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Development Process Based On Healthy Artificial Rice By Using Local Tuber Single Screw Extruder

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Abstract —*One of the problems in order to diversify staple food is rice-eating people's habits. The development of healthy artificial rice from local ingredients such as maize, cassava and sago starch has not been developed commercially because of the complexity of processing. Extrusion cooking is a method that can simplify the process of stirring, printing and ripening into a single step process. To be applied in small industry in developing countries need to be developed extruder simple small machines.*

The purpose of this research is the development of a simple little machine extruder for making artificial rice which are of good quality and can provide an adequate profit margins for small industries. The study was organized into several stages, namely: (1) Design screw extruder and die; (2) Test the speed adjustment performance extruder with incoming materials, as well as the screw rotational speed cooking temperature; (3) Evaluate the character of the products in terms of quality and consumer acceptance; (4) Conducting economic feasibility studies.

The results obtained from the first year is the production of threaded and optimized with a single screw extruder, airangle of 7.5 degrees memghasilkan pressure fluid flow amounted to 1.2038339 x 10 ^ 17 Pa, a screw speed of 450 rpm with cold extrusion techniques which can produce artificial rice optimum use of raw materials formulations 30% flour and 70% corn flour mocaf which produces a color measurement value L 76.26, a + b + 5.35 and 31.39, protein content 9.73%; the fiber content of 5%; the water content of 9%; ash content of 0.52%; fat content 1.12%; and Kamba density of 0.58 g / ml. The bacteria that are used to biologically Modified Cassava Flour is a bacterial result of the development of the research team with the new strain L. plantarum polije 15420. Good design threaded design, formulation and methods of making artificial rice and bacteria have been filed for the patent drafting process.

Keywords*-artificial rice, maize, mocaf, single screw extruder*

I. INTRODUCTION

Indonesian habits people consume rice constrain diversification of staple food in order to improve national food security. Various types of materials carbohydrate source such as corn, cassava and sago has not been utilized optimally for the public opinion, "didnt eat if you do not eat rice". One attempt to solve the problem is to manufacture products that resemble rice (rice artificial) of maize, cassava and sago.

The solution is the development of artificial rice. Artificial rice production from local material formulations such as local soybeans, local maize and cassava has not been commercially developed due to the complexity of processing and constrained rheological properties of unknown material optimization. Currently on the market are caught in mocked by mocaf.

II. LITERATUR VIEW

Thought for the provision of "artificial rice" can be considered realistic as long as technically and economically feasible to do. While this technology making artificial rice cannot be widely implemented because the manufacturing process is complicated. To overcome these problems, the technology can be developed is extrusion. In the extrusion process there are several steps that can be covered are: mixing, stirring, printing and ripening (Guy [3]). Screw extruder configuration affects the amount of shear stress and affect the quality of the product (Bjorck and Asp, 1983). Value shear stress and high pressure die will result in expanded extrusion products (Guy [3]). In the manufacture of artificial rice it is undesirable. For the manufacture of artificial rice necessary modifications to the extruder machine, namely:

Adoption of extrusion cooking in developing countries is still very limited due to industrial units which produce extruded food generally from non-government and international scale. This is because generally the extruder is designed for large-scale production, which requires large capital and high technical ability. Development of a simple little machine is very suitable for the conditions of developing countries and its application to artificial rice processing is expected to develop small industries and increase diversification.Mouquet et al. [5], has been applying extruder simple small machines for the manufacture of instant porridge, wherein the engine has been used in Vietnam.

III. METHODOLOGY

3.1 Designing and Die Screw Extruder

The purpose of this phase is to determine the design of the screw and the die which will produce rice-shaped beads with optimum properties. For the use of computer simulation using CATIA and ANSYS computer programming. Some models of screw and die are tested in computer simulations. Finally there are four pairs of screw and die to be tested in an experimental stage.

In the experimental phase parameters were observed:

1. *Shanon enthrophy* : to measure the degree of agitation of the screw extruder.
2. The yield (% of rice produced): measures the ability of a screw and die in the printing of rice.

The data obtained were tested with Random Group 1 (a) factors and continued with the least significant difference test. Screw and die the most optimum chosen to test the effectiveness (Galmo [2]).

3.2 Machine-Extruder

Extruder machine is made by means of an extruder that has been designed previously. The use of a single screw extruder that simple. Power of the driving motor 10.5 kW, where the barrel length, the ratio of length / diameter and the shape and size adapted from the research stage before, with the diameter of the screw and the slope angle is adjusted from the previous stage research. To ensure the regularity of the speed of the incoming material, an extruder equipped with a feeding screw which can regulate the speed of the incoming material from 5 to 39 kg / h.

Outputs from this phase research study is an extruder machine that can be used in making artificial rice.

3.3 Testing the properties of the resulting artificial rice

The parameters observed in this study are:

- Proximate analysis (AOAC[1])
- Comparison of properties with ordinary rice

IV. RESULT

4.1 Characteristics of Raw Materials

The difference between the results of the initial analysis for raw materials with the result of referrals from the literature due to differences in varieties, harvesting and climate. Different levels of resistant starch with references to the literature allegedly caused vaietas processing and the raw materials used. These results have been shown inTable 1 below.

Table 1 Analysis of Chemical Raw Corn and Cassava Mocaf

Parameter	Corn		mocaf		Cassava	
	*	**	*	**	*	**
Water (%)	15.17	13.00	68.72	64.00	64.64	62.40
Ash (%)	1.70	1.40	1.05	-	0.26	1.30
Fat (%)	4.14	4.00	0.10	0.10	0.40	0.30
Protein (%)	8.93	10,00	2.45	2.00	1.23	1.20
Starch (%)	66.55	61,00	20.63	19.10	30.79	34.00
Amylose (%)	19.57	17.08	7,05	4.01	7.02	5.78
Amylopectin (%)	46.98	43.92	13.58	15.09	23.77	28.22
ratios	29:71	28:72	34:66	21:79	23:77	17:83
Ca (%)	0.06	0.03	0.02	0.01	0.02	0.03
resistant starch	6.62	> 15.00	6.30	> 15.00	6.01	11.50

Description: *: Results Analysis
**: Literature

These trends also occur in the protein content in cassava fermentation process results (mocaf). This is due, in addition to the protein content of the raw materials of cassava is low and also the absence of a protective pericarp, causing some proteins can be increased solubility in the pH tends to be alkaline (away from the point isoelektris), as a result of immersion in alkaline. The highest levels of resistant starch derived from corn starch instead. Maize has the highest amylose content and easy teretrogradasi, with a pattern of escalating along with the high amylose retrogradation. Starch granules are rich in amylose to crystallize due to the intensification of the hydrogen bonds that result does not swell or undergo gelatinization ripening perfectly on time so that the digested more slowly.

Corn starch does not undergo gelatinization perfect when heating such as cassava, which allegedly resulted in the lack of digestibility. On the other hand, the content of phosphorus in mocaf allegedly acted as an ester-phosphate in amylopectin molecules, causing the negatively charged repel generate Coulomb force which might givemocaf contribution starch granule development. The different properties of the three materials will provide the composition characteristics to be ideal for the raw material of artificial rice.

Extrusion is one of the stages of the process that is widely used in the industry. The extrusion process can be performed using a single screw or double screw. In this research, a single screw for geometry that is simpler and more widely applied by the food industry. In the extrusion process will produce a shear stress that will change the shape of the dough / materials so that the shear stress is an important parameter in the extrusion process. In addition the flow rate will determine the magnitude of the pressure gradient, temperature profile, the shear stress (shear stress) and residence time.

Analytical approach to the design of the extruder has some limitations because it is very difficult to analyze flow in the form of a complicated extruder. A better approach for analyzing complex mixer is by using mathematical models and computer simulations. FLUENT is a CFD program that uses a type of pattern volume method so that all the functions needed to calculate a solution can be displayed and accessible on FLUENT through an interactive menu.

From the simulation results obtained using software FLUENT fluid flow velocity value of the average of the largest occurred in a screw with a 2.5 degree angle that is equal to 0.26417857 m / s while the angle of 5 degrees and 7.5 degrees of 0.2649498 m / s and 0.2649498 m / s. As for the largest total pressure generated in the extruder with a screw angle of 2.5 degrees is equal to 1.2219334 x 10 ^ 17 Pa, whereas for the screw angle of 5 degrees and 7.5 degrees angle of 1.2038339 x 10 ^ 17 Pa and 1, 2038339 x 10 17 Pa rank. For the value of shear stress on material particles, The smaller the angle of the screw extruder is the shear stress generated in the material particles will be even greater. This happens due to the increase of the viscosity of the material has the greatest presentation on a threaded screw with a slope angle that is getting smaller. Extrusion process in artificial rice using optimal screw speed is 450 rpm and making artificial rice developed by a joint team of researchers from the Polytechnic of Jember by a team of researchers from the University of Jember is using cold extrusion techniques with the use of a temperature of 65oC.

Screw for artificial rice that has been generated by the research team can be seen in Figure 1 below. Optimizing the screw has been donethe difference Compression Ratio (1,5; 2,5; 3,5). Basic tools (excluding extruder and screw) are designed with the concept of a portable. Detailed tool design is still to be formulated in the draft concept design patents.

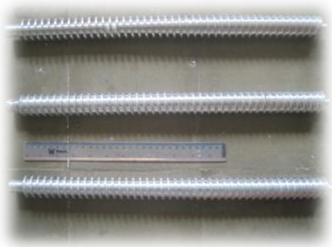

Figure 1. The threads are made with different compression ratio (1.5; 2.5; 3.5)

Optimum temperature used in the extrusion process is 65oC in all parts (feed, compressing and metering) with speeds used include auger speed of 18Hz, 11Hz and cutter 55,5Hz screw. The water content of incoming (feed) optimal 50%, because the results of the initial assessment that the relatively high water content will prevent the occurrence of viscous dissipation which will cause an increase in a cry, so there is no product development. Printouts by die then performed dryer drying process that results of research studies early, optimally used at a temperature of 65oC for 3 hours, until a dry product.

Early stage research (trial process) have used the process temperature is lower than the gelatinization temperature, it produces the conditioned artificial rice fragile and can not be processed into rice. In addition the results of initial studies have provided data that the weight per grain of rice mock determined at the time of printing with the extruder, with the most influential parameters are the screw speed and the speed of the cutter.

4.2 Artificial Rice Products

The basic material used for the artificial rice is mocaf cassava initially sieve powdered with a certain level and homogenized, then steamed and dried. The procedure used was submitted in draft form patents through IPR proposal funded by the Higher Education and Research University of Jember. Preliminary results showed that the ratio of the amount of starch and flour in the manufacture of the most optimum artificial rice is to use 30% of maize flour and supplemented with 70% flour mocaf. In the preliminary study also generate initial information that for the optimization process, it can not be used just one meal but at least two types of flour in each formulation, namely cornmeal and flour substitution (mocaf flour) with an optimal ratio of 5: 4.

Results artificial rice products can be seen in Figure 2, and after the cooking process (cooking) within 2 minutes, the result of artificial rice products can be seen in Figure 3. Approximately nine untrained panelists (consumers pujasera canteen Jember University of Agricultural Technology) gave a score of 4 (scores range from 1 to 6) to test the taste preferences, while still giving an average score of 2 (range of scores from 1 to 6) to test the color and appearance preferences. This is due to the result of color measurement by means Chromameter artificial rice it produces measurements with a value of L 76.26, a + b + 5.35 and 31.39, so the color of artificial rice in the range of red-brown color. While quality tanak fisikomikia determined based on properties such as gelatinization temperature, volume expansion, water absorption,

Figure 2 Rice artificial that has been produced by a team of researchers from the Polytechnic of Jember

Mocaf making techniques developed by the research team are biologically engineering Modified Cassava Flour and shortened by BMCF. The use of starter mocaf developed which requires 1.5 kg BMCF for soaking cassava with 1 m3 container and drained by a press machine. In the process of making 1 kg mocaf takes 3.5 kg of cassava and takes approximately 1 hour for cassava material in the container 1 m3. Studies were obtained from initial studies indicate that the filter used in the amount of 60 mesh to produce the most optimal grain flour. Currently the technique of making mocaf with BMCF techniques being developed for a patent, because the procedures carried out were not going to provide the appropriate conditions for fungal contaminants,

The interesting thing is the manufacture mocaf is being developed using a new strain of lactic acid bacteria, namely: L. plantarum polije: 15420. Polije is dingkatan of Polytechnic of Jember. This bacterium is the development of patents and registered with the Ministry of Justice and Human Rights with registration number: 050.0226A by the Center for Research and Services (P3M) Polytechnic of Jember. Bacterium L. plantarum polije: 15 420 verified results from one lab at Brawijaya University in Malang and Laboratory TDC Airlangga University Surabaya, was in addition to having the ability to produce pectinolytic enzymes that can destroy the cell wall material resulting in the liberation of the starch granules, is also able to produce nisin which is an antimicrobial that mocaf dihasikan flour has a better power savings compared to conventional methods. The lactic acid produced also increased by 16%, which, when viewed from the bacterial DNA sequence turned out to have a common trait with L.casei which is encoded by the gene LC2W_0247, LC2W_0909, LC2W_0925, LC2W_2007, LC2W_2678, as well as the similarity of 174 base pairs to 75% by L. jensenii encoded by genes LACJE0001_1464 and HMPREF0886_1035, The presence of lactic acid produced optimally, causing changes in the characteristics of the flour produced in the form of the increase in viscosity, gelation capability, power rehydration, and ease dissolves. The nitrogen content mocaf with the use of new bacteria turned out to be decreased, thus reducing the intensity of the brown color upon drying or heating.

Preliminary research results also show the right amount optimum water used is 50 percent of the total formulation. Early analysis, with technology developed mocaf, artificial rice has a protein content of 9.73 percent, higher than the original rice that contains 7.2 percent. While the original rice fiber content of just 0.3 percent, but the artificial rice has nearly 5 percent fiber. The content of the water content in artificial rice by 7 to 9 percent, which is still below the threshold required maximum water content SNI or BSN is equal to 13 percent. Low water levels in rice caused by the drying process forces the water past the point of equilibrium. Alleged period (power) save the artificial rice related products with RH has generate the data that up to week 6, the product does not increase the water content, so that the artificial rice allegedly still safe to eat up to week 8. Alleged storage life by method better, as well as analyzing the composition further artificial rice will be done in the second year. The interesting thing is the carbohydrate content, for both the original artificial rice or rice turns almost flat at around 80 percent. Other proximate analysis results conducted on artificial rice with the final formulation is: 0.52 percent ash and 1.12 percent fat content. The ash content related to the amount of minerals and inorganic substances contained in the product,

Results of analysis of artificial rice Kamba density showed a higher yield compared to the original rice, which is about 0.58 g / ml. Physical examination was conducted on the length and diameter of the artificial rice, rice also showed differences with the original, but has a uniform size, according to the type of extruder used. At the beginning of the study were not studied any loss of product (yield) during the process. This is due to the diversity of the value of the yield in the manufacture of artificial rice, cover the dough moisture content, speed of entry of the dough into the extruder tool and cutting products output (although done manually, because automated tools that are not available in the market).

The advantages of artificial rice has a glycemic index of food is suspected is low, this will be examined in the second year. The glycemic index food is a food unique nature and influenced by many factors, including the type of materials, processing methods and characteristics (composition and biochemical properties) materials. According to previous studies, these properties can not be predicted from the character of the material only, but of contributions and the nature sinergism interplay between material properties so that the final outcome will provide specific glycemic response. Nonetheless, allegations of a low glycemic index can be seen from the carbohydrate content which allows absorption into the blood to be slow. The carbohydrate content is influenced by the amylose and amylopectin available in artificial rice. Allegedly a high amylose content, causing the complex material is digested more slowly than with amylopectin, because amylose is a polymer of a simple sugar with a straight-chain, branched and does not pick tergelatinisasi not easy. The digestibility of starch will be studied in both in vitro and in vivo, as the data hint artificial rice excellence. The digestibility of starch is the ease of a type of starch to be hydrolyzed by the enzyme that breaks down starch into units simpler. In general, the digestibility of starch can be given as a process of starch breakdown and absorption by the body. Breakdown and absorption of carbohydrates in the body must first be converted into glucose as the smallest component. Starch digestibility associated with dinitrosalisilat acid (processes that occur during fermentation mocaf) are suspected to affect the structure of the starch. The structure of starch which are analyzed using SEM, will be conducted in the second year.

The resulting artificial rice has significant differences with artificial rice made abroad. In Wahsinton, artificial rice with registered patent No. 020 816 can be made by flouring wheat (barley), the making of pasta by adding water up to 20 to 30% (on the condition of temperature 32 - 38oC), mixing degan mixer at 40 ° C, and then pressed with a roller on vacuum conditions using a machine called cromola. The rice has been investigated and is made using nano particle technology, with the addition of (fortification) some vitamins and minerals and even meat extracts. IPB produce rice analog which has a brownish color quality similar to artificial rice Polytechnic of Jember team, but in the manufacturing process, IPB team uses tween screw extruder-type machines with very different formulations developed by the team with the Polytechnic of Jember. In other developing countries, hingga current manufacturing technology of rice analog among other methods of granulation or granulation (Kurachi [4]) and the extrusion method (Scella et al. 1987; Bett-Gaber et al., 2004; Moretti et al., 2005; Mishra et al. 2012). The method differences lead to differences in the final form of the product. In the manufacture of artificial rice using rice granulation method will have a round shape like sago pearls, but in the extrusion method developed by Tim Polytechnic of Jember has the shape of a product is oval and almost resemble grains of rice.

V. CONCLUSIONS AND RECOMMENDATIONS

5.1 Conclusion

The results of the study concludes

1. Artificial rice can be produced using formulations from cornstarch and mocaf with the proportion of research and comparison of the results using a screw extruder that has been made by the research team. Commercial development will be conducted in the second year in cooperation with the Food Security Office regency.
2. The most critical and must be controlled when printing artificial rice is the accuracy of the temperature, screw speed and moisture content of the dough.
3. Artificial rice has characteristics similar to native rice, but still need further study in the second year to study the characteristics of the physical composition, chemistry, studies in vitro or in vivo as well as the structure of the starch granules further using modern tools.

5.2 Suggestion

Advice can be given is learning patterns artificial rice consumption in the district of Jember outside can be done with local government policy that starts from the simultaneous movement by taking an active role by local residents.

REFERENCES

[1] AOAC, 1995. Official Methods of Analysis of AOAC International 6 th. AOAC International, Suite 400, Virginia, USA.

[2] Galmo, EP, WE Sullevan and CR Canada. 1984. Engineering Economy. 7th Mac. Pub. Co. New York.

[3] Guy, R., 2003. Extrusion Cooking, Technologies and Applications. Woodhead Publishing Limited, Cambridge England.

[4] Kurachi, H., 1995. The Process of Making Artificial Enriched Rice. United States Patent 5,403,606.

[5] Mouquet, C., B. SALVIGNOL, N. Van Hoan, J. Monvois, S. Treche, 2003. Ability of a "very low cost extruder" to produce instant infant flour at a small scale in Vietnam. Food Chem. 82: 249-255