

Some Indigenous Corn-Based Foods from Indonesia, which are potential as staple foods

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ABSTRACT

Indonesia has many indigenous corn-based foods which are well known in each side of Indonesia particularly in corn-producing region. Corn is an important commodity as carbohydrate-rich foodstuff besides rice. The most common problem faced by corn-based foods is the unwillingness of people to process corn into various products due to the long preparation and cooking time. Through some technological touch, an innovative product called as parboiled polished corn (jagung sosoh pratanak = JSP) was produced. It was a convenient raw material for making some indigenous corn-based foods. By using this product, it was expected that the cooking time of corn-based foods could be reduced.

The aim of this research was to explore some indigenous corn-based foods which are potential as staple foods and to apply the parboiled polished corn (JSP) for making those indigenous foods. The research parameters were data collecting of indigenous corn-based foods (including the origin, procedure of processing, preparation and cooking time) and comparing the foods made from dry polished corn and parboiled polished corn.

There were ten indigenous corn-based foods from Indonesia which are potential as staple foods such as *nasi kemunak Batanghari* (Jambi, Sumatera), *lepet jagung* (East Java), *jagung bose* (East Nusa Tenggara), *kambeweno kahitela* (Muna, South East Sulawesi), *kambewe* (Muna, South East Sulawesi), *kampalusu* (Muna, South East Sulawesi), *katumbu* (Muna, South East Sulawesi), *kina gandu* (Tolaki, South East Sulawesi), *lapoti gandu* (Tolaki, South East Sulawesi) and *barobbo* (South Sulawesi). The result showed that cooking time of some indigenous foods made from parboiled polished corn was shorter than those made from dry polished corn. These foods were *jagung bose* (20 & 25min.), *kampalusu* (20 & 25min.), *kina gandu* (20 & 25min.), *lapoti gandu* (30 & 40min.) and *barobbo* (20 & 25min.). The other foods such as *nasi kemunak Batanghari* (20 & 15min.), *lepet jagung* (15 & 10min.) and *katumbu* (15 & 10min.) showed the longer cooking time than those made from dry polished corn, whereas *kambeweno kahitela* and *kambewe* had the same cooking time (25min.). The advantage of using JSP was the process could be conducted without polishing and soaking the dry corn which took until several hours. Sensory evaluation result showed that the most indigenous corn-based foods made by using dry polished corn were more acceptable in odor, color, taste and texture than those made by using JSP. Based on this research, it was concluded that (1) these ten indigenous corn-based foods were potential as staple food and (2) JSP could be processed into certain indigenous corn-based foods with the shorter cooking time and better acceptance.

Keywords: corn-based foods, parboiled polished corn (JSP), original formulation

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Introduction

Among some food commodities in Indonesia, corn is potential carbohydrate source foodstuff beside rice. It has relatively low price and produce in large quantities. National corn production in 2006 was 11,609,463 ton, and increased yearly. The production in year 2007, 2008 and 2009 was 13,287,527 ton, 16,317,252 ton and 17,592,309 ton, respectively (Central Bureau of Statistics, 2010).

Since generation, Indonesian people use corn as staple food. Certain ethnic in Indonesia possess indigenous corn-based foods such as *bassang* and *barobbo* (South Sulawesi); *bintebiluhuta* (Gorontalo), *jagung bose* (East Nusa Tenggara), *grontol* dan *lepet jagung* (Java), *nasi kemunak Batanghari* (Jambi), *kagili*, *lapoti gandu*, *kina gandu*, *katumbu*, *kampalusu*, *kambewe* (South East Sulawesi) and other menus which are made from corn (Mahendradatta dan Tawali, 2008).

These foods disappeared gradually from daily menu and some of these would be unknown, particularly by young generation. It was due to inconvenient preparation and cooking process, need long time, and uninterested appearance (Tawali, 2006). Beside that corn was still being considered as food for marginal people. It was difficult to find corn in supermarket because it was sold only in traditional market and at the side of street without special packaging and in form of dry corn.

Based on survey result it that the interest of people on corn product was actually high, but processing and serving of such products were inconvenient so that most people did not like to prepare it (Tawali et al., 2003). This problem could be solved by preparing the convenient raw material for making indigenous corn-based food from Indonesia. The raw material was parboiled polished corn (JSP) which has been developed through some researches. It became a convenient and interested raw material for many corn-based foods. This has been applied first to make *bassang*, indigenous corn porridge from South Sulawesi which needed 18 hours to prepare it from waxy dry corn into corn porridge, after polishing and soaking the corn before cooking. *Bassang* was made commonly from waxy corn with wheat flour, coconut milk and salt. By using JSP, the time could be reduced to 20-30 minutes without polishing and soaking the corn.

This research aimed to explore some indigenous corn-based foods from Indonesia which is potential as staple foods. The next step was to apply the JSP to make these foods and to compare the result of cooking time and sensory evaluation of both treatments.

Material and Methods

Material

Raw material used in this research were polished waxy corn, yellow corn, parboiled polished corn (JSP), kidney bean, mungbean, vegetables, grated coconut, coconut milk, salt, water, banana leaf, corn leaf, slaked lime. Chemicals used for proximate analysis were sulphuric acid, boric acid, chloride acid, potassium permanganat, sodium hydroxyde, chloroform, strong chloride acid, indicator red methil, ammonium hydroxide 1:1, sodium chloride, ammonium oxalate solution, argentums nitrate, NaCl pa, n-heptane and sodium carbonate.

Methods

1. Exploration

The aim of exploration was to identify indigenous corn-based food from Indonesia which potential as staple food. This was conducted by collecting two data:

1.1 Primary data

Primary data was collected from direct interview with persons who knew the indigenous corn-based foods well, i.e. native inhabitant and housewife. The data required included the name of foods, origin, raw material and product formulation.

1.2 Secondary data

Secondary data was collected from literature, internet, books and other authentic source. The data required was similar with primary data.

2. Development of indigenous corn-based foods by using parboiled polished corn (JSP)

2.1 Making of parboiled polished corn (JSP)

Parboiled polished corn was made according to its standard operational procedure as follows: (a) cleaning and washing the corn; (b) soaking the corn in water contained 0.005-0.05% enzim α -amilase and 0.01-0.1 % CaCl (w/w corn) for 24 hours at room temperature with ratio corn : water 1: 2 (v/v); (c) cooking the corn for 45 minutes; (d) dripping the gel, and (d) drying the corn using electric drying machine at temperature 75°C until water content of corn \pm 13%.

JSP was evaluated for its nutrition profile (proximate analysis) (AOAC, 1990) and product profile (rehydration time (Hubeis, 1985), yields and physical appearance)

2.2 Making of some indigenous foods using parboiled polished corn (JSP)

Indigenous corn-based foods which were resulted from exploration step were made by using JSP and compared to those made by using original raw material.

3. Observation

3.1 Comparison of cooking time

The indigenous corn-based foods was observed by comparing the cooking time of the products made by using JSP and by using original material. Cooking time was calculated since the corn was put into boiled water until the corn was soft or the product was cooked.

3.2 Sensory evaluation

The products were evaluated for their color, taste, odor, and texture by a sensory panel of twenty members using a five-point scale (5-excellent, 4-good, 3-acceptable, 2-doubtful, 1-unacceptable). Samples graded above point 3 were considered to be acceptable for consumption (Larmond, 1977).

4. Data processing

Data collected was processed using descriptive analysis by explaining the profile of each product. Cooking time was calculated for each food, and the time was then compared. Sensory score was calculated on the average of each panelst score concerning each evaluated product.

Results and Discussion

1. Exploration result

Based on exploration step, a data about ten indigenous corn-based foods was compiled in Table 1. These products came from several regions in Indonesia.

Table 1. Exploration research

No	Name of foods	Origin	Raw materials
a	Nasi Kemunak Batanghari	Jambi	<i>Keladi</i> , yellow corn
b	Lepet Jagung	East Java	Young corn, grated coconut
c	Jagung Bose	East Nusa Tenggara	White corn, salt
d	Kambeweno	Muna, South East Sulawesi	White corn, grated coconut, slaked

	Kahitela		lime
e	Kambewe	Muna, South East Sulawesi	Dry corn, coconut milk, kidney bean, slaked lime
f	Kampalusu	Muna, South East Sulawesi	Dry corn, grated coconut, slaked lime
g	Katumbu	Muna, South East Sulawesi	Young corn, coconut milk
h	Kina Gandu	Tolaki / Moronene, South East Sulawesi	Corn, viscous coconut milk, pandanus leaf, salt
i	Lapoti Gandu	Tolaki / Moronene, South East Sulawesi	Corn, grated coconut, mungbean, salt
j	Barobbo	South Sulawesi	Corn, spinach, vegetables

The appearance of these foods was displayed in Figure 1. The alphabet showed the name of these foods as written in Table 1.

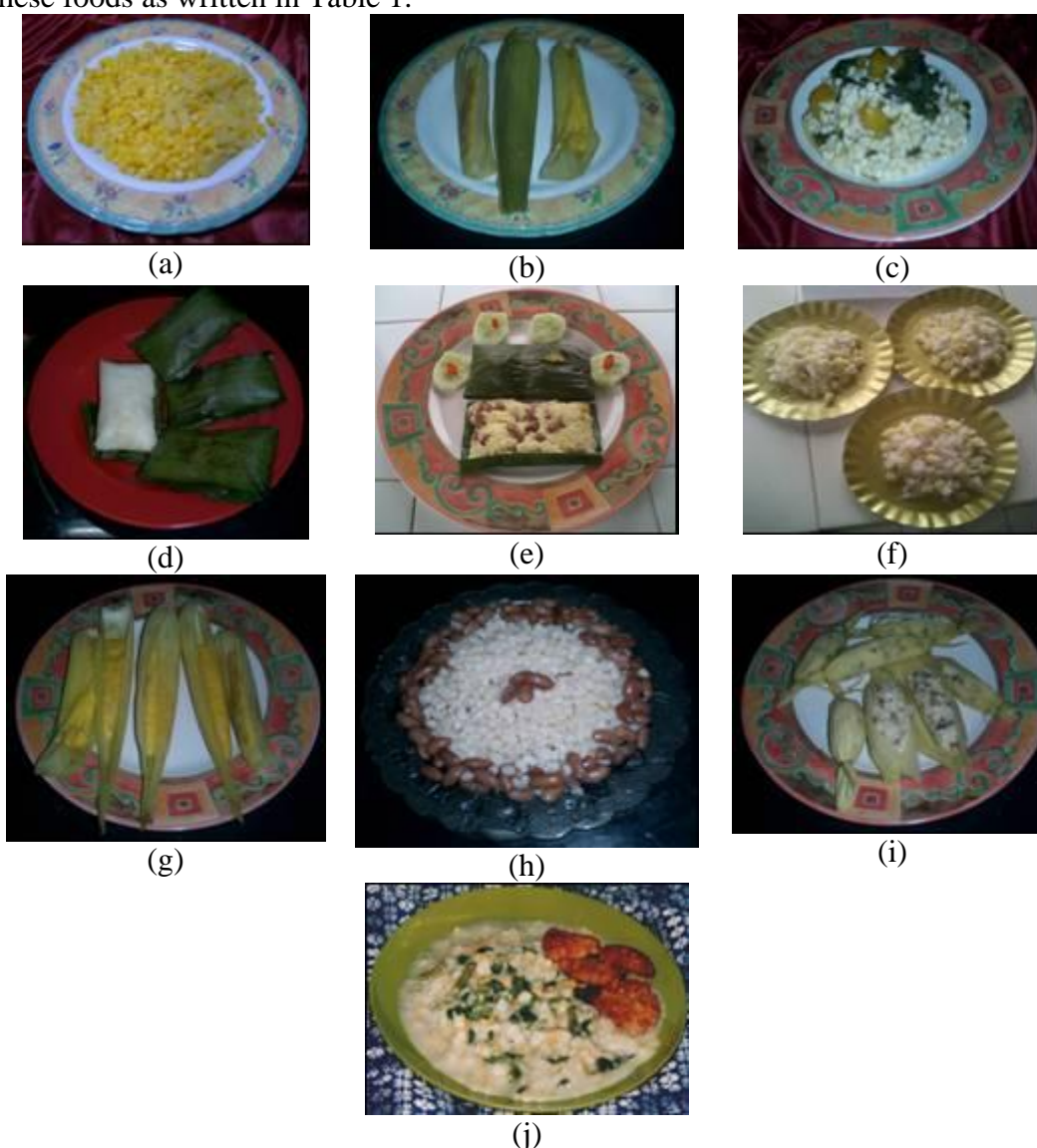


Figure 1. Some indigenous corn-based foods from Indonesia

2. Development of indigenous corn-based foods by using parboiled polished corn (JSP)

2.1 Making of parboiled polished corn (JSP)

JSP was processed through optimized procedure, which has been selected based on best result from several treatments (Tawali et al., 2003). First of all, dry corn was polished to obtain polished corn and then it was cleaned from the rest of residues and other

impurities. This process was done three times and produced clean polished corn. Clean polished corn then was soaked in water with addition of reagents. Soaking aimed to let the product to adsorb water rapidly and uniformly (Wimberly, 1983). In order to make the corn tissue open and apart, amylase enzyme and CaCl_2 were added to soaking water. As consequent, some of starch chains were broken and loose so that the starch could swell optimally. The reagents were the mixture of CaCl_2 -solution and enzyme α -amylase. Soaking was carried out until the corn swells. Furthermore, corn was cooked in soaked water and additional water was given until the ratio of water and corn was 2:1. Cooking aimed to gelatinize the starch (Miah et al., 2002). During cooking, the starch gelatinization was occurred therefore the texture of corn became soft. Cooking process was carried out until corn became softer and the water was more viscous. It then was washed from mucous and then the water remained was dripped until no more water left and the corn cooler. Finally, the dripped corn was dried using electric drying machine. Nutrition and physical profile of JSP was presented in Table 2. Physical appearance of JSP was displayed in Figure 2.

Table 2. Nutrition and physical profile of parboiled polished corn (JSP)

Nutrition profile		
	Compounds	Amounts
1	Water content (%)	11.46±0.4
2	Fat (%)	0.36±0.01
3	Protein (%)	8.59±0.01
4	Carbohydrate (%)	79.63±0.33
5	Ash (%)	0.24±0.06
6	Crude fibre (%)	1.1±0.10
7	Calsium (%)	0.14±0.02
Physical profile		
	Parameters	Results
1	Rehydration time (min.)	15 ± 0.05
2	Yields (%)	64.98
3	Physical appearance	Transparent and compact



Figure 2. (from left to right) Physical appearance of dried waxy corn, dried polished corn and JSP

2.2 Making of some indigenous foods using parboiled polished corn (JSP)

These indigenous corn-based foods were made by using JSP in comparison with original raw materials according to the recipe.

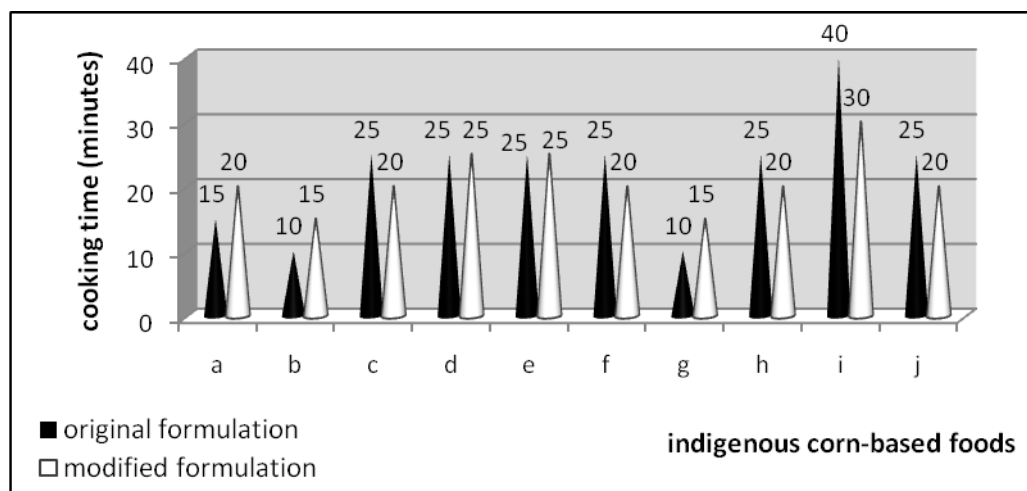
Table 3. Original formulation compared to modified formulation by using JSP

No	Name of foods	Original Formulation	Modified Formulation (using JSP)
1	Nasi Kemunak Batanghari	<ol style="list-style-type: none"> 1. <i>Keladi</i> is cleaned and washed, steamed until done, then cooled and grated crudely. 2. Corn is cooked until soft 3. <i>Keladi</i> is steamed again shortly if it will be served and is mixed with cooked corn. 	<ol style="list-style-type: none"> 1. <i>Keladi</i> is prepared as original formulation 2. JSP is washed, water is boiled 3. After boiling, JSP is put into the water, mixed and salt is added 4. Corn is cooked until done 5. Corn is served by adding <i>keladi</i>
2	Lepet Jagung	<ol style="list-style-type: none"> 1. Corn is grated and mixed well with grated coconut, sugar, salt and vanilie. 2. Mixture is wrapped with corn leaf and formed into small corn cob, steamed until cooked. 	<ol style="list-style-type: none"> 1. JSP is crushed, mixed with salt, sugar and grated coconut, mixed well 2. The mixture is wrapped with corn leaf and cooked until done
3	Jagung Bose	<ol style="list-style-type: none"> 1. Corn is crushed by mortar, some water is added to ease the crushing process 2. Crude corn is sieved to separate aleuron and the broken pieces 3. The broken pieces is cooked until done 	<ol style="list-style-type: none"> 1. Kidney bean is cooked until done 2. JSP is washed and put into boiled water 3. Vegetables and salt are added, mixed well, kidney bean is added, cooked until done
4	Kambeweno Kahitela	<ol style="list-style-type: none"> 1. Corn is cooked in water contained slaked lime, then washed and milled 2. Grated coconut is added and the mixture is wrapped by banana leaf and tied. 3. After cooking, it is ready to serve 	<ol style="list-style-type: none"> 1. JSP is crushed 2. Grated coconut, salt and some water are added 3. The mixture is wrapped with banana leaf and cooked until done
5	Kambewe	<ol style="list-style-type: none"> 1. Corn is mixed with slaked lime solution and cooked until done 2. Kidney bean is cooked until done 3. After cooking, corn is crushed 4. Crushed corn is mixed with kidney bean, coconut milk, mixed well, wrapped with banana leaf and cooked. 	<ol style="list-style-type: none"> 1. JSP is crushed 2. Kidney bean is cooked until done 3. Coconut milk is boiled, then JSP, salt and kidney bean are added, mixed well until coconut milk is adsorbed well 4. The mixture is wrapped with banana leaf and cooked until done
6	Kampalusu	<ol style="list-style-type: none"> 1. Corn is soaked in slaked lime solution then its aleuron is removed 2. Corn is cooked until done 	<ol style="list-style-type: none"> 1. JSP is washed and put into boiled water, mixed slowly and salt is added 2. JSP is cooked until done
7	Katumbu	<ol style="list-style-type: none"> 1. Corn is crushed finely and mixed with coconut milk and salt 2. The mixture is wrapped with corn leaf and cooked until done 	<ol style="list-style-type: none"> 1. JSP is crushed 2. Coconut milk is boiled, JSP and salt are put into coconut milk, mixed well until coconut milk is adsorbed. 3. The mixture is wrapped with corn leaf and cooked until done
8	Kina Gandu	<ol style="list-style-type: none"> 1. Kidney bean is cooked until done 2. Corn is soaked in water for \pm 2 hours and cooked until half done 3. Viscous coconut milk, pandanus leaf and salt are added 4. The mixture is steamed until done 	<ol style="list-style-type: none"> 1. Kidney bean is cooked until done 2. JSP is washed and put into boiled coconut milk, salt is added and stirred well until coconut milk is adsorbed 3. The mixture is steamed until done
9	Lapoti Gandu	<ol style="list-style-type: none"> 1. Mungbean is cooked 2. Corn is chopped finely 3. Salt is added into the mixture, wrapped with corn leaf and formed into corn cob 4. The mixture is steamed until done 	<ol style="list-style-type: none"> 1. Mungbean is cooked until done 2. JSP is washed, cooked shortly, mixed with mungbean, grated coconut and salt 3. The mixture is wrapped with corn leaf and cooked until done
10	Barobbo	<ol style="list-style-type: none"> 1. Jagung is grated and cooked. 2. Vegetables and other spices are added and cooked until done 	<ol style="list-style-type: none"> 1. JSP is washed, put into boiled water and stirred slowly 2. Vegetables and other spices are added and cooked until done

3. Observation

3.1 Comparison of cooking time

Figure 3 showed that there were eight products which had different cooking time. From eight products, there were *jagung bose*, *kampalusu*, *kina gandu*, *lapoti gandu* and *barobbo* which had shorter cooking time after application of modified formulation. It indicated that JSP could be used as alternative raw material for making some indigenous corn-based foods which needed relatively shorter cooking time than dry waxy corn. It is important to understand that by using of JSP, the preparation time of food made from dry corn would be reduced until several hours because soaking process (sometimes also polishing) was not necessary. According to Mahendradatta and Tawali (2008), JSP was made due to consideration of long time preparation and cooking time of *bassang*, well-known indigenous corn porridge from South Sulawesi. By using JSP, the time for making *bassang* could be reduced from 18 hours (including polishing and soaking the corn) to 20 minutes.



Note: a = nasi kemunak Batanghari
 b = lepet jagung
 c = jagung bose
 d = kambeweno kahitela
 e = kambewe
 f = kampalusu
 g = katumbu
 h = kina gandu
 i = lapoti gandu
 j = barobbo

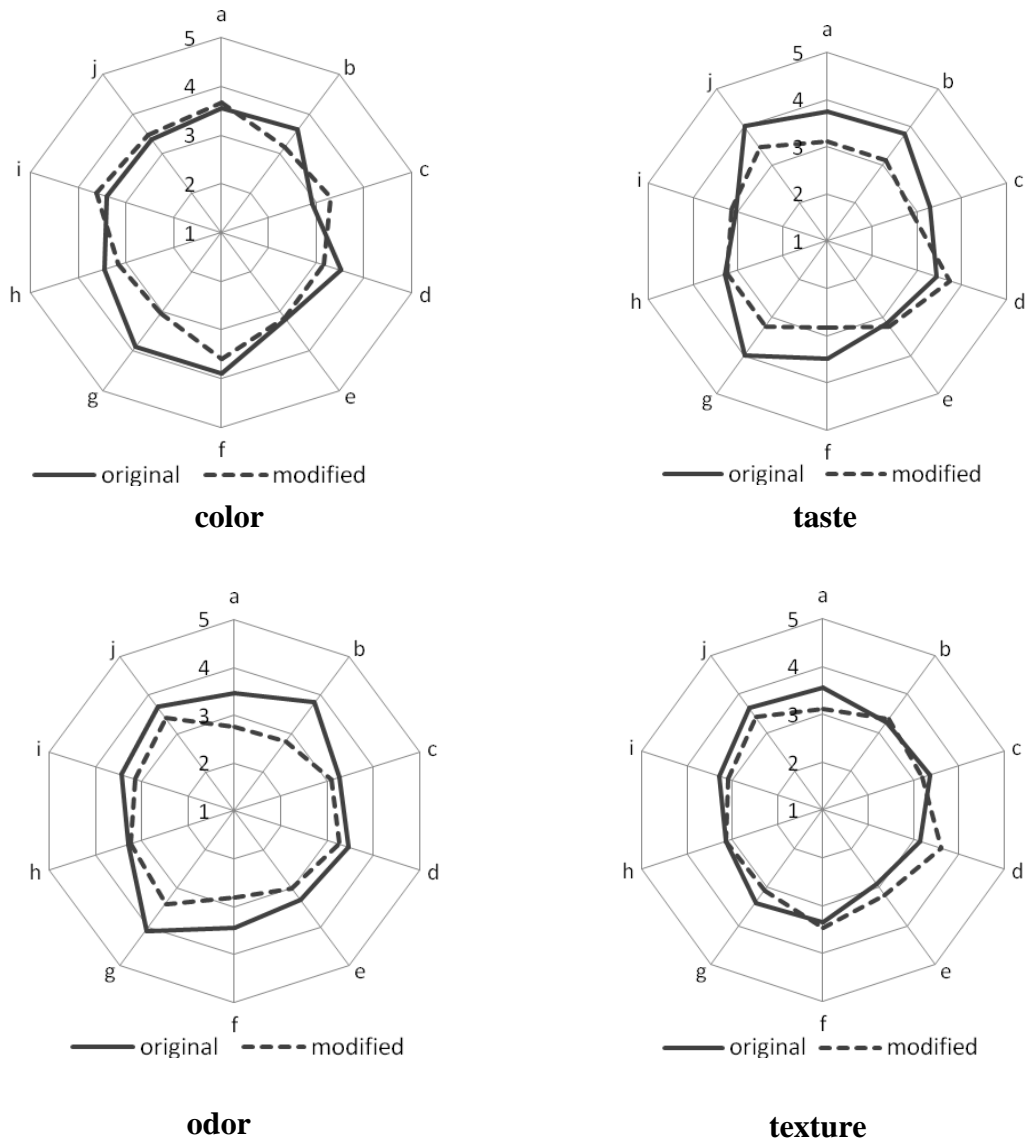
Fig. 3. Cooking time of indigenous corn-based foods made by original formulation and modified formulation

Research result showed that *nasi kemunak batanghari*, *lepet jagung*, and *katumbu* had the shorter cooking time by using original formulation than modified formulation. It was due to the raw materials used by original formulation, i.e fresh yellow corn which contained less starch and more sugar than other type of corn (Suarni and Widowati, 2007) and also young corn which had softer texture than dry corn. Dried gelatinized starch could adsorb water easily and in much amount (R&D Dept. of Agric, 2006). Sugiyono et al. (2004) said that the different variety of corn yield different cooking time. This might be due to the different structure of corn which might affect the water penetration into corn.

3.2 Sensory evaluation

Result of sensory score of the products for its color, taste, odor, and texture ranged between 2.9 – 3.9; 2.85 – 4; 2.75 – 3.8; and 2.9 – 3.65, respectively. Score more than 3 indicated that the product was accepted by the panelst. Some foods such as *nasi kemunak*

Batanghari, *lepet jagung* and *katumbu* used yellow and young corn according to the original formulation. It might be the reason why the acceptance of such products better than those made from JSP, because JSP was made from waxy corn. Amylopectin content of waxy corn might affect the acceptability on the products. According to Suarni and Widowati (2007), it has been showed that amylopectin could influence the sensory evaluation of corn particularly texture and taste. Result of sensory score was displayed in Figure 4. In general, indigenous corn-based foods made by using original formulation were better accepted, particularly its odor, than those made from JSP (see Fig.4).



Note: a = nasi kemunak Batanghari
 b = lepet jagung
 c = jagung bose
 d = kambeweno kahitela
 e = kambewe
 f = kampilusu
 g = katumbu
 h = kina gandu
 i = lapoti gandu
 j = barobbo

Figure 4. Sensory score of indigenous corn-based foods

Conclusion

1. There were some indigenous corn-based food which are potential as staple food such as *nasi kemunak Batanghari*, *lepet jagung*, *jagung bose*, *kambeweno kahitela*, *kambewe* (Muna, South East Sulawesi), *kampalusu* (Muna, South East Sulawesi), *katumbu* (Muna, South East Sulawesi), *kina gandu* (Tolaki, South East Sulawesi), *lapoti gandu* (Tolaki, South East Sulawesi) and *barobbo* (South Sulawesi).
2. Parboiled polished corn (JSP = jagung sosoh pratanak) could be used as alternative raw material for making indigenous corn-based foods, observed from shorter preparation and cooking time than those made from raw material based on original formulation. By using JSP, preliminary step such as polishing and soaking the corn was not necessary.

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References

- AOAC, 1990. "Official Methods of Analysis". The Association of Official Analytical Chemist. Washington D.C.
- Central Bureau of Statistic, 2010. Data of corn production yearly, Jakarta.
- Hubeis, M., 1985. Pengembangan metode uji keputulenan nasi. Program Studi Ilmu Pangan, IPB, Bogor.
- Larmond, E., 1977. Laboratory Methods for Sensory Evaluation of Food. Research Institute, Canada Department of Agriculture, Ottawa.
- Mahendradatta, M. dan A.B. Tawali, 2008. Jagung dan Diversifikasi Produk Olahannya. Penerbit Masagena Press bekerjasama dengan Pusat Kajian Makanan Tradisional Universitas Hasanuddin, Makassar, 36 – 38.
- Miah, M.A.K, Haque, A., Douglas, M.P., and Clarke, B. (2002). Parboiling of rice. Part II: Effect of hot soaking time on the degree of starch gelatinization. *Int. J. of Food Sci and Tech*, 37, 539 – 545.
- R&D Department of Agriculture, 2006. Produk-produk instan dalam industri. <http://www.litbang.deptan.go.id/special/komoditas/files/0106L-PPANEN.pdf>
- Suarni dan S. Widowati, 2007. Struktur, komposisi dan nutrisi jagung. In: *Jagung: teknik produksi dan pengembangan*. Sumarno (ed.) Balai Penelitian dan Pengembangan Pertanian. Pusat Penelitian dan Pengembangan Tanaman Pangan, Bogor, 410 - 426.
- Sugiyono, Soewarno T. Soekarto, Purwiyatno H. dan Agus S, 2004. Kajian Optimasi Teknologi Pengolahan Beras Jagung Instan. *Jurnal Teknologi dan Industri Pangan Perhimpunan Ahli Teknologi Pangan Indonesia*. 15 : 119 – 128.
- Tawali, A.B., A. Laga dan M. Mahendradatta, 2003. Pengembangan Produk Bassang. Laporan Penelitian Rusnas Diversifikasi Pangan Pokok.
- Tawali, A.B., 2006. Jagung Sosoh Pratanak (JSP), produk inovatif yang praktis sebagai bahan baku Bassang, makanan tradisional asal Sulawesi Selatan. *FoodReview Vol. II*, No. 7 (Juli 2007).

Wimberly, J.E., (1983). Parboiling. In: Technical Handbook for the paddy rice post harvest industry in developing country, Manila International Rice Institut, pp 101-116.