

Formulation of Artificial Rice Cereal by using Fermentation of *L. Plantarum* POLIJE 15420 for Diabetes Mellitus Patients

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Abstract. The rheological characteristics of POLIJE's artificial rice cereal have been examined by using a single screw extruder with a fermentation process using a new strain of *L. plantarum* bacteria POLIJE 15 420 (HI.05.01.03.050.0226/2010/US Patent) on the raw materials used. Nowadays, the development of artificial rice cereal variants has been investigated as a form of serving instant healthy food, using various combinations of the formulation and optimizing POLIJE extruder machine (Patent number: P00201100694 in 2011). The research objectives are optimizing the screw extruder cereal, examining the extruder performance on produced formula, and evaluating the characteristics of the products developed commercially. The results showed that POLIJE's single screw extruder machine reached the maximum speed at 225 ± 25 rpm with a fluid speed of 0.19×10^{-157} Pa. Based on FLUENT, it indicated that the biggest speed of fluid flow from the screw angle of 2.5 degrees was 0.780727403 m/s, while the screw angle of 5 degrees and 7.5 degrees were 0.184929482 m/s and 0.534818848 m/s.

1. Introduction

The development of artificial rice becomes one of the priorities and it plays a pivotal role in reducing the rate of rice consumption and functioning as food alternatives for controlling *diabetes mellitus*. Indonesia as a developing country has the largest rice consumption rate compared with other Asian countries. This position makes Indonesia becomes the largest net importers of rice. On the other hand, Indonesia has high potential of crops such as cassava and corn which is classified as indigenous natural wealth. Indonesian people have not maximized the consumption of these indigenous crops, even put them inferiorly. Some previous research result show that indigenous crops have a complex carbohydrate with a low GI value and contain a component for lowering blood sugar.

In 2014, a research team has developed encapsulation of POLIJE 15420 *L. Plantarum*. Further research has been done in 2015, and pursued the development of further generation artificial rice by using a single screw extruder machine with the formulation of utilizing bacteria. The results of the studies provided a recommendation to develop artificial rice in the form of instant cereal breakfast which meets the necessity of today's demand. However, only few studies had been conducted especially on the cereal production with the concept of single screw extruder and utilizing bacteria in it.

The steps of producing cereal also involves gelatinization process. It is the conversion of a raw material to a cooked and digestible material by the application of heat and less water of 12-22% [1]. The design of the screw has been modified to affect the cutting process of the starch [2]. She further



gives the example of amylopectin on corns and soybeans which can be cut through friction forces. From this process, it also indicates the degradation of molecular weight both amylose and amylopectin. [3] adds the information that the degradation of molecular weight on corn starch frequently happens in amylopectin

Cereals also undergo protein changing. Extrusion on soy shows changes in protein solubility and the composition of globulin [4]. Due to a non-covalent interaction and a formation of *disulfide*, the protein is not dissolved during extrusion. That is why cereals made from artificial rice technique is new and unexplored, mainly because it involves indigenous raw ingredients.

Nowadays, the study which focuses on the composition formula and optimization of single screw extruder of the rheological characteristic of artificial rice cereal has not been done, including studies to decrease blood sugar. It is expected that the research results can develop artificial rice cereal which provide pivotal benefits to the community.

2. Research method

Determination of screw and die designs that will produce rice-shaped grains with optimum properties. For this reason, computer simulations are used using CATIA and ANSYS computer programming. Several screw and die models were tested in the computer simulation. Finally four screw and die pairs were obtained which will be tested in the experimental stage.

At the experimental stage the parameters observed are Shanon entrophy (Shanon, 1948) to measure the level of stirring from the screw extruder and the yield (% of rice produced): measures the ability of threads and dies in printing rice.

Artificial rice cereal variants can be made with the formulation of 40% corn and 50% mocaf (modified cassava flour) and other additional ingredients (in the process of drafting a patent). The first phase of research was examining the rheological aspects of the composition formula as shown in *Shanon entrophy* data, contribution, and feed density by optimizing screw extruder. It also covered the pace of incoming ingredients, the speed of screw rotary, and cooking temperature. The second phase was investigating proximate analysis aspects, the digestibility of *granulas'* micro-structure and the consistency of gel granules of artificial rice cereal as well as components in decreasing blood sugar.

3. Result and discussion

The artificial rice cereal is easy to prepare. Pour the cereal into your bowl and add boiled water slowly, until the cereal begins to float a bit and wait for about 15 minutes. Finally, it is ready to be served.

This artificial rice cereal had rheological characteristics which has been identified by using *chromameter*. It had a specific color with the value of L 81.11, a + b + 3.21 and 26.03. It indicated that the color of the artificial rice cereal was brown. This product contained 11.02 protein, 27.2 % amylose, and 155% expansion value. The water content in this product was 11%. It was under the maximum water content required by SNI (Indonesian National Standardization) or BSN with the level of 13 %. The storage life of this product which relates to Aw and air RH was 5 weeks without showing increasing water content. It is assumed that this product can be consumed safely until the eighth week at room temperature.

Further results showed that the POLIJE's screw extruder machine reached the maximum speed at 225 + 25 rpm with a fluid speed of 0.19 x 10⁻¹⁵⁷ Pa. Based on FLUENT result, it indicated that the biggest speed of fluid flow from the screw angle of 2.5 degrees was 0.780727403 m/s, while the screw angle of 5 degrees and 7.5 degrees were 0.184929482 m/s and 0.534818848 m/s. It was indeed well known that the smaller angle of the screw extruder, the bigger friction force produced. This happened because the increase of viscosity of the material had the greatest effect on a screw with a smaller angle.

The Artificial rice cereal variants could be made with the formulation of 40% corn and 50% mocaf (modified cassava flour) and other additional ingredients (in the process of drafting a patent). The preliminary characteristics which was essential for POLIJE's artificial rice cereal was development index of 155 % and amylose of 27.2 %. The pre-test which has done on mice using this product for 4 (four) weeks proved the decreasing level of sugar by 30 % and suspected to show improvement of insulin sensitivity. The value of IG for artificial rice cereal POLIJE variant is 70.

4. Conclusion

The artificial rice cereal can be produced by using the formulation of indigenous ingredients with a particular proportion and optimizing a screw extruder. When cutting the artificial rice cereal, it is urgent to consider about temperature accuracy, screw speed and water content of the dough. This artificial rice cereal can be developed commercially with the advantages of having a low GI, a longer shelf life of 4 (four) weeks, and ability to lower blood insulin levels by 30 percent

5. References

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