

Conference Paper

## Chemical Characteristics of Cereal Based on Local Food from Flores to Prevent Stunting

Nur R. Adawiyah Mahmud\*, Dewi Handayani, Ernawati

University of Muhammadiyah Kupang, Jl. KH. Ahmad Dahlan No. 17, Kupang, East of Nusa Tenggara, 85111, Indonesia

\*Corresponding author:

E-mail:

[nuradawiyah836@gmail.com](mailto:nuradawiyah836@gmail.com)

### ABSTRACT

The program for providing additional nutritious based on local food is one of the stunting prevention strategies in East of Nusa Tenggara (NTT). *Jagung titi* is one of local food from Flores that has been known for long time. Although it is familiar for NTT community, not many publications have been found for its chemical characteristic. This research aimed to determine the chemical characteristic of cereal based on *jagung titi* (flaked corn) (CCF) and pumpkin flour (PF). This cereal was formulated from cracker corn flour and pumpkin flour in three compositions (90% CCF + 10% PF; 80% CCF + 20% PF; and 70%CCF + 30% PF). The proximate analysis of samples was using the AOAC method. CCF in 100 grams contains 76.18% carbohydrate, 9.03% protein, 2.18% fat, 0.96% ash, and 5.77% water. PF in 100 grams contains 43.9% carbohydrate, 12.53% protein, 5.35% fat, 7.14% ash, and 21.81% water. The chemical properties of cereal products can be affected by the formulation of CCF and PF. The third cereal composition (70% CCF + 30% PF) was the highest rate of acceptability by consumer panelists for the sweet flavor, aroma, and texture. This cereal product was promising as alternative nutritional local food to prevent stunting due to its effectiveness in presentation and consumption.

*Keywords: Chemical characteristic, flaked corn, pumpkin, cereal, stunting*

### Introduction

Stunting is one form of under-nutrition manifestation. Stunting is defined as low height for age. It is the result of chronic or recurrent under-nutrition, usually associated with poverty, poor maternal health and nutrition, frequent illness, and/or inappropriate feeding and care in early life (WHO, 2023). Indonesian Ministry of Health reports that the prevalence of stunting for children under five (toddlers) in Indonesia was 21.6% in 2022, and East Nusa Tenggara had the highest prevalence of stunting in Indonesia in this year, namely 35.3% (Widi, 2023). This year, the Indonesian Health Ministry launched a program called Feeding Supplement with local food for toddlers and pregnant women. This program is held to accelerate the decline of the stunting rate in Indonesia, including East Nusa Tenggara (NTT) province (Indonesian Ministry of Health, 2023). Corn and pumpkin are two familiar plants that are processed as local food in NTT communities.

Corn (*Zea mays*) is one of the major food sources in the world. Corn contains significant amounts of bioactive compounds providing desirable health benefits beyond its role as a major source of food. The health benefits of corn are not only from basic nutrients such as carbohydrates, vitamins, and minerals, but also from their unique phytochemicals such as phenolic acids, flavonoids, plant sterols, and other phytochemicals (lignin and bound phytochemicals) (Sheng et al., 2018). Corn has become the main local food in NTT. Some traditional foods are made from corn like *jagung bose*, *jagung katemak*, and *jagung titi* (Cracker corn). Among others, cracker corn is a local food with a dry texture and can be saved for months. Cracker corn is a traditional culinary

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from East Flores, Lembata, and Alor, and is also well-known in the East of Nusa Tenggara community. This cracker corn is made from corn seed that is roasted (fried without oil) until cooked, then forged using a pair of stones (one as foundation and the other is moved from the top to the bottom of the corn seed to be pointed) (Yokasing et al., 2019). Previous publications reported the nutritional change of cracker corn during 7 months of storage in different plastic materials. Water content increased during storage from 3.20% to 14.01%, while protein content was tented to be stable during storage (9.85%), and fat content was slightly decreased from 2.10% to 1.66% (Daulima, 2010).

Pumpkin (*Cucurbita moschata*), belonging to the family *Cucurbitaceae*, is a well-known vegetable, cultivated and abundantly used as herbal medicine and functional food. Pumpkin is widely grown in most of the countries with minimal cost. Pumpkin flesh is an excellent source of different bioactive compounds, vitamins, minerals, carotene, and dietary fiber (Hussain et al., 2022; Ahmed et al., 2023). In NTT, pumpkin is well cultivated, and consumed, and its dry fruit could be saved for months.

Because of those benefits, corn, and pumpkin was also scientifically studied as practice cereal food. Previous studies were published about cereal made from pumpkin and corn, by combining those (corn flour and pumpkin flour) (Ramadhani et al., 2012) or with other foodstuff, such as white millet (Zhavira et al., 2020), sorghum (Usha et al., 2010), Cowpea (Firdausy et al., 2023), Rice Bran (Kusnandar et al., 2020), Cassava Flour (Susanti et al., 2017), Brown rice (Nakhon et al., 2018). Combining corn flour (maize) and pumpkin flour in the previous study (Ramadhani et al., 2012) shows that the suitable composition for cereal products was with a higher amount of corn flour. Therefore, this study aimed to study the chemical characteristics and organoleptic test of cereal made from local cracker corn (*jagung titi*) and pumpkin, with higher amounts of corn flour (90%, 80%, and 70%).

## Material and Methods

Jagung titi was obtained from Solor Island, East Flores. Pumpkin was purchased from the local market in Kupang. These two samples were taken to the Biology laboratory, at the University of Muhammadiyah Kupang for preparation. Analysis has been carried out for chemical characteristics and organoleptic tests. Chemical characteristic was analysed in the Nutrition Lab of Agricultural Polytechnic Kupang and BPOM (Agency for Drug and Food Control) Kupang.

### Sample preparation

Jagung titi (Cracker Corn, CC) was cleaned and dried for 10 min at 100°C. Then, powdered to obtain cracker corn flour (CCF). Pumpkin was cleaned, cut, and flesh was separated from rid, seed, and fibrous material. The flesh was then sliced (1 mm), dried (60°C for 24h, then 100°C for 5 min), and powdered to get pumpkin flour (PF). The cereal sample was a combination of cracker corn flour (CCF) and pumpkin flour (PF). Samples were combined for three cereal samples, i.e., 90% CCF + 10% PF, 80% CCF + 20% PF, and 70% CCF + 30% PF.

### Analysis of chemical characteristics

This analysis was conducted to determine the crude nutritional content of samples, including carbohydrates, protein, fat, water, ash, and fibre. The analysis of the sample was carried out using a standard method that has been mentioned in previous studies (Zhavira et al., 2020).

### Organoleptic test

Organoleptic test with hedonic method aimed to determine the power of consumer acceptance of the product on a laboratory scale. The sample was a cereal sample, and the material here was organoleptic form and a test kit (spoon, cup). The cereal sample was prepared without adding water or milk, so the panelist can give a physical assessment directly. The panelist here was 25 students of the Biology Education Department, University of Muhammadiyah Kupang.

Panelists were asked to give their responses and preferences to cereal sample (colour, aroma, texture, taste), then fill in the organoleptic form.

## Results and Discussion

Chemical characteristics include carbohydrate, protein, fat, water, ash, and fibre content was shown in Table 1.

Table 1. Proximate analysis of cereal samples

Samples	Carbohydrate (%)	Protein (%)	Fat (%)	Water (%)	Ash (%)	Fiber (%)
100% CCF	76.18	9.03	2.18	5.77	0.96	1.65
100% PF	43.90	12.53	5.35	21.81	7.14	1.38
90% CCF + 10% PF	73.94	8.70	2.41	13.65	1.30	1.60
80% CCF + 20% PF	69.72	9.73	2.46	15.81	2.28	2.50
70% CCF + 30% PF	66.49	10.08	3.58	17.18	2.67	2.86

Cracker Corn Flour (*Jagung titi*) CCF contain higher carbohydrate and fibre. Pumpkin flour (PF) contains higher protein, fat, water, and ash. Therefore, the mixed sample with 10-30% incorporation of pumpkin flour (PF) showed an increased level of moisture content, protein, and fat. Increasing incorporation of cracker corn flour (CCF) in mix sample showed an increased level of carbohydrate.

Carbohydrate is the main calory source for human. The carbohydrate content of CCF that analysed in this study was 76.18%. This is slightly higher than carbohydrate content of raw white corn that reported in previous publication, i.e., 74,26% (Sheng et al., 2018). Heat treatment in sample will causing water lost and increase the percentage of carbohydrate. Carbohydrate content of PF in this study was 43.9%, which is smaller than in other study, that reported 61,71%. This correlated to the higher amount of water in this study than in the same publication, 14.18% (Mardiah et al., 2020).

Protein is composed by amino acids, that is important for structure, function, and regulation of human body. Protein content of CCF was 9.03% which is slightly similar to protein amount of cracker corn in other study, i.e., 9.85%. Flour milling of corn only change the shape and size of corn without making any significant changes in protein content. While, protein percentage of PF was 12.53%, which is higher than previous study, i.e., 4.28% (Gumolung, 2019), and 11.56% (Mardiah et al., 2020). Higher amount of protein PF also correlated to the heat treatment in sample, that causing water lost and increase the percentage protein. The higher amount of protein in this food, the better nutritional value for body.

Fat content of CCF was 2.18, that is similar amount to the cracker corn in other study, i.e., 2.10% (Daulima et al., 2010). For PF, fat content in this study was 5.35% that is slightly higher than other study, 4.51% (Mardiah et al., 2020). Fat is essentials to give energy and support cell function.

Heat treatment in the process in this study was causing water lost and make significant difference of water content between the fresh material and the flour product (Ramadhani et al., 2012). From literature the water content of dried white corn is 10.37% (Sheng et al., 2018), and water content of CCF in this study was 5.77%. Fresh pumpkin flesh contains almost 92% of water (Hussain et al., 2022), and PF in this study was lower, i.e., 21.81%. Water content in foods determine freshness and durability of those foods. High content of water in foods make microbes easy to grow and causing changes in the food (Gumolung, 2019).

Ash content in food indicate inorganic residue after complete oxidation of organic component in the food (Gumolung, 2019). Ash content of CCF here was 0.96%, while in other study ash content of corn flour (maize) was 1.4-2.6% (Qamar et al., 2017). Ash content of CCF was higher than other study. Ash content of PF here was 7.14%, while in another study reported that the ash content was 8.05% (Mardiah et al., 2020), indicated that the ash content in this study was slightly higher than other study.

Raw fibre in plant consists of cellulose with small amount of lignin and pentose (Gumolung, 2019). Fibre content of CCF here was 1.65% which is in value of fibre content of maize from another study, i.e., 0.95-2.01% [18]. Raw fibre content of PF here was 1.38% which is higher than another study that reported 0.93%. Fibre is a complex carbohydrate in food that cannot be digested by enzymes in human body. In Large intestine, raw fibre will be digested by probiotic bacteria. This makes fibre become prebiotic. Daily fibre consumption can prevent some digestive disease (Gumolung, 2019).

The cereals sample in this study that is a combination of cracker corn flour and pumpkin flour also tested for its organoleptic to consumer panelist. The organoleptic test and panellist preferences for cereal sample is shown in Table 2 and Figure 1.

Table 2. Organoleptic test of cereal samples

Parameters	Sample		
	90% CCF + 10% PF	80% CCF + 20% PF	70% CCF + 30% PF
Colour	White-orange	White-yellow	White-brown
Aroma	Distinctive aroma of corn and pumpkin	Distinctive aroma of corn and pumpkin	Distinctive aroma of corn and pumpkin
Texture	Soft enough	Soft	Very soft
Taste	Less sweet	Sweet	Very sweet

Cracker corn flour have white colour because made from white corn (glutinous corn). Pumpkin flour has yellow-orange colour which come from major carotenoid pigment,  $\beta$ -carotene (Provesi et al., 2015). The aroma of pumpkin due to six-carbon alcohols and aldehydes. The most prominent is cis-3-hexen-1-ol (The Chemistry of Pumpkin, 2023). Sweet taste in cereal come from pumpkin flour. Pumpkin is sweet due to the high content of sugar in eat. The sugars in pumpkins are a complex carbohydrate called fructo-oligosaccharides.

### Panelists Preference of Cereal Samples

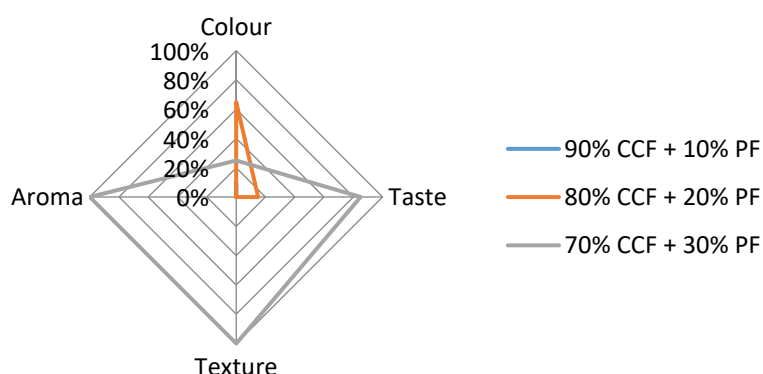


Figure 1. Panellist preferences of cereals samples, in term of colour, aroma, texture and taste, for first cereal sample (90% CCF + 10% PF), second cereal sample (80% CCF + 20% PF), and third cereal sample (70% CCF + 30% PF)

For colour, 65% of panellist choose second cereal sample, with white-yellow colour. All panellist chooses a second sample for aroma with the distinctive aroma of corn and pumpkin, and soft texture. For taste, the third cereal sample was chosen by 85% of the panelist. In general, the third cereal sample (70% CCF + 30% PF) was the most selected cereal sample for aroma, texture, and taste.

Corn and pumpkin with all the benefit of nutrient content and has long been known and consumed in NTT community, can be promoted as an alternative food for stunting prevention. Even so, several studies need to be done to complete this study such as a combination to other foodstuff that contain other macro and micro nutrient that crucial, easy to found, processed and consumed, in order to prevent stunting.

## Conclusion

Different foods will have different chemical characteristics, including carbohydrate, protein, fat, water, ash, and fiber. Cracker corn flour (CCF) have high carbohydrate and fibre content, while Pumpkin flour (PF) have high in protein, fat, water, and ash. Higher content of CCF in mix sample cereal causing higher percentage of carbohydrate, and higher content of PF in mix sample cereal causing higher percentage of protein, fat, and water. From organoleptic test, the third cereal sample (70% CCF + 30% PF) become the most sample selected by panellists for aroma, texture, and taste. The combination of corn and pumpkin in the cereal can complement each other for nutritional needs.

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## References

- Ahmed, M. W., Khan, M. S. I., Parven, A., Rashid, M. H., & Meftaul, I. M. (2023). Vitamin-A enriched yogurt through fortification of pumpkin (*Cucurbita moschata*): A Potential alternative for preventing blindness in children. *Heliyon*, 9, e15039. <https://doi.org/10.1016/j.heliyon.2023.e15039>
- Daulima, A. M. (2010). Penentuan umur simpan jagung titi berdasarkan metode isotermi sorpsi. *Thesis*. Institut Pertanian Bogor. Bogor
- Gumolung, D. (2019) Analisis proksimat tepung daging buah labu kuning (*Cucurbita moschata*). *Fullerene Journ. of Chem.*, 4(1), 8-11.
- Firdausy, N., Rosida, D. F., & Winarti, S. (2023). Chemical characteristic of flakes with the proportion of corn flour and cowpea flour enriched with sunflower seed oil. *Jurnal Pangan dan Agroindustri*, 11(1), 21-29
- Hussain, A., Kausar, T., Sehar, S., & Sarwar, A., Ashraf, A. H., et al. (2022) A Comprehensive review of functional ingredients, especially bioactive compounds present in pumpkin peel, flesh, and seeds, and their health. *Food Chemistry Advances*, 1, 10067. <https://doi.org/10.1016/j.focha.2022.10067>
- Indonesian Ministry of Health. (2023). *Petunjuk Teknis Pemberian Makanan Tambahan (PMT) Berbahan Pangan Lokal untuk Balita dan Ibu Hamil*. [https://kesmas.kemkes.go.id/assets/uploads/contents/others/20230516\\_Juknis\\_Tatalaksana\\_Gizi\\_V18.pdf](https://kesmas.kemkes.go.id/assets/uploads/contents/others/20230516_Juknis_Tatalaksana_Gizi_V18.pdf). Accessed in July 17, 2023.
- Kusnandar, F., Suryani, & Budijanto, S. (2020). Functional, physical, and sensory characteristic of corn breakfast cereals substituted by fermented rice bran. *Jurnal Aplikasi Teknologi Pangan*, 9(3), 1-5. <https://doi.org/10.17728/jatp.7517>
- Mardiah, T. F., Widowati, S., & Andini, S. F. (2020). Proximate composition of three varieties of pumpkin flour (*Cucurbita* Sp). *Jurnal Agroindustri Halal*, 6(1), 1-5.
- Nakhon, P. P. na S., Jangchud, K., Jangchud, A., & Charunuch, C. (2018). Optimization of pumpkin and feed moisture content to produce healthy pumpkin-germinated brown rice extruded snacks. *Agriculture and Natural Resources*, 52, 550-556. <https://doi.org/10.1016/j.anres.2018.11.018>
- Provesi, J. G., & Amante, E. R. (2015). Chapter 9: Carotenoids in pumpkin and impact of processing treatments and storage (pp: 71-80). *Processing and Impact on Active Compound in Food*. <http://dx.doi.org/10.1016/B978-0-12-404699-3.00009-3>
- Qamar, S., Aslam, M., Huyop, F., & Javed, M. A. (2017). Comparative study for the determination of nutritional composition in commercial and noncommercial maize flour. *Pakistan Journal of Botany*, 49(2), 519-523. <https://www.researchgate.net/publication/317010970>
- Ramadhani, G. A., Izzati, M., & Parman, S. (2012). Analisis proksimat, antioksidan, dan kesukaan serela makanan dari bahan dasar tepung jagung (*Zea mays* L) dan tepung labu kuning (*Cucurbita moschata* Durch). *Buletin Anatomi dan Fisiologi*, XX(2), 1-5.
- Sheng, S., Li, T., & Liu, R. H. (2018). Corn phytochemicals and their health benefits. *Food Science and Human Wellness*, 7, 185-195. <https://doi.org/10.1016/j.fshw.2018.09.003>
- Susanti, I., Lubis, E. H., & Meilidayani, S. (2017). Breakfast flakes based on mocaf and corn flour. *Warta IHP/Journal of Agro-based Industry*, 34 (1), 44-52
- The Chemistry of Pumpkin. (2023). [<http://www.calpaclab.com/the-chemistry-of-pumpkins/>] accessed on July 17<sup>th</sup> 2023
- Usha, R., Lakshmi, M., & Ranjani, M. (2010). Nutritional, sensory and physical analysis of pumpkin flour incorporated into weaning mix. *Mal J Nutr.*, 16(3), 379-387

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- WHO (World Health Organization). (2023). *Malnutrition*. [https://www.who.int/health-topics/malnutrition#tab=tab\\_1](https://www.who.int/health-topics/malnutrition#tab=tab_1). Accessed in July 17, 2023.
- Widi, S. (2023). *Sebaran prevalensi stunting Indonesia 2022, Tertinggi di NTT*. <https://dataindonesia.id/ragam/detail/sebaran-prevalensi-stunting-indonesia-2022-tertinggi-di-ntt>. Accessed in July 17, 2023.
- Yokasing, Y. B., Abdullah, A., & Pangalinan, A. (2019). Effect of rotation, mass, distance, and wide end of the stem forging against the thinnest of 'Jagung Titi' on the performance of the forging corn mechanism. *ICESC 2019*, October 18-19, Indonesia. <https://doi.org/10.4108/eai.18-10-2019.2290005>
- Zhavira, H., Nurwantoro, & Rizqiati, H. (2020). Effect of yellow pumpkin (*Cucurbita moschata*) flour addition on proximate levels and calories of white millet (*Panicum milliaceum*) Flakes. *Journal of Applied Food Technology*, 7(2), 33-37. <https://doi.org/10.17728/jaft.7268>