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Quality Properties, Antioxidant Capacity and Total Phenolic Content of Traditional Deep Fried Shredded Meat (Abon) of Palu, Central Sulawesi

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ABSTRACT

Spices that contain antioxidant and antimicrobial properties were commonly used in Indonesia to preserve and enhance aroma of processed food. The aims of this study were to find out the quality properties (physicochemical characteristics, microbial quality and organoleptic properties), antioxidant capacity and total phenolic content of deep fried shredded beef from Palu, Central Sulawesi. Samples of deep fried shredded beef were purchased from cottage level industries in Palu and were determined its protein, fat, moisture contents; water activity value and microbial content. The antioxidant capacity and total phenolic content of best deep fried shredded beef , non-meat ingredients (mixture of spices, mixture of spices and salt, mixture of spices and salt and sugar, mixture of spices and sugar), fresh beef and uncooked shredded beef (mixed spices, salt, sugar and fresh beef) were also determined. The commercial deep fried shredded beef contained moisture (4.20-9.02%), water activity (a_w) (0.41-0.64), protein (23.98-36.39%), fat (21.55-39.00%) and the microbial count were in the range of 1.51-2.21 log CFU g^{-1}. It was found that the organoleptic traits (colour, aroma, texture and taste) were also different between samples obtained from different cottage level producers and it was due to different kind and amount of spices added during preparation. The highest antioxidant capacity (394.57 mg VCE 100 g^{-1}) was observed in mixture spices and sugar while highest total phenolic content (332.4 mg GAE 100 g^{-1}) was observed in the best deep fried shredded beef sample. It can be concluded that physicochemical and organoleptic characteristics as well as microbial quality of traditional deep fried shredded beef (abon sapi) samples produced by cottage level producers were in a very wide range and no standard operating procedures and formula available. Therefore a standard processing steps and its formula need to be set up and this product could be considered as a potential natural antioxidant source due to its high antioxidant capacity and phenolic content.

Key words: Deep fried shredded beef, quality properties, antioxidant capacity, total phenolic content

INTRODUCTION

Deep fried shredded meat or meat floss and locally in Indonesia is known as Abon is a traditional spicy dried meat which is very popular side dish in Indonesian cuisine. The most popular deep fried shredded meat is prepared from beef (abon sapi) and beside beef in some regions deep fried shredded meat also prepared from chicken, goat, pork and fish. According to Chang and Pearson (1992), Lin *et al.* (1999), Ogunsola and Omojola (2008) and Huda *et al.* (2012), there are similar products in other countries such as serunding (Malaysia), moo yong (Thailand), mahu (Phillipines), rou song (China), zou soon (Taiwan), thit heo kho tien (Vietnam) and danbunama (Nigeria).

The traditional production formula of abon are varies in each region of Indonesia and therefore no national standard of preparation of abon available. In general the preparation include boiling meat, shredded the boiled meat, mixed with spices, coconut milk, salt, sugar and deep fried in cooking oil, then pressed out the oil in the products before packed in plastic pouches. Huda *et al.* (2012) also reported that manufacture of serunding, a Malaysian deep fried shredded meat also still do not have a standard procedure.

In Indonesia the spices used are also varied in each region and the major spice added was garlic (*Allium sativum* L.) followed by red onions (*Allium cepa* L.), coriander (*Coriandum sativum*) and tamarind (*Tamarindus indica* L.) pulp and in some cottage industry, roots of Galanga (*Alpinia galanga*) and coconut (*Cocos nucifera*) milk are added. The purpose of addition of these spices and coconut milk are more in improving organoleptic properties of end products. An intensive studies on the development of preparation procedures of deep fried shredded meat or meat floss, as well as its physicochemical and organoleptic characteristics and microbial quality had been carried out and reported by Chang *et al.* (1991), Chen *et al.* (1997), Ockerman and Li (1999), Li *et al.* (2000), Ogunsola and Omojola (2008) and Huda *et al.* (2012).

Garlic (*Allium sativum* L.), red onions (*Allium cepa* L.) and pulp tamarind (*Tamarindus indica* L.) were reported containing antioxidant and antimicrobe components such as phenolic acid, quercertin, gallic acid, allicin and flavonoid. An intensive studies on antioxidant activities and components of spices include garlic (*Allium sativum* L.), onion (*Allium cepa* L.) and tamarind (*Tamarindus indica* L.) pulp had been reported by Khairunnuur *et al.* (2009), Temitope *et al.* (2010), Bayili *et al.* (2011) and Isha and Milind (2012).

These spices together with sugar and salt which were added during preparation of deep fried shredded meat could act as a preservation agent for end products. Purnomo (1983) noted that coconut (*Cocos nucifera*) sugar and cooking salt added during preparation of spicy dried meat could reduce the moisture content and a_w of end products but natural and fresh spices such as coriander (*Coriandum sativum*), garlic (*Allium sativum* L.), tamarind (*Tamarindus indica* L.) pulp and roots of Galanga (*Alpinia galanga*) which are also added did not give any significant effect on moisture content and water activity (a_w) of end products. However there are very limited informations available on the commercial abon sapi (deep fried shredded beef) produced in Palu, Central Sulawesi and therefore the aims of this study were to find out the quality properties, antioxidant activities and total phenolic content of abon sapi which produced at cottage level. The result of this study is expected could be used for improveming the quality of cottage level deep fried shredded beef product.

MATERIALS AND METHODS

Materials: Nine Samples of abon sapi (1 kg each pack) were purchased from nine different cottage level industries in Palu, Central Sulawesi, where the cottage industry was chosen using purposive random sampling as described by Nasir (2005). While the non-meat ingedients (coriander 0.45 g 100 g^{-1} fresh meat, garlic 6.82 g 100 g^{-1} fresh meat, red onion 4.55 g 100 g^{-1}

fresh meat, tamarind pulp 0.03 g 100 g^{-1} fresh meat as a mixed spices), coconut sugar 27.27 g 100 g^{-1} fresh meat, cane sugar 27.27 g 100 g^{-1} fresh meat and cooking salt 5.45 g 100 g^{-1} fresh meat were used in this study. Non-meat ingredients and fresh meat, fresh meat only and best abon sapi chosen based on physicochemical, organoleptic and microbial analysis were samples for antioxidant capacity and total phenolic content measurements.

Methods

Physicochemical analysis: Moisture, Protein and fat contents of abon sapi samples were determined using method No. 50.40, No. 992.15 and No. 960.39 (AOAC, 2000), respectively. The a_w value of abon sapi samples was measured using Rotronic Hygroscopic meter according to the method as described by Sedjati (2006).

Organoleptic test: Organoleptic test was conducted with 30 panelists (lecturers and post graduate students of Department of Animal Food Technology, Faculty of Animal Husbandry, Brawijaya University) and deep fried shredded beef were served to the panelists. The organoleptic attributes such as colour, aroma, texture and taste were evaluated on 5 point in hedonic scale scoring method (1 = dislike very much, 2 = dislike, 3 = neither dislike nor like, 4 = like and 5 = like very much) as described by Setyaningsih *et al.* (2010).

Microbial counts: Total Plate Count of deep fried shredded beef samples were determined using the method as described by Pettipher (1999). Samples of deep fried shredded beef (15 g) were taken asseptically and homogenized in 0.1% (w/v) peptone solution for 1 min. The homogenate was serially diluted and used for microorganism enumeration and nutrient agar were used for total bacteria counts after 48 h incubation at 37°C. The populations of bacteria were expressed as log CFU g^{-1}.

Antioxidant capacity and total phenolic content

Sample extraction: Samples of fresh meat, non-meat ingredients (spices, salt and sugar) or its combination and deep fried shredded beef after homogenized each was extracted in 100% methanol with the ratio of 1: 5 and the supernatants were used to determine antioxidant capacity and total phenolic content. The results obtained from three measurements of independent samples are expressed as Mean±standard deviation.

Antioxidant capacity: The antioxidant capacity of non-meat ingredients (spices, sugar and salt), non-meat ingredients mixed with fresh meat, fresh meat only and best deep fried shredded beef samples were determined using diphenylpicryl-hydrazyl (DPPH) assay as described by Tangkanakul *et al.* (2009). The DPPH assay was carried out by 0.15 mL diluted extract was added to 0.9 mL of 0.1 mM methanolic DPPH solution and the absorbance of the mixture were measured at 517 nm after 20 min. Pure methanol was used as control in this determination. The percentage of DPPH scavenging activity (%SA) was calculated following the equation:

$$\frac{(1\text{-X})}{(\text{C})}\times 100$$

where, X is extract's absorbance and C is control's absorbance. The %SA of each sample was used in antioxidant capacity determination by comparing with vitamin C as an antioxidant component and antioxidant capacity of samples were expressed as mg Vitamin C Equivalent (VCE) 100 g^{-1} fresh sample. Various vitamin C concentrations (25.4; 50.8; 101.6; 203.2 and 406.4 mg mL) were used for standard curve. The inhibition (%) of DPPH was calculated following the equation:

$$\frac{\text{(Abs control-Abs sample)}}{\text{(Abs control)}}\times 100$$

Total phenolic content: Total phenolic content was measured following the method as described by Tangkanakul *et al.* (2009). Folin-Ciocalteu reagent were used in total phenolic content of samples measurement and 2 mL of diluted samples extract were reacted with 10 mL of diluted Folin-Ciocalteau reagent in a 25 mL volumetric flask. After 8 min an amount of 8 mL 7.5% sodium carbonate was added and the volume was made up with distilled water, then the solution were heated for 30 min in a water bath at 40°C. The absorbance of developed colour of solution was then measured at 765 nm and various concentrations of gallic acid (24, 48, 72, 96 and 120 ppm) were prepared for standard curve and the total phenolic content was expressed as mg Gallic Acid Equivalent (GAE) 100 g^{-1} fresh sample.

Statistical analysis: A completely randomized design with 9 treatments (1: Fresh meat (beef), 2: Mixed spices, 3: Mixed spices+fresh meat, 4: Mixed spices+salt, 5: Mixed spices+fresh meat+salt+sugars, 6: Mixed spices+sugars, 7: Fresh meat+sugars+salt, 8: Fresh meat+salt and 9: Deep fried shredded meat) and 3 replications. Data was analysed with analysis of variance. Differences among treatments were tested with Duncan's multiple range test for significance.

RESULTS

Nine commercial deep fried shredded beef (abon sapi) samples bought from nine different cottage industries showed a wide variety of either moisture content, a_w value, protein and fat contents as well as its microbial count. The physicochemical and microbial quality of commercial abon sapi samples in Palu, Central Sulawesi were presented in Table 1. The moisture content of commercial abon sapi samples were in the range of 4.20-9.02% with a_w value of 0.41-0.64 while

Table 1: Physicochemical and microbial quality of commercial abon sapi samples in Palu, Central Sulawesi

Sample No.	Moisture content (%)	a_w	Protein content (%)	Fat content (%)	Microbial count (log CFU g^{-1})
1	6.60 ± 0.33^{b}	0.58 ± 0.02^{f}	26.16 ± 0.47^{b}	27.29 ± 0.56^{d}	2.21 ± 0.15^{a}
2	9.02 ± 0.44^{d}	0.64 ± 0.00^{g}	23.98 ± 2.46^{a}	39.00 ± 0.61^{f}	1.85 ± 0.70^{a}
3	6.19 ± 0.98^{b}	0.54 ± 0.01^{b}	30.86 ± 1.09^{cd}	33.09 ± 1.09^{e}	1.62 ± 0.31^{a}
4	6.51 ± 0.31^{b}	0.50 ± 0.00^{cd}	30.11 ± 0.69^{c}	23.65 ± 1.64^{bc}	2.12 ± 0.11^{a}
5	4.20 ± 0.38^{a}	0.41 ± 0.01^{a}	33.46 ± 0.46^{e}	24.91 ± 0.48^{c}	1.61 ± 0.21^{a}
6	6.57 ± 0.57^{b}	0.48 ± 0.00^{b}	27.07 ± 0.43^{b}	27.20 ± 1.07^{d}	1.92 ± 0.17^{a}
7	6.01 ± 0.43^{b}	0.45 ± 0.01^{b}	32.66 ± 1.00^{de}	22.39 ± 2.19^{ab}	1.83 ± 0.09^{a}
8	4.58 ± 0.25^{a}	0.42 ± 0.01^{a}	33.53 ± 0.82^{f}	26.09 ± 0.83^{cd}	1.85 ± 0.87^{a}
9	7.82 ± 0.13^{c}	0.51 ± 0.00^{d}	36.39 ± 1.00^{f}	21.55 ± 2.00^{a}	1.51 ± 0.22^{a}

Means with standard deviation followed by same superscript in one column was significant difference ($p<0.05$) and means were measured from three different samples of same home industry

Table 2: Results of organoleptic scoring test of commercial abon in Palu, Central Sulawesi

Sample No.	Colour	Aroma	Texture	Taste
1	2.24 ± 0.99^{a}	4.44 ± 0.84^{e}	1.92 ± 0.84^{a}	2.84 ± 0.97^{a}
2	4.39 ± 0.98^{e}	4.30 ± 0.83^{d}	4.12 ± 0.98^{c}	3.92 ± 0.96^{d}
3	4.11 ± 0.71^{d}	3.77 ± 0.96^{ab}	3.80 ± 0.95^{b}	3.22 ± 0.98^{b}
4	4.47 ± 0.66^{e}	4.02 ± 0.76^{bc}	3.76 ± 0.93^{b}	4.23 ± 0.65^{e}
5	3.98 ± 0.89^{cd}	3.99 ± 0.92^{bc}	3.66 ± 0.88^{b}	3.54 ± 0.96^{c}
6	3.34 ± 0.48^{b}	3.82 ± 0.98^{ab}	3.67 ± 0.95^{b}	3.47 ± 0.97^{bc}
7	4.42 ± 0.75^{e}	3.98 ± 0.65^{bc}	3.80 ± 0.99^{b}	4.11 ± 0.92^{de}
8	4.39 ± 0.65^{e}	4.14 ± 0.71^{cd}	3.72 ± 0.90^{b}	4.12 ± 0.92^{de}
9	3.86 ± 0.65^{c}	3.66 ± 0.97^{a}	3.67 ± 0.97^{b}	3.24 ± 0.94^{b}

Means with standard deviation followed by same superscript in one column was significant difference ($p<0.05$) and means were measured from three different samples of same home industry

the protein and fat contents were in the range of 23.98-36.39% and 21.55-39.00%, respectively and total microbial count was in the range of 1.51-2.21 log cfu g^{-1}. The best sample determined using index affectivity (DeGarmo *et al.*, 1984) was found in sample no 5 which had a_w value 0.41 and contained moisture 4.20%, protein 33.46%, fat 24.91% and microbial counts 1.61 log cfu g^{-1}. The formula of this sample was 4.5 g coriander, 68.2 g garlic, 45.5 g red onion, 0.3 g tamarind pulp, 27.27 g cane sugar, 27.27 g coconut sugar and 54.5 g cooking salt for 1 kg beef.

The panelists' organoleptic scores of abon sapi samples purchased from cottage level industries in Palu, Central Sulawesi were presented in Table 2. The colour scores of abon sapi samples were in the range of 2.24-4.47 from scale scoring of 1-5 and this means that the abon sapi samples were just right. Deep fried shredded meat or meat floss usually have a meaty aroma together with spicy pungent and unique combination aroma and the aroma score of abon samples were in the range of 3.66-4.44 from 1-5 scale scoring and this indicated the high acceptance of panelists. The panelists score for texture of abon sapi samples were in the range of 1.92-4.12 from scale scoring of 1-5 and this indicated that sample No. 1 (1.92) was unacceptable while sample No. 2 was the most preferable abon sapi from texture point of view. The other samples were also acceptable as its texture score were in the range of 3.66-3.80. Organoleptic test results for taste traits of abon sapi samples were in the range of 2.84-4.23 and most of samples had a taste score between 3.22-4.23 with the lowest score 2.84 was found in sample No. 1 while the highest score 4.23 was found in sample No. 4.

Antioxidant capacity of fresh meat, non-meat ingredients, uncooked abon sapi mixture and deep fried shredded beef (abon sapi) were evaluated by DPPH radical scavenging assay using various concentrations of vitamin C for standard curve and the regression line was $y = 0.0011x-0.0049$ ($R^2 = 0.9992$). While the total phenolic content were determined colourimetrically using the Follin-Ciocalteau method and various concentrations of gallic acid were prepared for standard curve and the regression line was $y = 0.0082x-0.0688$ ($R^2 = 0.9983$). The results of antioxidant capacity and total phenolic content of samples were presented in Table 3.

The highest antioxidant capacity was determined in sample of mixed spices and sugar i.e., 394.57 mg VCE 100 g^{-1}, followed by deep fried shredded beef (abon sapi): 269.30 mg VCE 100 g^{-1}, mixed spices only: 230.01 mg VCE 100 g^{-1} and mixed spices and salt: 228.70 mg VCE 100 g^{-1}, respectively. While the highest total phenol content was observed in deep fried shredded beef (abon sapi) sample (332.41 mg GAE 100 g^{-1}), then followed by mixed spices and salt sample

Table 3: Antioxidant capacity and total phenol of fresh meat, non-meat ingredients, uncooked and deep fried shredded beef

Sample No.	Antioxidant capacity (mg VCE 100 g^{-1})	Total phenol (mg GAE 100 g^{-1})	Inhibition (%)
Fresh meat	53.95±0.29^{b}	51.63±0.55^{c}	22.77
Fresh meat+salt	47.38±0.16^{a}	14.77±0.20^{a}	26.79
Fresh meat+salt+sugar	62.32±0.12^{d}	18.01±0.10^{b}	31.90
Mixed spices	230.01±0.64^{g}	82.49±0.19^{g}	42.51
Mixed spices+fresh meat	68.74±0.32^{e}	76.40±0.30^{f}	28.52
Mixed spices+salt	228.70±0.74^{f}	85.60±0.03^{h}	45.58
Mixed spices+sugar	394.57±0.29^{i}	71.97±0.34^{e}	77.28
Mixed spices+fresh meat+salt+ sugar (uncooked abon sapi mixture)	59.03±0.23^{c}	65.10±0.86^{d}	26.26
Deep fried shredded beef (abon sapi)	269.30±0.33^{h}	332.41±0.19^{i}	65.07

Means with standard deviation followed by same superscript in one column was significant difference ($p<0.05$) and means were measured from three different samples

(85.6 mg GAE 100 g^{-1}), mixed spices sample (82.49 mg GAE 100 g^{-1}), mixed spices and fresh meat sample (76.40 mg GAE 100 g^{-1}) and mixed spices and sugar sample (71.97 mg GAE 100 g^{-1}).

DISCUSSION

The physicochemical and organoleptic characteristics as well as microbial counts of abon sapi samples purchased in cottage industries were observed in a wide range and these condition were possibly due to different raw material, spices and other non meat ingredients added during preparation and also different steps of processing. In this study the preparation of deep fried shredded beef (abon sapi) was as follow: Meat was boiled for 6 h at 100.33±0.58°C and after finely shredded and thoroughly mixed with spices, coconut sugar, cane sugar and cooking salt then it was deep fried in cooking oil for 1-10 min at 130.33±0.58°C. It was also observed that the major spices used at different cottage level industries were garlic, red onion, coriander and roots of galanga and in some of the cottage industry other spices added were ginger, lemon grass, tumeric and white pepper. Coconut sugar and cooking salt were mainly added during preparation although in some cottage level industries cane sugar was also added. These different non-meat ingredients affected the quality especially the organoleptic traits of end product. Huda *et al.* (2012) noted that deep fried shredded meat or meat floss production in Malaysia still not yet meet the standard quality. Furthermore, Huda *et al.* (2012) reported that 25 students of Food Technology Programme of University Sains Malaysia as panelists in sensory evaluation of Malaysian commercial shredded meat found a significant different in all sensory characteristics of samples evaluated.

The moisture contents of commercial abon sapi produced by cottage industries in Palu, Central Sulawesi were still acceptable as according to Fachruddin (1997) that moisture content of abon sapi in National Indonesian Standard (SNI) should less than 7%. Ockerman and Li,(1999) reported that moisture content in their products were in the range of 3.47-5.23% while Ogunsola and Omojola (2008) also found a similar moisture content in Nigerian shredded meat (danbunama) i.e. in the range of 6.50-7.37%. The a_w value of nine abon sapi samples were similar than the one reported by Chang *et al.* (1991) that the a_w value of Zouson a popular deep fried shredded meat in Taiwan was 0.40 while Chen *et al.* (1997) noted that their deep fried shredded samples a_w value were <0.60.

Fachruddin (1997) noted that according the Indonesian National Standard (SNI) protein content of abon should be more than 15%, in this study the lowest protein content (23.98%) found in sample No. 2 and the highest protein content was 36.39% in sample No. 9. Ogunsola and Omojola (2008) also found a similar protein content in Nigerian dehydrated shredded meat (Danbunama) i.e., 38.9-43.5%, while Ockerman and Li (1999) also reported a similar results in pork floss i.e., 34.09-42.90%. The fat content also varied between commercial abon sapi samples and according to Huda *et al.* (2012) it was affected by processing method and removal of excessive oil. A similar results was also reported by Ogunsola and Omojola (2008) in Nigerian dehydrated shredded meat (Danbunama) i.e., 35.57-40.85%. Fachruddin (1997) noted that according to Indonesian National Standard (SNI) deep fried shredded meat should contain fat less than 30%.

The differences of microbial counts between samples were possibly due to different sanitation and hygiene conditions in the production areas, wide variation of spices and other non-meat ingredients used as well as different processing steps applied during preparation of abon sapi. A quite low microbial content of these samples were also due to the low moisture content and a_w value of samples, where combination of cooking salt, cane sugar and coconut sugar followed by boiling and deep frying reduced either moisture content, a_w and microbial counts of samples. Ockerman and Li (1999) also reported similar microbial count in shredded pork samples (2.01-2.18 log cfu g^{-1}) and this condition were caused by continous thermal processing up to 93.3°C and autoclave treatment. They also noted that there were possibilities of air contamination during post production handling and packaging end products.

In general the most preferable colour of abon were golden brown or redish brown, however the end products colour were depended on non-meat ingredients interact with meat components by heating process especially deep frying. There were Maillard reaction and caramelization as well as changes of myoglobin of meat during processing together with the present of salt and sugar. According to Li *et al.* (2000) a dark colour of shredded meat was not preffered while Huda *et al.* (2012) reported that although chicken shredded meat and fish shredded meat had lighter colour than beef serunding, however the overall acceptability were statistically not significant difference. The differences of aroma detected by panelists were caused by different non-meat ingredients added during preparation of abon especially different kind and concentration of spices as well as the addition of coconut milk.

Data in Table 3 showed that mixed spices contribute the high antioxidant capacity and total phenol and this is due to the antioxidant components naturally found in spices used (coriander, garlic, onion and tamarid pulp). The edible part of red onion showed 15 times higher antioxidant activities compared to other onion variety as reported by Nuutila *et al.* (2003) and Elhassaneen and Sanad (2009) observed that red onion (*Allium cepa* L.) variety in Egypt had a higher potential antioxidant activity compared to the white variety.

The addition of sugar could increase the antioxidant capacity and this condition possibly due to the antioxidant already present in sugar. Nayaka *et al.* (2009) reported that antioxidant activity of jaggery Indian coconut (*Cocos nucifera*) sugar) and brown sugar had an EC_{50} value of 7.8 and 59.38 μg mL^{-1} in the DPPH scavenging assay which means that these sugars have the potential as antioxidant. Pengseng *et al.* (2011) noted that antioxidant activity of sucrose was not affected by heat treatment and they also observed that antioxidant activity of glucose increased after heating at 121°C for 15 min in Thomka paste extract measured using DPPH scavenging activity assay. Furthermore, Pengseng *et al.* (2011) also noted that the type and amount of monosaccharide affected the antioxidant activities while Tangkanakul *et al.* (2009) observed that heat treatment did not affected natural antioxidants activities of some Asian foods.

Benkeblia (2005) and Lanzotti (2006) noted that antioxidant properties are correlated with total phenol content in garlic and onion. Total phenolic acids content in red onion variety Rouge Amfota was 18 to 20 mg 100 g^{-1} fresh weight while garlic containing 49 mg 100 g^{-1} as reported by Benkeblia (2000, 2005) also noted that quercentin in garlic has a higher scavenging activity compared to the one from red onion. According to Hansen *et al.* (2012) that total phenolics content of onion extracts steamed for 0 min (raw), 1, 3, 6, 10 and 15 min were 0.50±0.02, 0.52±0.02, 0.43±0.02, 0.46±0.06, 0.54±0.03 and 0.48±0.04 GAE mg mL^{-1}, respectively, indicated that steaming time did not affect the total phenolic content of onion.

CONCLUSION

The wide range of physicochemical determination results, organoleptic scores and microbial counts indicated that standard operating procedures in processing of deep fried shredded beef (abon sapi) and its formula are not yet available. Therefore to produce deep fried shredded beef products with relatively similar physicochemical quality and organoleptic traits at cottage level producers in Palu, Central Sulawesi, a standard processing steps as well as its formula need to be set up. This product has the potential to be classified as natural antioxidant source due to its high antioxidant capacity and total phenol content.

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