The Quality of Instant Noodle Made from Local Corn Flour and Tapioca Flour

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Abstract—The demand for imported wheat flour is predicted to increase by at least 6% every year in Indonesia. Whereas on the one hand, each region in Indonesia actually has the potential of local food such as corn and cassava flours. The objective of this study was to obtain the best formulation in the production of instant noodle made from corn and cassava flours. Research was conducted experimentally using Complete Randomized Design with three replications for each treatment. The data obtained were analyzed by ANOVA and the sensory evaluation data were analyzed by Q Test. Results show that addition of 55% cassava flour resulted in instant noodle which meet the Indonesian quality standard of Instant Noodle (SNI 01-3551-2000) except for protein content of less then 4%. Sensory test data showed no difference between instant noodle made from local corn flour substituted with cassava flour and that from commercial instant noodle.

Index Terms—Instant noodle, corn flour, tapioca, quality

I. INTRODUCTION

Indonesia is one country that has a less stable food security. People’s dependence on rice is quite high, so the demand for rice is very high and when there is a shortage of rice in the country, the government had to import it. Therefore, there is a need for diversification in order to reduce the dependence on the rice. Today, fast food and drinks are very attractive to the public. One of the popular fast food for Indonesian society is instant noodles. The instant noodles have now become the second staple food after rice. However, in contrast to rice, 100% of the main raw material for making the instant noodles must be imported from abroad. Wheat flour is a product that can only grow well in a four-seasoned and sub-tropical region. This has led to increased imports of wheat flour from abroad. In order to reduce imports of wheat flour, a lot of efforts have been made to find a replacement. One source of carbohydrates that can replace wheat flour is corn flour.

Corn is one of the food alternatives to replace rice in Indonesia. It can be seen in the Madura and West Nusa Tenggara, Indonesia. Therefore, the use of corn flour as raw material for making instant noodles can likely be accepted by many people of Indonesia. Corn production in Indonesia in 2014 was 19,032,677 tons, the production increased by 2.81% as compared to the year 2013 which reached only 18,511,853 tons [1].

The corn noodle has its own advantages compared to other noodles such as having a natural yellow color produced by β-carotene, lutein, and zeaxanthin. In addition, the corn noodles also have a greater nutritional value than rice, cassava and sweet potato i.e., about 360g kalori/100 material “unpublished” [2]. The purpose of present study was to determine the formula and optimal manufacturing process design of the instant noodles made from the corn flour and tapioca.

II. MATERIAL AND METHODS

A. Materials and Tools

The main raw material used in this study was dried corn from the local varieties of Pelalawan Regency and commercial tapioca. The additional ingredients in making the instant noodles were eggs, CMC, cooking oil and chemicals for analysis. The tools used in this study includes the tools for making instant noodles and other equipments for the analysis of quality parameters such as analytical balance, oven, AAS (Atomic Absorption Spectrophotometer).

B. Research Methods

The research for making of the corn instant noodles was experimentally conducted using Completely Randomized Design (CRD) with the treatment of tapioca flour addition as follows:

JT0 = 100% the corn flour and 0% tapioca flour
JT1 = 75% the corn flour and 25% tapioca flour
JT2 = 65% the corn flour and 35% tapioca flour
JT3 = 55% the corn flour and 45% tapioca flour
JT4 = 45% the corn flour and 55% tapioca flour

C. Preparation of Corn Flour

In this study, the corn flour of Riau local corn originating from Pelalawan Regency was used. The ground corn was first cleaned of the dirt by winnowing. Once clean, the corn was refined using the corn grinding machine twice. The first grind was to break down corn kernels into broken corn. A second grinding is to smooth the corn into corn flour. The corn flour was aerated on the floor paved with sacks. If this is not done, the corn flour will smell bad and the corn flour color change due to browning reactions. Then corn flour is sifted using a sieve size of 100 meshes. Part of the corn which cannot pass the sieve will be refined in order to be re-sieved using a 100 mesh sieve.
D. Preparation of Instant Noodles

Stages of making corn instant noodles were made by standard methods [3, 4] with slight modifications. The main ingredient only consisted of 250 grams of corn flour or tapioca flour and corn flour with appropriate treatment. Additional ingredients are CMC (1%), salt (1.3%), an egg and backing soda (0.3%) and 150 ml of water. Mix the main ingredients with additional materials and knead them evenly for ± 15 minutes until smooth clotted dough is formed. The dough is then made into small dots, and then milled with sheet-forming roller, folded twice and then rolled back. This process is done several times until the surface is completely flat dough. The dough sheet steamed in a steamer boiler at a temperature of 100°C for 15 minutes and allowed to cool. After that, the dough sheets were cut to form strands of noodles. The noodles were dried using a cabinet dryer at a temperature of 65-75°C for 2-3 hours. Noodles then were continued with the frying process, in order to get instant noodles. Furthermore noodles packed in suitable packaging and analyzed. Parameters observed were were made according to the Indonesian National Standard for instant noodles (SNI 01-3551-2000). Observations were focused on the intactness of the noodles, the water content after drying and frying, protein content, acid value using Method of AOAC [5] and acceptance test by the panelists.

E. Data Analysis

The Data were statistically analyzed with an analysis of variance. If F count is greater than or equal to F tables, analysis was continued with DNMRT test at 5% level. While the data acceptance by panelists were tested using Cochran’s Q test.

III. RESULTS AND DISCUSSION

A. Intactness

The results from the analysis of variance show that the treatment ratio of the corn flour and tapioca had a significant effect on the intactness of the instant noodles (Fig. 1).

![Figure 1. The intactness of instant noodles made from corn flour and tapioca flour](image)

*The different small letters are significantly different according to DNMRT test at the 5% level.

Fig. 1 shows that the average intactness of corn flour and tapioca-based instant noodles varies between 42.78-96.96%. The treatment of JT0 was not significantly different from that of JT1, but was significantly different from that of JT2, JT3 and JT4. The treatment of JT0, a treatment using 100% of corn flour has the lowest intactness scores. This is maybe due to lack of amylopectin fraction in the corn flour. Amylopectin can stimulate puffing process and make the material becoming wetter, form a cohesive gel and gummy texture as well as more amorphous [6]. The elastic and cohesive nature of amylopectin structure resulted in a more pliant dough so that the instant noodles is not easily broken.

Instant noodles made from wheat flour have better intactness because they have high gluten content with the protein fraction such as gliadin and glutenin. This is consistent with [7] who says that the gluten in wheat can make the dough more tough and not easily torn or broken due to its elastic, cohesive and strong nature. It is different from corn flour which does not have enough gluten to form elastic dough. Thus, the corn flour instant noodles are easily broken, fragile and low intactness. This results from high zein content which could amount to 60% in the corn. This finding is consistent with [8] who stated that the high zein content makes noodles difficult to be shaped and molded because zein can shape the dough elastic-cohesive mass.

The intactness of instant noodles made from the treatment JT4 has already met the quality Indonesian standard of instant noodles (SNI 01-3551-2000) with intactness scores of 96.96%.

B. Moisture Content

Moisture contents are important components in foodstuffs that can affect the quality of the material. Decreased amount of water can affect the rate of food destruction caused by microbiological, chemical and enzymatic. The low moisture content of a foodstuff is one way to preserve the food. Moisture content reduction process can be done with the drying or frying process. In the drying process, the moisture content is reduced by evaporating moisture in the material using heat energy, whereas in the frying process, the removal of a large amount of water occurs of the food and the oil absorption into the food.

According to SNI 01-3551-2000, the moisture content of the instant noodle maximally scores 14.5% (after drying) and 10% (after frying) respectively. The results of analysis of variance of the instant noodles made from local corn flour and tapioca with different ratio had no significant effect on the moisture content after drying but had a significant effect after frying process. The average moisture content of the instant noodles is presented in Fig. 2 and Fig. 3.

Fig. 2 shows that the average water content of the corn flour and tapioca instant noodles varies between 6.96-7.71%. Such an average water contents were not significantly different at each treatment because the composition of constituent materials was not different as well. In a relatively similar process, the difference of the water content can be caused by the different water content of the raw materials or the material physical difference, especially the water holding capacity.
The water content of the instant noodles for all treatments after drying process had conformed to the quality standard of the instant noodles (SNI 01-3551-2000) with the scores of not more than 14.5%.

![Figure 2. The moisture contents of the corn flour and tapioca instant noodles after frying](image)

**Figure 2.** The moisture contents of the corn flour and tapioca instant noodles after drying

![Figure 3. The water contents of corn flour and tapioca instant noodles after frying](image)

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The water content of the instant noodles for all treatments after drying process had conformed to the quality standard of the instant noodles (SNI 01-3551-2000) with the scores of not more than 14.5%.

C. Protein Contain

Protein is an important nutrient for the body, because these substances in addition to functioning as a fuel in the body, it also serves as a builder and regulator substances [10]. The protein is a compound composed mostly of nitrogen. The number of these elements can be used as a basis for determining the protein content in instant noodles made from corn flour and tapioca.

Results from analysis of variance showed that treatment of corn flour and tapioca ratio significantly affected the protein content of instant noodles (Fig. 4).

![Figure 4. The protein content of corn flour and tapioca instant noodles](image)

**Figure 4.** The protein content of corn flour and tapioca instant noodles

Fig. 4 shows that the instant noodle protein content varies between 2.83-6.08%. The data show that protein content decreased when tapioca was added. The more the tapioca added, the lower the protein content. This is due to the protein content of the raw materials used in making the instant noodles. Corn has protein content for 9.54% and tapioca has only 0.03-0.6%.

The instant noodle protein content in the treatments JT0, JT1, JT2 and JT3 with average protein content varies between 2.83-6.08%. The data show that protein content had not met the standard because it contained less than 4.0% of protein.

D. Total Acid Value

Acid value indicates the number of free fatty acids in oils and is expressed as mg base per 1 g of oil. Fatty acids contained in the foodstuff both high and low levels will undergo chemical changes that could affect the smell and taste of the food, so the more free fatty acid content, the faster the material will be rancid. According to SNI 01-3551-2000, total acid value of the instant noodle product should be less than 2%.

Results from the analysis of variance showed that treatment of corn flour and tapioca ratio significantly affected the acid value of instant noodles produced (Fig. 5). The addition of tapioca affected significantly on the total acid value. Treatment JT0 using 100% of corn flour (JT0) have higher acid number than 25% of the tapioca addition (JT1) and 35% (JT2), but lower than the use of tapioca of 45% (JT4) and 55% (JT4). Fat content in the corn flour comes from endosperms that were not removed during the process of making corn flour. “Reference [11]”, fat content in corn
are undercooked, the center of the noodle still feels hard
noodles. If the noodles are overcooked, then the noodles
important to produce the desired texture of cooked
overcooked. Determination of optimal rehydration time is
fully cooked and ready to eat, but keep them from being
and then calculates the time it takes until the noodles are
rehydration is done by cooking noodles in boiling water,
tough and elastic like before it dried. Optimum timing of
for the noodles to re-absorb water so that the texture is
rehydration time. Rehydration time is the time required
water will be higher.
of hydroxyl groups is increasing, the ability to absorb
resulting in swelling of the starch granules. If the number
absorption of water into the noodles. This is consistent
with Suarni and Richana [10] who stated that the
absorption of free hydroxyl groups due to the content of free hydroxyl
groups due to the high amyllose content in corn flour. The
presence of free hydroxyl groups resulted in the easier
absorption of water into the noodles. This is consistent
with Suarni and Richana [10] who stated that the
presence of free hydroxyl groups will absorb water,
resulting in swelling of the starch granules. If the number
of hydroxyl groups is increasing, the ability to absorb
water will be higher.

E. Rehydration Time

One of the important parameters of instant noodles is
rehydration time. Rehydration time is the time required
for the noodles to re-absorb water so that the texture is
tough and elastic like before it dried. Optimum timing of
rehydration is done by cooking noodles in boiling water,
and then calculates the time it takes until the noodles are
fully cooked and ready to eat, but keep them from being
overcooked. Determination of optimal rehydration time is
important to produce the desired texture of cooked
noodles. If the noodles are overcooked, then the noodles
can become sticky and easily crushed. Conversely, if they
are undercooked, the center of the noodle still feels hard
when chewed.

The results from analysis of variance showed that
treatment of corn flour and tapioca ratio significantly
affected the rehydration time of instant noodles (Fig. 6).
The data from Fig. 6 showed that the average time of
rehydration of the instant noodles ranged from 4.30 to
5.41 minutes. This time was much longer than the
rehydration time of the commercial instant noodles which
is around 4 minutes.

The length of time can be caused by the rehydration of
the surface hard and dense texture of the noodle, due to
the combination of drying and frying process so that it is
hard for the water to get into the noodle quickly during
the rehydration [4]. In addition, the addition of tapioca as
a binder increases the density of the tapioca molecules in
the dough, so it takes the water longer time to get into the
starch “unpublished” [14].

“Reference [15]”, the short time of rehydration in
wheat instant noodles is due to the formation of pores in
the noodle which make it easy for the noodle to absorb
the water when cooked. The pores are formed by the
mixing of flour with water in a certain ratio so that the
protein in the flour will form dough mass or plastic
colloidal dough that can hold gas and will form a spongy
structure when baked.

Rehydration process on corn flour and tapioca instant
noodles may occur due to the content of free hydroxyl
groups due to the high amyllose content in corn flour. The
presence of free hydroxyl groups resulted in the easier
absorption of water into the noodles. This is consistent
with Suarni and Richana [10] who stated that the
presence of free hydroxyl groups will absorb water,
resulting in swelling of the starch granules. If the number
of hydroxyl groups is increasing, the ability to absorb
water will be higher.

F. Acceptance Test by the Panelists

Table I shows that there were 36 panelists who
accepted the sample of the uncooked commercial instant
noodles and there is only 1 panelist who did not receive it.
All panelists (37) received the sample of cooked
commercial instant noodles. Whereas, the sample of the
raw corn flour and tapioca instant noodles was accepted
by 34 panelists and 3 panelists rejected the sample. There
were 33 panelists who accepted the sample of cooked
corn flour and tapioca instant noodles and 4 of them
rejected the sample.

| TABLE I. NUMBER OF PANELISTS WHO ACCEPTED OR REJECTED THE CORN FLOUR & TAPIOCA INSTANT NOODLES AND COMMERCIAL INSTANT NOODLES |
| Samples | No. of panelist Accepted | No. of panelist Rejected |
| Commercial instant noodles (uncooked) | 1 | 36 |
| Commercial instant noodles (cooked) | 0 | 37 |
| Corn flour & tapioca instant noodles (uncooked) | 3 | 34 |
| Corn flour & tapioca instant noodles (cooked) | 4 | 33 |
Data were then analyzed for Cochran’s Q Test Acceptance using SPSS and the results can be seen in Table II.

### TABLE II. STATISTIC TEST OF CORN FLOUR AND TAPIOCA INSTANT NOODLES

<table>
<thead>
<tr>
<th>Panelist Number (N)</th>
<th>Cochran’s Q</th>
<th>DF</th>
<th>Asymp. Significance (Cumulative probability score)</th>
</tr>
</thead>
<tbody>
<tr>
<td>37</td>
<td>5.455a</td>
<td>3</td>
<td>0.141</td>
</tr>
</tbody>
</table>

Table II shows that the chi-square score or Cochran is 5.455. At the level of 5%, the score was 7.814. Since X² is smaller than the critical value, H₀ is accepted and H₁ is rejected. In addition, there is also a cumulative probability value or Asymp. Significance of 0.141. Since the cumulative probability value of 0.141 is bigger than significance level value of 0.05, then null hypothesis is accepted and alternative hypothesis is rejected (If the cumulative probability value > significance level value, H₀ is accepted, and if the cumulative probability value < significance level value, H₀ is rejected). This analysis shows that corn flour and tapiocal instant noodles before and after being cooked can be accepted by the panelists. The main factor of the panelist’s acceptance of the corn flour and tapioca instant noodles is the long shape and appearance of the noodles and looks like commercial instant noodles. The assessment of the food product quality is very dependent on several factors such as taste, color, texture and the nutritional value. However, before considering such factors as texture and the product appearance are very essential. A nutritional and tasty food product is unacceptable when the appearance and texture are not attractive [16]. Texture and intactness of instant noodles are generally influenced by the raw material formula. Besides, processing also influences the texture and intactness of instant noodles [4].

## IV. CONCLUSION

Instant noodles produced by applying corn flour 45% and tapioca 55% had met the quality of the Indonesian standard for instant noodles, except the protein content of 2.81% (minimal 4% according to the quality standard). Instant noodles made from local corn flour substituted with cassava flour could be accepted by panelists like commercial instant noodles.

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### REFERENCES


Usman Pato is professor in Food Sciences at Faculty of Agriculture, Riau University. He was born in Kalosi, South Sulawesi, Indonesia on 20 January 1966. He obtained his BSc in Agricultural Product Technology from Hasanuddin University, Makassar, South Sulawesi, Indonesia in 1989, and MSc. in Food Science from Shinsu University, Japan in 1997. He earned his PhD in Food Science from the United Graduate School of Agricultural Sciences, Gifu University, Japan in 2000. He has been working in Faculty of Agriculture, Riau University, Pekanbaru, Indonesia since 1990. He served as Vice Dean on Academic Affair from 2005-2009. Then he was assigned as a Dean of this faculty for first period from 2009-2013 and the second period from 2017-2017. He already published 5 books and around 65 articles in the national and international proceedings and journals. Recently published book is: LOCAL PROBIOTIC, Prospect and Its Application (Pekanbaru, Indonesia, UR Press, 2013) and published paper entitled “Bile and acid tolerance of lactic acid bacteria isolated from tempeyak and their probiotic potential” (Journal of Agricultural Technology, 9(7):1849-1862, 2013). Recent and previous research interest is mainly on processed food and functional food from various local raw foodstocks. Prof. Usman is a member of both Indonesian Association of Food Technologist (PATPI) and the Indonesian Society for Microbiology (PERMI).
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