018a; Hashem et al., 2020). It is widely distributed throughout the world (FAO, 2008). Currently, the global sheep population is more than 1 billion heads (FAO, 2015). On a global scale, sheep meat production is small, with less than 8.6 million tonnes. The largest producers of sheep meat are China, India, Sudan, Nigeria and Pakistan. The three largest destinations for sheep meat worldwide are China, EU, and US, accounting for about 60% of global exports (FAO, 2015). Meat is the most important source of animal protein for the human diet (Hossain et al., 2018b). However, the traits that define its degree of acceptance and quality vary with the point of view and interest of the producer, trade, industry and consumers. From an industrial perspective, quality is defined and determined by objective factors relating not only to the quality demanded by the consumer, but also to industrial meat characteristics (Osório et al., 2009). In the context of the supply chain and meat science, the analysis of colour, pH, water holding capacity, cooking losses, tenderness, chemical composition, fatty acid profile among many others are all important in the concept of integrated quality and the search for more homogeneous products. The quality traits defined by the final consumer and industry depend on a long list of inherent to the animal and inherent to management, environment factors. The meat quality is defined by animal age, sex, and physiological state and the post-mortem biochemistry of muscle and fat, carcass composition, feed contribution to flavour, protein and fat levels, as well as the effect of genetics on tissues and metabolism, pre and post slaughter handling and storage, among others (Webb et al., 2005). In the case of lamb, an increase in consumption accompanied by a demand for increased quality has been observed. This situation forces the supply chain to better understand the factors affecting meat quality; we need to consider the number of factors that affect the quality of lamb meat. The main factors interfering with the quality of lamb meat are breed, sex, age, genetic characteristics and type of muscle fibers.

Lamb from native sheep breeds is very popular among followers of this type of meat because of its exceptional taste. Knowledge about the quality of raw materials from indigenous breeds can help to popularize and help to develop the market for sheep and goat products. Sheep and goats provide valuable products that are appreciated by consumers who are looking for food that is not only tasty but also healthy and lamb and goat meats are certainly one of these. Both lamb and goat meat is classified as red meat, but their organoleptic properties and nutritional composition differs. Lamb meat is juicier than goat kid meat due to higher fat content that is more acceptable. It is characterized by valuable nutritional features: high biological quality protein, micro and macro elements, L-carnitine and conjugated linoleic acid (CLA) isomers that was associated with immune-modulating, anticarcinogenic and antiatherogenic properties, prevention of diabetes and reduction of body fat (Ciliberti et al., 2021). In contrast, goat meat is considered as lean, with a similar nutritional value to sheep meat, but contains more protein, trace elements contents and less fat compared to lamb and mutton so more healthier compared to other types of red meat. It is advisable to consumers of a more sensitive health status like children, elderly, cardiovascular patients, convalescents (Ivanovic et al., 2014; Vnučec et al., 2020). The traditional production systems used for local breeds, with extensive grazing on natural pastures, also has particular importance to the quality of the meat obtained from these two species. The constraints of inadequate and poor quality feeds are associated with lower birth weight, average daily gain

(ADG) and slaughter weight and profitability of sheep farming in Bangladesh (Alemu, 2008). The increase in body temperature is associated with marked reduction in feed intake, redistribution in blood flow and changes in endocrine functions that will affect negatively the productive and reproductive performance of sheep (Alam et al., 2011; Rana et al., 2014). High ambient temperature and humidity are the major constraint on sheep productivity in tropical and sub-tropical regions (Hashem et al., 2013).

Different sheep production systems are performed world wide according to availability of grass lands, pastures and other feed resources, production specialization of the farm (milk, meat, wool or combination of these yields), consumer demands and financial conditions of the sheep farmers (Hossain et al., 2021a; Islam et al., 2019; Sun et al., 2020). The quality of a product is defined by the set of attributes that allow satisfying the consumers. It has been broken down into six core attributes *viz.* organoleptic, nutritional, safety, commercial, technological and image, the latter covering such as cultural, ethical and environmental dimensions associated with food production (Parche et al., 2022). The consumer perception about safe and quality food as well as meat is increasing day by day. The organic production of meat animal has become popular in Bangladesh. However, the management of organic production is a great challenge. Traditional sheep production in Bangladesh is based mainly on the use of natural grass lands, stubble and fallow pastures. In most of the sheep enterprises, no concentrate feed is supplied to lambs in the traditional system and lambs suckle their dams until the slaughter age. Sheep production is neglected due to the misconception of inferior quality of meat but there is very little variationin the meat quality of sheep and goat. Adequate amount and poor quality feed resources are the main constraints to sheep production under the existing systems (Katole et al., 2017). Consequently, poor feeding regime is affecting on the genetic potentiality of native sheep and breed improvement programs. Under organic agricultural systems, the main purpose is to produce higher quality food from healthy animals. In this system, animals should have access to outside areas and fed through grazing on pasture and housing conditions should allow them to perform their natural behaviour. The use of man-made fertilizers, growth regulators, pesticides, medicines and feed additives are avoided in this system (Harisha et al., 2014; Sailo et al., 2016). The outcome of debates in scientific, nutritional and sensory differences between conventional and organic production system, consumer's perception and preference plays a vital role in determining premium market value for organic lamb meat. When the lamb chop arrives at the market, it is a product of interactions among multiple factors such as breeding, reproduction, nutrition, management, animal health, environment, animal welfare and care, workers, processing method and facility. It is important for the readers to recognize these complicated interactions when make direct comparisons between traditional and organic lamb production. There was no investigation on organic and conventional production system for productive performances of lamb in Bangladesh. Pasture-fed lambs have leaner carcasses, lower dressing%, whereas concentrate-fed lambs showed higher growth rates, better carcass conformation and lower ultimate pH (Zervas and Tsiplakou, 2011). Light lambs are typical in Mediterranean country production systems (Berge et al., 2003). Their meat is pale with cute flavour (Carrasco et al., 2009). This category contains the very young suckling lambs from dairy-purpose herds that are slaughtered at 25–45 days (Sañudo et al., 1998). Heavy lambs are slaughtered at between 3 and 12 months of age usually before 8 months (Berge et al., 2003).

Carcass traits

Dressing percentage was found significantly higher ($p<0.05$) in 1.5 % compared to 0, 1 and 2 % concentrates (Hossain et al. 2023). Similar results were found by different researchers in case of dressing % (Ayrle et al., 2019; Worku et al., 2020). Costa et al. (2019) also found a significant ($p<0.05$) effect of hot carcass and dressing percentage which was very much similar with the study of Hossain et al. (2023). Gashu et al. (2017) stated that the sheep consuming higher level of concentrate supplements had significantly heavier carcass than lower level of concentrate feed. The hot carcass weight (6.36–7.73 kg) of Jamuna basin lambs was found by Hossain et al. (2023) was not higher to the Ethiopian indigenous sheep breeds might be due to the breed variation (Worku et al., 2020). Hossain et al. (2023) found higher hot carcass in Jamuna basin lambs (JBL) (7.93 kg) compared to Barind region lambs (BRL) (6.04 kg) and Coastal belt lambs (CBL) (6.56 kg). The result was not supported by the findings of Mobin et al. (2022). Both lamb types and slaughter ages had significant effect ($p<0.001$) on hot carcass weight having 6.08, 5.46 and 7.15 kg, respectively for JBL, BRL and CBL (Mobin et al., 2022). They showed higher dressing % (46.46) in BRL compared to JBL (46.31) and CBL (45.94) whereas Hossain et al. (2022b) found higher dressing % (49.01) in CBL (49.01) compared to JBL (48.88) and BRL (48.01). Ahmed et al. (2018) found higher hot carcass weight (11.79 kg) in CBL compared to JBL (8.59) and BRL (10.36) whereas dressing % was found higher (50.44) in CBL compared to JBL (48.93) and BRL (48.86). Moniruzzaman et al. (2002) showed that the age of animal had significantly influence on dressing % and the quality of meat. Weight of edible by-products *viz.* liver, heart, spleen weight reported by Hossain et al. (2023) was similar and the kidney weight was not similar with the findings of Adem et al. (2019). Hossain et al. (2022a) found that hot carcass (kg) of Jamuna basin lambs was significantly higher ($p<0.05$) in grazing system whereas, dressing % had no statistically significance ($p>0.05$). Dressing % was higher in 9 and 12 months (47.38 and 47.04). Lamb types and slaughter ages had significant effect ($p<0.05$) on blood, skin, viscera, head, leg, pluck, neck, shoulder, rack and loin wt. % except shank where only slaughter ages had significant effect but effect of lamb types was not statistically significant ($p>0.05$) reported by Mobin et al. (2022). Hot carcass (kg) and dressing % were found significantly ($p>0.001$) increased with the increasing of age 6, 9 and 12 months (4.35, 44.36; 6.00, 45.29; 7.6, 48.15) showed by Hossain et al. (2021). These results differed to the findings of Claffey et al. (2018) where they stated that hot carcass (kg) and dressing % were 25.7 and 47.9 of 12 months aged lambs. Similar results were found by Polidori et al. (2017). The higher hot carcass was found in Jamuna basin lamb (JBL) (7.93 kg) compared to Barind region lamb (BRL) (6.04 kg) and Coastal belt lamb (CBL) (6.56 kg) reported by Hossain et al. (2022b). The result was not supported by the findings of Mobin et al. (2022). The lamb types and castration had significant effect ($p<0.001$) on hot carcass weight having 7.93, 6.04, 6.56 and 7.04, 6.64 kg, respectively for JBL, BRL and CBL. The lamb types and castration had not significant effect ($p>0.05$) on dressing % of castrated (49.58) and uncastrated (47.80) for JBL, BRL and CBL, respectively. These results were in close agreement with the findings of Claffey et al. (2018) where they showed dressing % was 45.7 and 47.6 in ram and wether at 12 months aged lambs. Goats had proportionally smaller carcasses. Sheep yielded more meat as dressing % of sheep (sheep=39.85, goat=37.22) were higher than that of Morshed et al. (2014). A similar trend of dressing percentage was stated by Hossain et al. (2023b), Kawsar et al. (2006) and Sarker et al. (2008).

Proximate components

The proximate componetns consists of dry matter (DM), crude protein (CP), ether extract (EE), ash and moisture. It is an important tool to evaluate the quality of lamb meat. Hossain et al. (2021) showed DM of Jamuna basin lambs for 6, 9 and 12 months aged 24.72, 24.26 and 27.54 %, respectively that had significantly difference (p<0.001). Hossain et al. (2022b) found DM 27.02 and 27.15% for uncastrated and castrated native lambs which was not statistically significant (p>0.05). Boby et al. (2021) found 53.67, 52.18, 50.82 and 49.78 % DM of chicken meatballs for control, 0.01% butylated hydroxitoluene (BHT), 0.05 and 1 % long coriander leaves extract during refrigerated condition. Disha et al. (2020) found 53.66, 51.99, 50.29 and 49.19 % DM of chicken meatballs for control, 0.01, 0.05 and 1 % lemon extract during frozen storage condition whereas Bithi et al. (2020) found 48.36, 47.16, 45.52 and 45.19 % DM of broiler meatballs for control, 0.01 % BHT, 0.05 and 1 % telakucha (*Coccinia cordifolia*) leaves extract treatment groups. Khatun et al. (2021) found 52.25, 50.48, 48.92 and 47.91 % DM of chicken meatballs for control, 1 & 4 %, 1 & 8 % and 1 & 12 % ginger and carrot extract, respectively. These results were not in agreement with the findings of others researchers (Disha et al., 2020; Rima et al., 2019; Sidiqua et al., 2018). Islam et al. (2022) found 21.70, 22.63, 23.50 and 24.33 % DM of gamma irradiated mutton for control, 5, 2 and 4 kGy, respectively whereas Sadakuzzaman et al. (2021) found 24.55, 25.26, 25.70 and 25.70 % DM of irradiated beef for control, 3, 5 and 7 kGy treatment groups at ambient temperature condition. Extra cellular fluid of meat might be shrinked during irradiation process, resulting in less moisture content in the muscle. As the irradiation breaks the collagen and other fibers might help to reduce or evaporate water from muscle after irradiaton (Cheung et al., 1990). Hossain et al. (2022b) found higher CP % (24.27) in JBL compared to BRL (22.55) and CBL (22.18) whereas EE % was found higher (3.78) in BRL compared to JBL (3.52) and CBL (2.94). Hossain et al. (2021) found CP and EE were 15.91, 18.12, 24.05 % and 1.45, 1.77, 3.51 % in 6, 9 and 12 months aged lambs, respectively which was significantly differed (p<0.001) whereas ash was statistically non-significant (p>0.05). Boby et al. (2021) found 22.40, 21.30, 20.20,20.09; 8.63, 8.47, 8.37, 8.09 and 1.69, 1.64, 1.62 , 1.26 % CP, EE and ash of chicken meatballs for control, 0.01 % butylated hydroxitoluene (BHT), 0.05 and 1 % long coriander leaves extract during refrigerated condition. The CP, EE and ash of chicken meatballs during frozen storage condition at different treatment were 19.87 to 22.40, 8.12 to 8.60 and 1.12 to 1.68, respectively and days of interval for CP, EE and ash were 19.25 to 20.95, 8.28 to 8.27 and 1.33 to 1.44 %, respectively (Disha et al., 2020). Bithi et al. (2020) found 19.55, 19.28, 20.04, 20.32; 10.52, 10.14, 9.21, 8.00 and 1.84, 1.67, 1.60 1.56 % CP, EE and ash of broiler meatballs for control, 0.01% BHT, 0.05 and 1% telakucha leaves extract treatment groups. Khatun et al. (2021) found 19.70, 18.56, 18.26, 18.02; 10.66, 9.90, 9.32, 8.90 and 2.19, 1.98 1.79, 1.53 % CP, EE and ash of chicken meatballs for control, 1 & 4%, 1 & 8% and 1 & 12% ginger and carrot extract, respectively. Rima et al. (2019) and Islam et al. (2019) found significant different results of CP, EE and ash for different irradiated doses (1, 2, 3.5 kGy; 1, 2, 3 kGy) broiler and chicken meat groups. The storage period was also found significant different (p<0.05).

Physicochemical traits

The physicochemical traits consist of drip loss (DL), ultimate pH, cooked pH, cooking loss (CL) and water holding capacity (WHC). Tareque et al. (2018) found ultimate pH of raw chicken at refrigerated storage condition 6.18, 5.91, 6.06, 6.15 for control, 0.2 % clove extract, 2 % garlic extract and combined 0.2 % clove extract and 2 % garlic extract whereas cooking loss was 23.05, 22.79, 22.36 and 22.61 %. These results were found significantly difference (p<0.001) both treatment and days of storage. Cetin et al. (2012) showed ultimate pH of lamb and goat meat were 5.96 and 5.87 whereas WHC % 3.67, 3.36, 3.10 and 3.81, 3.53, 3.12 for 1, 3 and 7 days of interval. Hossain et al. (2022b) found non-significant effect of castration in native lambs for drip loss %, cooking loss %, ultimate pH, coked pH and WHC % whereas Hossain et al. (2023) showed the significant (p<0.01) effect of concentrate feeds on physicochemical traits of lamb meat in their study. On the other hand, non-significant effect was found of feeding system of the performance on physicochemical traits of Jamuna basin lamb meat (Hossain et al., 2022a). Hossain et al. (2022b) found higher drip loss % (3.28) in JBL compared to BRL (2.22) and CBL (2.47) whereas cooking loss % was found higher in CBL (30.88) compared to JBL (28.99) and BRL (29.13). They found desirable ultimate pH in JBL (5.40) compared to BRL (5.83) and CBL (5.49) whereas WHC % was found higher in JBL (87.83) compared to BRL (85.26) and CBL (83.60). Jamaly et al. (2017) found ultimate pH 5.67, 5.74, 5.79, 5.83; cooked pH 5.93, 5.98, 5.97, 5.94; cooking loss 24.70, 23.58, 16.72 and 21.11% in beef meatballs for control, 5, 10 and 15 % wheat flour used as dietary fiber whereas, Sadakuzzaman et al. (2021) found significant effect (p<0.05) of irradiated beef on physicochemical traits for control, 3, 5 and 7 kGy treatment groups at ambient temperature condition. Islam et al. (2019) found ultimate pH 6.00, 5.97, 5.97, 5.97 and coking loss 20.07, 22.91, 23.57, 24.98 %, respectively in irradiated indigenous chicken meat for control, 1, 2 and 3 kGy treatment groups in which pH was non-significant (p>0.05) and cooking loss % was statistically significant (p<0.001) whereas Islam et al. (2022) found pH 5.86, 5.83, 5.77, 5.74 and cooking loss 38.58, 39.35, 40.00 and 40.76 % in irradiated mutton for control, 1.5, 2 and 4 kGy treatment groups respectively. The pH value was decreased significantly with increasing doses of irradiation (p<0.05). This is because an increase in fat values in irradiated samples caused decrease raw pH of meat (Morales et al., 2009). The cooking loss was significantly increased with irradiation doses as well as days of interval (p<0.05). Yoon (2003) reported that irradiated chicken breast showed a higher cooking loss than non-irradiated meat. This result was similar to Islam et al. (2022). Other researchers found similar ressults of pH and cooking loss in their study (Sadakuzzaman et al., 2021; Rima et al., 2019).

Sensory attributes

The sensory attributes consist of colour, flavour, tenderness, juiciness and overall acceptability. Tareque et al. (2018) found colour and flavour of raw chicken meat at refrigerated storage condition were 4.11, 4.20, 3.86, 4.08 and 3.51, 4.02, 4.19, 4.11 for control, 0.2 % clove extract, 2 % garlic extract and combined 0.2 % clove extract and 2 % garlic extract. These parameters showed statistically significant (p<0.001). Rahman et al. (2022) found mean value of colour 7.28, 7.10, 7.18, flavour 7.30, 7.20, 7.28, tenderness 7.28, 7.20, 7.18, juiciness 7.17, 7.12, 7.15 and overall acceptability 7.22, 7.15 and 7.15 in broiler and native chicken meat for 0, 50 and 100% rice dietary treatment groups. Tenderness and juiciness showed significantly differed (p<0.001). Hossain et al. (2022b) found higher colour, flavour, tenderness, juiciness and overall acceptability (3.28, 4.87, 4.89, 4.89 and 4.85) in JBL compared to BRL (2.22, 4.26, 4.11, 4.23 and 4.16) and CBL (2.47, 3.62, 3.99, 4.04 and 3.50). They found significant effect of castration in native lambs for colour, flavour, tenderness, and juiciness except overall acceptability whereas

Hossain et al. (2023a) showed the significant ($p<0.01$) effect of concentrate feeds on sensory attributes of lamb meat in their study. The non-significant effect was found of feeding system of the performance on sensory attributes of lamb meat (Hossain et al., 2022a). Jamaly et al. (2017) found colour 4.24, 4.57, 4.18, 3.90; flavour 4.11, 4.33, 4.11, 3.89; tenderness 4.00, 3.89, 4.22, 3.89; juiciness 4.62, 4.63, 4.36, 4.23 and overall acceptability 4.44, 4.53, 4.44, 3.72 in beef meatballs for control, 5, 10 and 15 % wheat flour used as dietary fiber in which colour and overall acceptability were statistically significant ($p<0.001$) whereas Sadakuzzaman et al. (2021) found non-significant effect ($p>0.05$) of irradiated beef on sensory attributes except juiciness for control, 3, 5 and 7 kGy treatment groups at ambient temperature condition. Jahan et al. (2018) found colour 3.55±0.37, 4.00±0.25, 4.17±0.28, 4.50±0.16, 4.17±0.31; flavor 3.55±0.35, 3 92±0.32, 4.08±0.31, 4.42±0.16, 4.42±0.32; tenderness 3.73±0.35, 4.17±0.25 4.33±0.35, 4.67±0.20, 4.75±016; overall acceptability 3.55±0.35, 3.92±0.32, 4.08±0.31, 4.33±0.25, 4.17±0.38 in beef meatballs for control, 0.1 % BHA, 0.1, 0.2 and 0.3 % pomegranate extract used as natural antioxidant in which colour and overall acceptability were not statistically significant ($p>0.05$). Islam et al. (2019) found colour 5.33, 6.11, 6.33, 6.33; flavour 6.33, 5.77, 5.55, 5.44; tenderness 5.55, 6.00, 5.89, 6.17; juiciness 5.88, 5.44, 6.11, 6.22 and overall acceptability 4.55, 4.77, 5.11, 5.16, respectively in irradiated indigenous chicken meat for control, 1, 2 and 3 kGy treatment groups in which all sensory attributes were non-significant ($p>0.05$) except colour value whereas Islam et al. (2022) found significant effect of colour and flavour ($p<0.05$) in irradiated mutton for control, 1.5, 2 and 4 kGy treatment groups respectively. Rima et al. (2019) found non-significant effect of all sensory attributes in irradiated chicken meat whereas Sadakuzzaman et al. (2021) showed non-significant effect of all sensory attributes but juiciness was significant ($p<0.05$) in irradiated beef sample in their research works. Islam et al. (2019) found flavour 4.56, 4.91; tenderness 5.12, 5.72; juiciness 5.09, 5.06 and overall acceptability 4.82 and 5.34 of sheep meat raised in organic and traditional production systems.

Instrumental colour values

Colour measurement is more important for the visual impression of the meat than an actual quality parameter. Colour is usually measured in the CIE Lab L*, a*, b* scale where L* denotes the lightness, a* the redness and b* the yellowness. The colour values obtained from image analysis in beef were 50.75±3.43, 13.08±6.96, 13.66±2.33 for L*, a*, b* respectively (Rahman et al., 2020). The L*, a*, b* values from direct measurement using colorimeter were 41.67±4.08, 14.35±2.1 and 10.44±1.89, respectively (Rahman et al., 2020). Fatih et al. (2016) found 48.90, 24.21 and 12.31 for L*, a*, b* respectively from image analysis and 46.73±1.01, 21.94±1.24 and 13.11±1.00 for L*, a*, b* respectively from direct measurement. Kamruzzaman et al. (2016) stated L*, a*, b* values for beef were 47.25±5.19, 15.81±2.25 and 7.56±3.29 respectively. Hossain et al. (2022b) found higher CIE L* value (49.62) in BRL compared to JBL (47.34) and CBL (48.26) whereas higher CIE a* and CIE b* value was found in CBL (17.46, 11.86) compared to JBL (15.10, 9.85) and BRL (16.90, 8.12). The L* and a* values found from colorimeter by Weglarz (2010) were 37.40±1.38 and 13.44±2.07, respectively. Hossain et al. (2022a) found CIE L*, a* and b* values of lamb meat in grazing and stall feeding systems 43.56, 41.48; 22.63, 14.83; 16.62, 11.52, respectively in which a* and b* values were statistically significant ($p<0.001$) but CIE L* value was not statistically significant ($p>0.05$). The hue angle and saturation index were 28.59, 32.16, 27.64, 21.23 in same rearing systems of lamb. The saturation index value was statistically significant ($p<0.001$) whereas hue angle was not statistically significant ($p>0.05$). According to CIE the values of L*, a*, b*, hue angle and saturation index at different treatments (0%, 15%, 1.5% and 2% concentrate feed) were ranged at 42.03–51.81, 15.83–18.15, 9.27–12.71, 20.75–26.11 and 16.78–22.65, respectively (Hossain et al., 2023). All these values were found significantly difference ($p<0.05$). Costa et al. (2019) found that the CIE L*, a* and b* values of unweaned lambs and supplemented weaned lambs were 41.67 & 43.17, 15.23 & 15.98 and 6.34 & 6.55, respectively. The higher hue angle and saturation index were found in control group than treatment groups. The higher hue angle and saturation index were found significantly difference ($p < 0.01$) among all treatments groups. The hue angle and saturation index values were not influenced by the higher concentrate supplemented groups (Gashu et al., 2017). Hossain et al. (2021b) showed that L*, a* and b* values were found 46.54, 13.84, 9.07; 44.31, 14.14, 11.34, and 41.13, 18.08, 12.47 in three treatments (6, 9 and 12 months of age), respectively which was significantly ($p<0.05$) differed. Emami et al. (2015) reported that the function of CIE a* and b* values and the hue angle value might be provided more realistic information regarding meat browning than single colour values. In their study, the conventional meat had higher hue angle and therefore, meat was lighter. The hue angle from 6 months aged lambs had significantly higher ($p<0.001$) than other two groups. The 12 months lambs had significantly higher ($p<0.001$) saturation index (SI) value than that of 6 and 9 months aged lambs which indicates more colour intensity. This result was similar to Kopuzlu et al. (2018) where they reported that SI value increased with the increasing of age.

Conclusion

Many factors influence the carcass traits and sheep meat quality. The factors such as breed, sex, age and weight at slaughter, genes, muscle fiber and meat quality must be considered in management practices. Due to the influence of these factors on meat traits, standards of quality must be known by lamb producers in order to define the type of animal required to meet the demands of consumers. Many researchers found variations on carcass traits and meat quality in their research works. The variation of carcass traits and meat quality of sheep meat must be minimized by providing proper management practices, improved feeding and skill labour, hygienic slaughtering and processing strictly maintained from farm to laboratory. From different study it can be concluded that there is no significant difference in carcass traits and meat quality in traditional and organic production systems. The sensory evaluation of meat indicated that the meats from traditional production system were more acceptable by the panelists according to flavour acceptability, odour intensity and overall acceptability than the meat from organic production systems. Consumers have a range of different needs, perceptions and preferences, but they are concerned towards more ethical and friendly environment with alternative food systems (organic farming, community supported agriculture and local food markets) along with the dominant agro-industry systems. In conclusion, the study reflects the superiority of JBL over BRL and CBL in terms of overall carcass traits and meat quality attributes in Bangladesh.

Connflicts of Interest

The authors declare that there are no potential conflicts of interest.

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