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## Quality Test of Corn Flour from Pulut Corn Cob Waste (*Zea mays ceratina*. L) by Fermentation

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**Abstract.** Pulut type corn or waxy corn has been developed in several areas in South Sulawesi. From year to year, the productivity of corn pulut has increased, this also shows that agricultural waste production has also increased. The agricultural waste produced by corn cobs. The purpose of this study was to determine the processing of corncob waste into cornflour and to determine the characterization of the quality of cornflour, especially microbial contamination based on SNI standards. Methods: water content using a gravimetric method, ash content using a gravimetric method, microbial contamination test using ALT method of 25-250 colonies/gram counted, and analysis of mold and *E. coli* bacteria. The results showed that the ash content was 0.0766%, 17.49 % moisture content, 17.49% protein content, ALT  $1.9 \times 10^6$ , mold analysis of  $10,4 \times 10^2$  colonies/gram, and analysis of *E. coli* bacteria amounting to 8,1 APM / g and *Bacillus cereus* with a resistance value of  $<1.0 \times 10^2$  coloni/g (negative value) indicates that it does not meet the SNI standard.

### Introduction

For the people of Indonesia, corn is the main food commodity after rice which can improve the economy and agriculture of a region. *Pulut corn* or *waxy corn* is widely developed in several areas in South Sulawesi. Waxy corn contains 100% amylopectin which gives it a sweet, fluffier taste and good texture (Mahendradatta and Tawali, 2008). When compared to other types of corn, waxy corn gets less attention from farmers. This is due to the lack of promotion and education on how to treat it.

In addition to the seeds that can be consumed, the stems and leaves of waxy corn can be used. The stems and leaves can be used as animal feed and green manure or compost (Budiman, 2008).

From year to year, the productivity of waxy corn has increased, this also shows that the production of agricultural waste has also increased. Agricultural waste produced by corn cobs. Corn cobs are obtained when the corn kernels are separated from the fruit so that corn seeds are obtained. The nutritional content in corn cobs includes 72% carbohydrates, 29.54% water content, 8.01% protein, and 8.56% crude fiber (Gelora, 2019).

Corn cobs have benefits as animal feed, craft materials, and as an alternative fuel. However, the use of corn cobs into flour is still rarely done. Based on the chemical composition of corn cobs, corn cobs have prospects as food and industrial raw materials that provide added value for farming these commodities (Ratna, 2014).

Corn cobs are hard textured, dull white in color, has fairly lightweight, and usually have a sweet taste that is characteristic of corn which allows it to be used as cornflour. This modified cornflour from corn cob waste can be developed as a substitute for wheat flour into a food product.

Making corn flour from corn cobs waste by adding microbes to improve the quality of corn flour produced, such as the addition of bacteria belonging to the lactic acid group such as *lactobacillus casei* (Gerez et al, 2006). Tape yeast is a starter used to make tape, which contains microorganisms belonging to lactic acid bacteria such as *lactobacillus casei* (Ganzle, 2008). The production of lactic acid from the fermentation process has advantages over yeast (Khasanah, 2014). Production produced has a high purity of about 97% (Fafa and Hasbullah, 2017).

Fermentation is a relatively inexpensive process, with this process being able to simplify complex carbohydrates,

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forming proteins so that the nutritional value of the fermented material is higher than the original (Samsudiin, 2011). Research on the manufacture of corn flour using the fermentation method has been carried out by Nur Aini et al. (2016), while another study on the calculation of lignin and crude fiber content of corn cobs was conducted by Kriskenda (2016).

Based on the description of the background, as well as to increase the utilization of corn cobs which have been less economically valuable, a study was conducted to determine the quality content of cornflour and corn cobs, it is necessary to characterize the quality of corn quality, especially microbial contamination based on SNI standards.

This study aims to determine the processing of corn cobs waste into cornflour and to determine the characterization of the quality of cornflour, especially microbial contamination based on SNI standards. The manufacture of cornflour uses the fermentation method and the analysis of microbial contamination using the analytical method of SNI 3751-2009.

## Experimental

### Materials and Methods

The tools used include 80 mesh sieve, desiccator, oven, Kjeldhal flask, glassware, petri dish, water *bath shaker*, and autoclave.

The ingredients used include corn cobs, *Lactobacillus casei* bacteria, *Bacillus subtilis*, *Escherichia coli*, concentrated sulfuric acid ( $H_2SO_4$ ), sodium hydroxide 30%, BCG+MM indicator, 0.05 N hydrochloric acid, mold, *nutrient agar* (NA), *nutrient broth* (NB), PCA media, PDA media, CCA media.

### Procedures

Manufacture of corn starch from corn cobs with sticky use yeast fermentation process by adding tape, *Lactobacillus casei*. The production of waxy corn flour is done by soaking the corn cobs using *L. casei* bacteria. The comparison between corn cobs and *L. casei* bacteria was 1:2, this fermentation was carried out for 4 days. The analytical method used in this study refers to SNI 3751-2009, the procedure is as follows:

### Organoleptic Test

Analysis of the test samples organoleptically by paying attention to the smell, color, shape of cornflour. Organoleptic test category using a scale of 2.00-3.00 = dislike, 3.01-5.00 = like.

### Fineness degree measurement

Prussian 200 grams of sample was put into a 170 mesh sieve for 10 minutes. Weigh the remaining portion in the sieve.

### Ash content analysis

The porcelain dish is clean, heated using an oven at 550 °C for 30 minutes, then drains in a desiccator for 30 minutes, then weigh the dish (A gram). Weigh the sample as much as 3 grams (porcelain cup + sample = B grams). Put in the oven at a temperature of 550 0 C for 30 minutes, then cool in a desiccator for 30 minutes, and then weigh (porcelain cup + sample = C gram).

### Water content analysis

Weigh the sample as much as 2 grams, then analyzed using a moisture analysis tool. Record the results.

### Protein analysis

1 gram of the sample was weighed and then put into an Erlenmeyer flask. A mixture of 1 gram of catalyst selenium and 10 mL  $H_2SO_4$ , concentrated have been made previously entered then heated to boiling and turning into a greenish tint. Then it was distilled using a Kjeldahl flask. Then 15 mL of 30% NaOH solution was added and a mixture of BCG + MM indicator was added. Solution of the mixture digital with a solution of HCl 0.05 N then calculates the levels of protein her.

### Total Plate Number (Plate Count Method)

25 grams of the sample was weighed into an Erlenmeyer containing 225 mL of diluent then 1 mL was pipetted into a sterile petri dish. Pipette 15 mL median PCA into a petri dish and incubate for 3 days. Record the number of colonies.

### Mold

25 grams of sample is weighed into Erlenmeyer containing 225 mL of 1 mL of diluent then pipetted into a sterile petri dish. Pipette 15 mL median PDA into a petri dish and incubate for 3 days. Record the number of colonies.

### *Bacillus careus* Test

Weigh 50 grams of the sample into the bottle then add 450 mL of BPW. Make the dilution level from  $10^{-2}$ - $10^{-6}$ . Then inoculate 0.1 mL of 1:10 each using a sterile loop on

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the surface of the MYP salt medium for 24 hours. Record the number of colonies.

***Escherichia coli***

CCA media was poured into Petri dishes and then compacted. The resulting solution was then filtered using a filter membrane and then incubated for 48 hours.

**Result and Discussion****Organoleptic Test**

Organoleptic test or sensory test or sensory test is a test method using the human senses as the main tool for measuring product acceptance. Organoleptic testing has an important role in the application of quality. The test parameters on organoleptic were color, texture, taste, and aroma. The results of the organoleptic test on corn flour are presented in Table 1.

**Table 1.** Quality results of organoleptic test samples of corn cobs (*Zea mays ceratina* L.)

Organoleptic Test	Average	Category
Color	3.75	Like
Texture	4.50	Like
Taste	2.87	Do not like it much
Scent	3.84	Like

**Table 2.** Organoleptic test on samples of corn cobs (*Zea mays ceratina* L.)

Organoleptic			
Color	Texture	Taste	Smell
White	Smooth	Slightly sour	Acid

Based on Table 1 shows organoleptic tests on color, texture, and aroma are included in the like category. While the taste with an average value of 2.87 is included in the category of dislike. The taste produced from corn cobs waste is slightly acidic due to the fermentation process using *Lactobacillus casei* bacteria.

**Ash Content Analysis**

Ash content testing aims to determine the quality of processing, determine the type of material used, and as a parameter determining the nutritional value in food and beverages. Ash is an inorganic substance leftover from the combustion of inorganic material. The high value of ash content in a sample indicates that the essential mineral content is also high. The content of essential minerals in corn such as K, Na, P, Ca, and Fe.

Based on the results of the analysis of the ash content of the corn cobs waste samples obtained by 0.0766% while based on the SNI standard it shows a value of 1.5%, this shows that the samples of corn cobs waste meet the SNI standards.

**Water Content Analysis**

Determination of water content is useful for determining the resistance of a material in storage and is a good way of handling material to avoid the effect of microbial activity. The low amount of water content makes the material more resistant to storage for a relatively long period. The water content obtained in this study was 14.32%, while the quality requirement of the Indonesian National Standard (SNI) for flour was 10%. This shows that the sample of corn cobs waste has a relatively short storage time when compared to other types of flour.

**Protein Analysis**

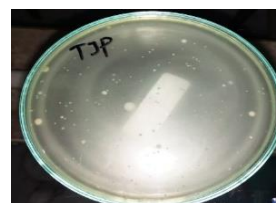
Protein analysis is generally carried out in the food industry, both food for humans and animals. Protein analysis is carried out to determine the amount of protein in food. Protein assay can be done by the Kjeldahl method. In principle, the sample is digested with strong acid, the peptide bonds will break down to release nitrogen atoms, whose levels are analyzed by titration techniques.

The protein content produced in this study was 17.49%, this figure indicates the digestibility and essential amino acid content of white rice flour. When compared with the SNI standard for flour, which is in the range of 7.0%, this indicates that the sample of waxy corn flour meets the SNI standard.

**Total Plate Number (plate count method)**

The total plate number aims to determine the number of bacteria in a sample. In addition, the ALT test was carried out to see the possible shelf life of cornflour.

Based on the requirements of the SNI quality test, the maximum number of colonies in the wheat flour sample was  $10^6$ , while based on the results of the study, the ALT results in the corn cobs waste samples were  $1.9 \times 10^6$ . This shows that the sample meets SNI standards.



**Figure 1.** ALT. Test Results

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**Mold**

Analysis of molds in wheat flour samples aims to determine the total amount of mold contamination in the sample. If the analysis value shows large, then the number of molds contained in the sample is also large. The results of the mold analysis obtained in this study were  $10.4 \times 10^2$  colonies/g. Meanwhile, based on the SNI quality standard, the mold analysis value was  $10^4$ . Which shows that the sample meets the SNI standard.



Figure 2. Mold Analysis Test Results

**Bacillus subtilis test**

The bacteria *B. subtilis* is one of the antagonistic bacteria that are widely used in controlling soil-borne pathogens. Soil-borne pathogens in the form of fungi, bacteria, nematodes, and viruses are capable of infecting and causing disease in plants. In addition, the presence of *B. subtilis* bacteria in food products can cause poisoning for those who consume them. So it is necessary to analyze to determine the presence of these colonies. Based on the results of research conducted on samples of corn cobs waste, the resistance value of  $<1.0 \times 10^2$  k colony/g (negative value) indicates that it does not meet the SNI standard.

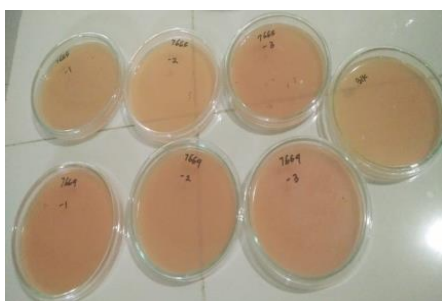


Figure 3. Molarity variation of  $\text{FeSO}_4$ ; samples K<sub>1</sub>, K<sub>2</sub>, and K<sub>3</sub> on UV-Vis test

**Escherichia coli**

*E. coli* is a gram-negative bacteria that is found in the digestive tract, animal, and human feces. The bacteria *E. coli* was reported also often found top existing food and beverage products for the necessary tests to determine the

existence and the number of colonies in a sample. Given its existence that can endanger human health and has been resistant to antibiotics.

Based on the results of research conducted on samples of corn cobs waste, it was obtained 8.1 APM/g with a maximum limit of 10 APM/g. This indicates that the presence of *E. coli* bacteria in the sample meets SNI standards.

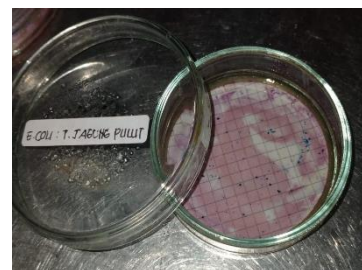


Figure 4. *E. coli* test results

**Conclusion**

The results of the corn flour test showed that the proximate content (ash content, protein content, and total plate count) with values of 0.0766%, 17.49%,  $1.9 \times 10^6$ , respectively has met the SNI standard (SNI 01-3751-2009), except for the water content with a value of 14.32% which indicates that corn flour has a short shelf life. The analysis test of mold and *E. coli* was  $10.4 \times 10^2$  colony/g and 8.1 APM/g, respectively. while *Bacillus cereus* with a resistance value of  $<1.0 \times 10^2$  k colony/g (negative value) indicates that it does not meet the SNI standard.

**Conflict of Interest**

The authors declare that there is no conflict of interest.

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