Effect of Different Sources of Red Meat Used in Preparing 'Serunding Daging' (Spiced Shredded Beef) on Physicochemical Characteristics and Consumer Perception

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Abstract

This study was conducted to investigate physicochemical properties of 'serunding daging' (a Malay Cuisine made of spiced shredded beef, SSB) made from *semitendinosus medius* (SM) frozen block. Three sources of red meats used in this study were local supplied beef, imported carabeef, and 'imported beef' as claimed by the shredded beef factory. pH levels of SM from all raw beef sources were between 5.28-5.89; with local beef significantly higher than the other two (5.89; $p<0.05$). The results indicated local beef had the lowest crude fat (15.34%; $p<0.05$) and the highest crude protein (19.56%; $p<0.05$). While the moisture content from all three sources of beef was comparable ($p>0.05$). Redness (a*) values of raw beef was comparable (13.28-13.73; $p>0.05$) but higher in cooked imported beef (9.18; $p<0.05$). DL of local beef, imported beef and carabeef was 12.38%, 11.84% and 11.36% respectively; cooking losses of local beef was significantly lowest (25.39%, $p<0.05$). Differences in sensory evaluation regarding consumer perception were no different. In conclusion, all these three sources of red meats are suitable for spiced shredded beef products.

Keywords: Imported beef, carabeef, shredded beef, physicochemical characteristic, consumer perception

Introduction

The sources of red meats in Malaysia are buffalo and mostly cattle. However, the current cattle population in Malaysia is insufficient to fulfil the demand for red meat. Several probable constraints causing the low supply from the local beef producers are inadequacy of suitable land for grazing to maintain a large population of breeding cows, low supply of quality breeding stock, and irregular supply of high nutritive value of feed (Ariff et al., 2015; Dahlan et al., 1986). Many strategies proposed to boost beef production yielded no significant impact on the domestic beef supply.

To address this problem, an efficient marketing system in the value chain from farm to fork has been expanded to align with the Idea, Creativity, Innovation, and Commercialization (ICIC) ways as proposed by Dahlan (2019). Many entrepreneurs chose to meet the demand by involving in the production of processed food products including spiced shredded beef (SSB) locally known as 'serunding daging'. To ensure a sustainable supply of beef sources at a reasonable price, SSB manufacturers diversified their sources of beef meat. However, this marketing strategy could be confusing as prices between shredded beef from local beef and imported beef are quite different.

Numerous studies reported that Malaysia has tightened the imports of buffalo meat or carabeef from India. Ariff et al. (2015) mentioned that 70% of the shortfall in Malaysia domestic supply of red meat was caused by carabeef importation from India with different prices and qualities. The use of carabeef in the shredded beef industry has raised some issues since beef and carabeef cannot be easily differentiated. Most of the shredded beef manufacturers claimed that their imported red meats are not carabeef even though the label on the imported beef packaging is written Caribou beef. Moreover, study regarding shredded beef is scarcely reported in Malaysia. Hence, the objective of this study was to compare physicochemical characteristics and consumer perception on spiced shredded beef prepared from beef (cattle meat) and carabeef (buffalo). Based on the results, a suitable source of red meat could be proposed to make shredded beef.

Materials and Methods

Sample preparation

Meat sources: Three sources of meat (*Semitendonosus medius*), from local beef, imported carabeef, and imported Australian beef were obtained from the local market in the form of a frozen block, stored at approximately -20ºC. The samples were thawed at (5 ± 1ºC) overnight before further processing.

Cooked sample preparation

Cooking

The meat samples were prepared according to the cooking procedures and recipe suggested by the SSB factory. The meats were boiled in water (1.5 litres to 1.0 kg of meat) for 3 hours at a temperature of 72ºC which is similar to the ideal internal temperature for beef suggested by Shahrai et al. (2021) for biological safety. After boiling the meat, samples were rested for 15 minutes.

Preparation of shredded beef

The cooked beef samples were shredded into and formed bundle of strings. While the palm oil was pre-heated to 200ºC to cook with beef at a 1:0.8 ratio. The mixed spices recipe was added in the ratio of 1:10 (100 g of spices to 1000g of beef), and 200g of ground onion on a DM basis was mixed to every 100g of spices used. The continuous mixing and pounding were monitored approximately in one (1) hour until the beef strands disengaged and turn into shreds. Then, the sample was rest for 1 hour, packed, and labelled for further analysis.

Proximate analysis

The raw beef samples and freshly prepared shredded beef were analyzed for moisture, ash, crude protein (CP), and crude fat (CF) according to AOAC (2012). The Kjeldahl method was used in crude protein analysis while the Soxhlet method was used for lipid content analysis. Ash was determined by prolonging the heating of dry matter used in moisture content analysis to ash the sample in a furnace (550 ± 5ºC) and was left overnight. The moisture content was determined by drying the samples overnight at 105ºC.

pH and colour analysis

A pH-meter with a glass electrode was automatically standardized for pH 4.6 and 7.0

and corrected for determined pH values, taking into account the muscle temperature. The samples colour was tested using computer colour vision (Konica Minolta CR-10 series; Japan). The colourimetric characteristics included lightness (L*), redness (a*), and brightness (b*).

Water holding capacity (WHC) analysis

The water holding capacity was analyzed according to drip loss and cooking loss percentage. Cooking loss (%) was measured as suggested by Omojola et al. (2014) and Shahrai et al. (2020). Beef samples were removed and equated at room temperature (28^{o}C) as the following formula:

$$\text{Drip loss} = \frac{\text{frozen wt} - \text{thawed wt}}{\text{frozen wt}} \times 100$$

$$\text{Cooking Loss} = \frac{\text{Thawed wt.} - \text{cooked wt}}{\text{Thawed wt}} \times 100$$

Warner-Bratzler shear force (WBSF) analysis

All samples were analyzed for shear force by pressing the load parallel to the longitudinal axis of the samples, using a TA-XT2 texture analyzer (Texture Technologies Corp., Godalming, UK) with 1-mm thick of Warner-Bratzler shear blade; 4.0 mm/s distance with 5g force. The texture was determined by peak force during the first compression cycle as outlined by several studies (Shahrai et al., 2020; Warner, 2014; Yusop et al., 2012).

Consumer perceptions

The sensory assessment was conducted by recruiting untrained panellists (n=47) from several working backgrounds such as owners of several SSB factories, shredded beef sellers, staff of the Department of Veterinary Services in Kota Bahru, Kelantan, and lecturers in meat study. The panellists were female (n=33) and male (n=14).

The panellists were asked to identify and differentiate the three SSB samples presented. The panellists must perform the test at least twice, receiving a different randomized serving order. Each sample was duplicated and served on the sensory tray with control. All samples were wrapped with aluminium foil and put in an unlidded container to reduce bias such as the mixture of odour. The panellists were provided with toothpicks, serviette, palate cleansers (a cup of plain water and unsalted cracker) to reduce the carry-over effect from the previous samples as suggested by several studies (Aminah 2000, Shahrai et al., 2021, Yusop et al., 2009a, Yusop et al., 2009b, Yusop et al., 2010, 2012).

Each panellist received a set of sample ballots (single sheet) and samples, labelled A to F, to eliminate bias due to the order of presentation. Before the sensory evaluation started, the panellists were briefed about each attribute in sensory ballots. The study reported the final decisions from the panellists based only on their perceptions. They were required to fill out a questionnaire regarding the SSB samples. The information was then collected, tabulated, and presented as percentages.

Statistical analysis

The data obtained were analyzed using one-way Analysis of Variance (ANOVA), followed by DUNCAN Multiple range test via SPSS 25.0 (SPSS Inc., Chicago, IL) for significance differences at $p<0.05$.

Results and Discussion

Nutrient content

The CP content of the raw meat samples ranged between 18.5 to 19.6% as shown in Table 1. There was no significant ($p>0.05$) difference found between the imported beef and carabeef; while local beef has a significant ($p<0.05$) highest CP%. This data was in the line with Pighin et al. (2016) and Williams (2007), who reported that the meat contains around 19% and 20 to 25%, respectively. The CF content of the shredded meat samples ranged between 15.3 to 18.5%; with local beef and carabeef having the least and the highest fat content respectively. Imported beef has the highest ash content compared to carabeef and local beef. Shredded beef is a type of nutrient-dense product and it is most likely a reflection of the raw meat that it is made from (Omojola et al., 2014). In the current study, different sources of beef were hypothesized to contribute to different chemical characteristics of shredded beef products. In general, the chemical composition of raw beef or carabeef consists of more than 70% of moisture, 15-19-22% of protein, and 5-34% of fat (Dahlan et al., 1988, Lapitan et al., 2007).

Table 1. The nutrient content of raw beef and spiced shredded beef from three different sources of beef based on wet-basis (Mean ± SE)

Items		Local Beef	Carabeef	Imported Beef
Raw beef (Non-Cooked)	Moisture	81.46 ± 0.35^{a}	79.06 ± 3.60^{a}	79.08 ± 2.32^{a}
	Ash	4.97 ± 0.13^{c}	8.95 ± 0.36^{b}	9.87 ± 0.25^{a}
	Crude Fat (%)	15.34 ± 0.05^{b}	18.48 ± 0.04^{a}	18.30 ± 0.03^{a}
	Crude Protein (%)	19.56 ± 0.23^{a}	18.79 ± 0.21^{b}	18.49 ± 0.18^{b}
Spiced shredded beef (Cooked)	Moisture	13.56 ± 0.17^{a}	13.00 ± 0.17^{b}	11.95 ± 0.12^{c}
	Ash	4.32 ± 0.18^{a}	4.32 ± 0.17^{a}	4.35 ± 0.13^{a}
	Crude Fat (%)	19.25 ± 0.22^{a}	17.36 ± 0.77^{a}	17.44 ± 0.88^{a}
	Crude Protein (%)	31.94 ± 0.7^{a}	27.17 ± 0.56^{b}	26.11 ± 1.91^{b}

[a,b,c] Means in the same row with different superscripts are significantly different ($p<0.05$)

There were significant differences ($p<0.05$) between CP% of the SSB from different red meat sources. According to studies, the protein content of lean and cooked meat was 18 to 30% (Ahmad, Imran & Hussain 2018, Williams 2007). Cooked red meat contains 28 to 36% because the water content decreases and nutrients become more concentrated during cooking. Muscle protein can be divided into three groups based on its solubility, which are sarcoplasmic protein (30%), myofibrillar protein (55%), and stromal protein or muscle tissue (15%). Meat protein is the second-largest source of protein (Baldwin 2012, Ismail et al., 2019). After the raw meat has been processed, the moisture content becomes less due to cooking pressure. The crude protein was higher could be due to the interaction of meat other ingredients (Huda et al., 2012, Omojola et al., 2014) however, it was uncertain in this current study.

There were noticeable significant percentage changes in moisture and ash percentage of raw meat compared to cooked meat as all these three types of samples; local beef, imported beef, and carabeef decreased by 100%, 84.88% and 83.56% and 13.10%, 55.93%, 51.73%, respectively. The nutrient profile of the samples increased over their raw meat counterparts. CP% increased by 63.29%, 41.21%, 44.60% while CF% increased by 25.50 % for local beef but decreased in imported beef and carabeef over their respective raw meat. Based on the results, shredded beef is considered a nutrient-dense product. There were no significant differences ($p>0.05$) in CP%, ash, and fat contents of the shredded beef were probably a reflection of the reactions between raw beef and the added spices in the study.

According to Shahrai et al. (2020), the shrinkage of beef muscle size is affected by the source of beef, which is related to the increase of end product toughness. This study also found that the fat content of shredded beef followed a similar trend observed in the sausages made with beef (Omojola et al., 2014). Carabeef and imported beef initially had higher fat content than local beef. Consistent with Shahrai et al. (2020) fat content influenced fat retention and water retentions which may contribute to product quality assessment as mentioned in Shahrai et al. (2021). Another study highlighted that during a frying process, a substance with initial high fat absorbs less fat from the frying medium and vice versa (Omojola et al., 2014, Huda et al., 2012).

pH and colour

The most important traits of meat quality are pH and the colour of samples (Table 2). The pH of local beef was significantly ($p<0.05$) lower than the imported beef (pH 6.57) while carabeef (pH 5.62) showed no significant difference ($p>0.05$) in pH compared to the imported beef. The pH range was similar to the values obtained in previous studies, in which the pH values of beef, Caribou, or carabeef were ranged between pH 5.48 to 6.0 (Dahlan et al., 1988, Lapitan et al. 2007).

Table 2. The mean pH and values of instrumental colour parameters and Warner-Bratzler shear force of non-cooked (raw) and cooked beef (spiced shredded beef) from three different sources of beef (± SE).

Items			Local Beef	Carabeef	Imported Beef
Non-Cooked	pH		5.89 ± 0.07^a	5.67 ± 0.01^b	5.62 ± 0.03^b
	Colour				
		L*	29.87 ± 0.78^a	31.31 ± 2.82^a	30.44 ± 2.16^a
		a*	13.73 ± 1.03^a	13.28 ± 0.74^a	13.92 ± 1.18^a
		b*	14.07 ± 0.55^a	14.91 ± 0.65^a	13.29 ± 0.36^a
Cooked	pH		6.56 ± 0.029^a	6.34 ± 0.101^b	6.28 ± 0.06^b
	Colour				
		L*	20.98 ± 0.26^a	21.57 ± 0.72^a	20.57 ± 0.36^a
		a*	5.98 ± 0.44^b	9.18 ± 0.31^a	6.65 ± 0.23^b
		b*	6.52 ± 0.55^b	11.11 ± 0.65^a	6.64 ± 0.36^b

[a,b,c] Means in the same row with different superscripts are significantly different ($p<0.05$)

The lightness of meat (L*) from all samples were more than 25.00. This was explained by Dahlan et al. (1988), in which the SM muscle of buffalo beef or carabeef was lighter than the *Longissimus dorsi* (LD) muscle part. In the aspect of beef and carabeef differences, this study found that the lightness of imported beef and carabeef was comparable and higher than the local beef.

There was a significant difference in lightness (L*) between the local beef and other samples, in which the local beef had a significant lowest L* value. However, no significant difference ($p>0.05$) was found between carabeef and imported beef. The result could be explained based on the amount of fat in red meat. Fat plays an important role in giving the red meat colour lightness and surface appearance of beef (Dahlan et al., 1988; Shahrai et al., 2021). After being processed into shredded beef, the appearance and the L* value may be related to how non-meat ingredients interacted with meat components throughout the heating process, particularly during drying and mixing with spices (Huda et al., 2012). The most preferred shredded beef colour is golden brown or reddish-brown and the ultimate product colour is the best appearance to attract customers (Sukisman et al., 2014, Shahrai et al., 2021). This product development could be categorized as ICIC ways mentioned by Dahlan (2019), which contributes to the commercialization of animal protein foods and animal goods.

Water holding capacity (WHC)

The cooking loss was significantly different ($p<0.05$) between imported beef and carabeef (Table 3).

Table 3. Drip Loss and Cooking Loss of three different raw beef samples from different sources (Mean ± SE)

Items	Drip Loss	Cooking Loss
Local Beef	12.38 [a] ± 1.25	25.39[b]±0.56
Carabeef	11.36[a]±0.11	30.71[a]±0.56
Imported Beef	11.84[a]±0..37	32.38[a]±2.17

[a,b,c] Means in the same row with different superscripts are significantly different ($p<0.05$)

Local beef was observed to have a higher WHC to retain its intrinsic water during shredded beef preparation. Lapitan et al. (2007) found that beef had higher WHC compared to carabeef. In addition, there were several reports found that goat meat and mutton have higher WHC than beef (Omojola et al., 2014, Karakaya et al., 2006). It should be noted that meat with lower WHC is more undesired because it produces a lower product yield. However, the percentages of drip loss between the samples were not significant ($p>0.05$) due to physical aspects during handling and packaging, which were not controlled. Dahlan et al. (1988) believed that there was a significant effect of feed on cooking loss percentage related to buffalo beef and carabeef.

Shear force and consumer perceptions

Texture differences among shredded beef from different species are presented in Table 4. Hardness is the maximum strength on the first bite (Shahrai et al., 2021). The hardness of shredded beef made from local beef, imported beef, and carabeef was not significantly different ($p>0.05$).

Table 4. The texture hardness of beef and shredded beef from three different sources of beef

Items	Hardness (kgf)	
	Non-cooked	Cooked
Local Beef	584.85±1.44[b]	345.46±28.79[a]
Carabeef	434.51±1.79[a]	333.49±15.14[a]
Imported Beef	454.51±2.12[a]	338.34±16.69[a]

[a,b,c] Means in the same row with different superscripts are significantly different ($p<0.05$)

The highest hardness score was obtained by the local beef. In addition, Shahrai et al. (2020) found that beef from Malaysia Local Cattle; Kedah-Kelantan and Brahman cattle had a higher degree of hardness compared to Wagyu and Angus which might be related to end products quality as mentioned by Shahrai et al. (2021). Hence, in this study, shredded beef samples containing spices were not consistently different.

Table 5 shows the eating history of shredded beef among the recruited panellists. Interestingly, all of them had the experience of eating spiced shredded beef (SSB).

Table 5. Consumers' eating history

Items	Male (N=14)	Female (N=33)
Shredded imported beef	4	10
Shredded local beef	2	4
Shredded beef (Both local or imported)	7	17
Shredded carabeef	1	2
Never	none	none

Figure 1 addresses the consumers' perceptions of each sample. Shredded local beef was labelled as A and F, shredded imported beef was B and E, while C and D were shredded carabeef.

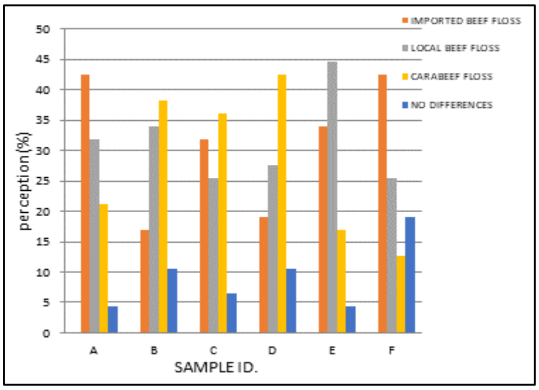

Figure 1.The consumers' perceptions of each shredded beef sample

According to the data, most of the panellists assumed that sample E was shredded local beef, shredded imported beef was sample A, while shredded carabeef were samples B, C, and D. Some panellists stated that they could not differentiate between the types of meat due to the similar appearance of the samples.

A total of 47 panellists responded to the question regarding their assumption on the different types of spiced shredded beef (SSB). Twenty respondents (42.55%) assumed incorrectly as samples A and F were shredded imported beef. They provided reasons for their selection such as the muscle fibre of samples A and F were bigger and darker than others. However, samples A and F were shredded local beef. Sample B was assumed as shredded carabeef and E was scored as shredded local beef, in which samples B and E were shredded imported beef. At least almost 4-20% of panellists responded there was no difference between every type of shredded beef. Most of the reasons given were primarily based on colour, muscle fibre size, amount of fat, leanness, general appearance, firmness, size of cut, texture, and spice coagulations. Meanwhile, most of the panellists mentioned the taste of all shredded beef samples was similar.

This study found that identical non-meat substances added to different types of red meat had a significant effect on the quality of the finished products, particularly the organoleptic features. Hence, there was no difference observed in the colour of carabeef after it was transformed into a product, even though the initial colour of carabeef is slightly different from the other types of beef. Lapitan et al. (2007) found that the beef had a slightly lighter colour than carabeef after it was being cooked plainly.

Several studies mentioned that the meat buyers preferred light coloured meat to darker meat as they choose beef rather than carabeef. However, this study suggested that the appearance could not be identified clearly, based on their end-product evaluations. From buyers' perspective, dark-coloured meat is synonymous with toughness and low-quality meat while the spices could be a factor that influenced the attractive colour of shredded beef as mentioned by several studies (Huda et al., 2012, Omojola et al., 2014). This needs to be validated because the procedure used is nonscientific. It is also necessary to clarify that the dark colour of shredded beef or carabeef was not directly related to a lower grade of meat quality.

Conclusions

The wide range of physicochemical characteristics of the shredded beef obtained in this study was contributed by the unavailability of standard operating procedures and formulas in processing shredded beef from different sources of red meat. Therefore, to produce shredded beef products with relatively similar physicochemical quality and consumer preference traits at the commercial level, standard processing steps starting from the types of beef until the shredded beef grading need to be set up to differentiate between beef and carabeef. This study also found that the imported beef used in making shredded beef was coming from imported carabeef, in which no significant differences were reported in their characteristics. Since the shredded beef product has the potential to be classified as a premium product for commercialization and export, a standard regulation needs to be implemented to differentiate between shredded local beef and shredded imported beef to ensure there are no unethical issues in the animal-based protein foods industry.

Conflicts of Interest

The authors declare no conflict of interest concerning this work.

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