PROCEEDINGS

IJCST

The 1st International Joint Conference on Science and Technology

October - 12 - 13th, 2016 - Bali, Indonesia.

PUBLISHER : UNIVERSITAS PEMBANGUNAN NASIONAL VETERAN JAWA TIMUR

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PREFACE

The 1st International Joint Conference on Science and Technology (IJCST) 2016 is a conference organized by the Faculty of Industrial Technology University of Pembangunan Nasional "Veteran" Jawa Timur in collaboration with Bali State Polytechnic, National Cheng-Kung University, Faculty of Social Science and Law Universitas Negeri Surabaya, Faculty of Mathematics and Natural Sciences Universitas Negeri Surabaya, and Faculty of Engineering University Technology of Madura. This is the extended version of the previously known BISSTECH (Bali International Seminar on Science and Technology) which have been successfully held for the third time. This year's theme covered broader topics across engineering, science, economy, and social themes.

We would like to thank all reviewers, keynote speakers, moderators, presenters, and participants for their cooperation and valuable suggestions that contribute to the success of this year's conference. We would also like to give our gratitude to all members of organizing committees of all events during this conference.

Finally, we sincerely hope that this conference would contribute to the development towards a better Indonesia, especially in science, economy, and social aspects.

Thank you.
Denpasar-Indonesia, October 12th, 2016
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CHARACTERISTICS OF ANALOG RICE FROM LESSER YAM TUBERS (*Dioscorea esculenta* L.) SUBSTITUTION WITH MOCAF FLOUR

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Abstract

Research on diversification of food product from lesser yam tubers into analog rice to increase the beneficial of local food sources was done. The research objective was to obtain the optimum formula analog rice from lesser yam tubers substitution with mocaf flour. There were 9 formula in this research which rasio lesser yam:mocaf flour were: F1=100%:0%, F2=95%:5%, F3=90%:10%, F4=85%:15, F5=80%:20%, F6=75%:25%, F7=70%:30%, F8=65%:35%, and F9=60%:40%. The Data were Analyzed using ANOVA (Analysis of Variant) and a further test using Duncan Multiple (Duncan't Multiple Range Teste). The results showed that the best formulation was a mixture of lesser yam flour 90% and mocaf flour 10%, which produce analog rice with the following characteristics: yield of 93.91±12.16%, water content 8.69±12.09%, ash 1.47±0.27%, dietary fiber 23.95±0.14%, starch 53.42%±0.20, amylose 14.17±0.04%, amylopectin 39.25±12.07%, the score of taste 3.6 and texture 3.73. Sensory method used in research was hedonic scale scoring.

Keywords: analog rice, lesser yam, mocaf, *Dioscorea esculenta* L.

INTRODUCTION

Food and nutrition is one of the determinants of increased productivity and national competitiveness in the global arena. Supply, distribution and consumption of food with the amount, security and adequate nutritional quality must be guaranteed. Diet and desires of the community in various area in Indonesia so diverse that need explore the potential of local food in each region so that people healthy and active life.

Indonesia is very rich variety of local food that is already exist and entrenched in society. Local food has a strategic role and it is tremendous potential, but currently there is a tendency for people ignoring local food sources and preffer imported food. The younger generation may be even did not know more local food in the area. The local food contains a lot of health benefits that are not less than imported food and has a strategic role as well as many benefits for health.

Despite of the many benefits, unfortunately, people still seem less appreciate and realize the importance of developing local food seriously. As a result, people become accustomed with food imports. Base on: Presidential Regulation No. 22 at 2009 on the Acceleration of Food Consumption Diversification base on local resources confirms that level to encourage food consumption patterns are diverse, nutritionally balanced, lawful and safe, needs strengthening and the participation of local governments in the development and implementation food diversification program based on local resources. One type of local tubers that need to be improved and empowered role is lesser yam tuber (*Dioscorea esculenta* L.).

Lesser yam is one kind of plant that grows in many parts of Indonesia, growing wild in the garden residents and in the forests. The tubers from this plant normally were used by community as source of carbohydrate alternative. Until now it is use still very limited.

The lesser yam plant advantages compared to other plants that can be grown on non-irrigated land, degraded land, without intensive care and as intercrops (Gsianturi, 2003), the tubers contain inulin which has activity as a prebiotic (Winarti, *et al*., 2011). Prebiotics are food components that can't be digested in the upper gastrointestinal tract, and can stimulate the selective growth and activity of beneficial bacteria in the digestive tract, such as bifidobacteria and lactobacilli, so as to improve the health of the host (Gibson, 2004; Pompei *et al*., 2008; Gaggia *et al*., 2010).

Development of analog rice from lesser yam tubers is one effort to new innovation to take beneficial of local food source that is relatively abundant in Indonesia, and providing alternative food that is cheap and nutritious, so it can be beneficial to strengthening food self-sufficiency.

Analog rice is the rice result from innovations base on lesser yam flour, made in the form of granules look like with the rice. There are two methods for making the analog rice. Analog rice produced by granulation technology has a hard texture and appearance beyond rude so less preferred by consumers. Therefore, we developed analog rice by extrusion technology. This analog rice has better quality and more preferred by consumers.

Extrusion is a process where materials imposed by the force of the screw to flow in a narrow room that will undergo mixing and cooking as well. The main heat source of the extrusion process from the conversion of mechanical (friction) is due to friction between the material and friction between materials with a screw. Work the thread also results in an

accumulation of pressure in the extruder barrel, the material is forced out through the mold (die) that is small in size and return to normal pressure (atmospheric) instantaneously ie when the product through the die (Oktavia, 2007).

Previous research that has been done was development prebiotic and synbiotic food product based on lesser yam tuber (Winarti and Saputro, 2013) and the extraction of inulin from the *Dioscorea* spp. tubers as prebiotic component (Winarti *et al*, 2011). But making analog rice has never been done from lesser yam tubers. Therefore it is necessary to do research on the innovation to making analog rice, the sensory test to know consumer preferences about analog rice from lesser yam tubers.

The research objective was to determine the effect of substitution mocaf flour (modified cassava flour) to quality and consumer preference analog rice from lesser yam tubers.

METHODOLOGY

Materials

Lesser yam tuber (*Dioscoreaesculenta* L.) was obtained from Nganjuk region, East Java. Supporting materials include mocaf, corn starch, skim milk and GMS (Gliserol Mono Stearat). Lactic acid bacteria Lactobacillus plantarum FNCC 0027 obtained from the Food Nutrition Culture Collection, Food and Nutrition Study Centre, Universitas Gadjah Mada. That media used to the growth of lactic acid bacteria were MRS broth and MRS agar.

Equipments

Spectrophotometer Spektronic 21D, autoclave, cabinet dryer, centrifuge, water bath shaker, mixer, viscometer, pH meter, incubators, and Quebec colony counter. Equipment for the processing of lesser yam tubers includes; flour grinding machine (disk mill), dryers (cabinet dryer), the packaging tool (sealer), oven, blender, mixer, stove, single screw extruder and plastic packaging.

Procedures for making analog rice

Procedures for making analog rice from lesser yam tubers was the follow:.**Stage 1**, a) Preparation of lesser yam flour, b) Preparation of mocaf flour by fermentation using *Lactobacillus plantarum* FNCC 0027. **Stage 2**: Formulation analog rice, the steps of making rice analog is as follows: (a) the lesser yam tubers flour (70%) mixed with corn starch (30%) and blend with mocaf flour (mocaf:lesser yam was 0:100%; 5:95%; 10:90%; 15:85%; 20:80%; 25:75%; 30:70%; 35:65% and 40:60%) with different initial water content to produce a dough that is the best formulation; (b) coupled with other ingredients namely GMS (Glycerol Mono Stearic), skim milk, vegetable oil, and water mixing until homogeneous; (c) mix flour formed with single screw extruder at a temperature of 100ºC; (d) the grain of analog rice dried at a temperature of 60°C, for 24 hours.

Hedonic scale scoring test was used to evaluation of sensory quality of cooked analog rice with 20 consumers. Range value in this test 1 until 5, 1= not preference and 5= very preference by consumer.

RESULTS AND DISCUSSIONS

Characteristics of lesser yam and mocaf flour which used as raw material for making analog rice were presented in Table 1. MOCAF (Modified Cassava Flour) is a derivate product from cassava flour that uses the principle of modified cassava cells by lactic acid bacteria during fermentation (Subagio, 2007; Haryadi, 2011). The lactic acid bacteria used in this study was *Lactobacillus plantarum* FNCC 0047 obtained from the Center of Food and Nutrition Studies, Universitas Gadjah Mada, Yogyakarta.

Table 1. Characteristics of lesser yam and mocaf flour

Component (%)	Lesser yam flour	Mocaf flour
The yield of flour	17.715	19.715
Water content	6.479	6.853
Ash	2.289	0.992
Dietary fiber	7.749	10.271
Starch	73.217	76.805
Amylosa	8.960	20.138
Amylopectin	64.257	56.669

Note: the average value of three replicates

The results showed that the dietary fiber on lesser yam flour is 10.271 % and the mocaf flour is 7.7488%. The previous research conducted by Prabowo (2013), the levels of dietary fiber in lesser yam flour is 12.7%, and mocaf flour contain dietary fibre is 3.4% (Subagio, *et al* (2008). High dietary fiber on food can be used to streamline the process of digestion in the body so that it can improve the health of the body.

Starch level on lesser yam flour is 73.217% and 76.807% on the mocaf flour. The level of amylose on lesser yam flour is 8.960% and 20.1376% on mocaf flour.

Starch content is one of the criteria for the quality of flour, both as food and non-food. Amylopectin content of the material is closely related to adhesion properties of these materials. The higher levels of amylopectin in rice cause the cook rice more closely/sticky. Starch tubers that have high amylopectin content also form the gel stickier compared with low amylopectin when starch is heated (Richana and Titi, 2004).

Water content of analog rice

Result from the research show that the water content of analog rice from lesser yam flour disubstitusion with mocaf flour difference among formulations. The average of water content of analog rice presented at Table 2.

The average of water content in analog rice ranges from 7.52%-8.76%. Increasing the mocaf flour on the formulation of analog rice can decrease the water content. This is because the mocaf flour has a high amylose levels compared with lesser yam flour. Amylose has easy to bind water and easy to release again compare with amylopectin, so on the drying process amylose will be easier to release the water contained in the materials. Starch is easy to binding water, if the starch heating will be gelatinisation and trapped the water in the starch granules. It is supported by Haryadi (1993), that the gelatinisation is the formation of starch gels with the occurrence of starch hydration, that absorption of water molecules by the starch molecules.

Table 2. Water content of analog rice

Proportion of lesser yam:mocaf flour	Water content (%)
F1 (100:0)	8.77±0.1
F2 (95:5)	8.59±0.1
F3 (90:10)	8.69±0.1
F4 (85:15)	8.49±0.0
F5 (80:20)	8.66±0.1
F6 (75:25)	8.44±0.4
F7 (70:30)	8.71±0.1
F8 (65:35)	8.54±0.0
F9 (60:40)	8.37±0.1

Note: the same letters following the values in each column indicates not significantly different

Ash content in analog rice

Result from the research show that the ash content of analog rice from lesser yam flour substitusion with mocaf flour significant difference among formulations. The average of ash content on the analog rice presented at Table 3.

Table 3. Ash content of analog rice

Proportion of lesser yam:mocaf flour (%)	Ash content (%)
F1 (100:0)	2.56 ± 0.12^{a}
F2 (95:5)	2.47 ± 0.03^{b}
F3 (90:10)	2.41 ± 0.14^{b}
F4 (85:15)	2.29 ± 0.14^{bc}
F5 (80:20)	2.06 ± 0.07^{c}
F6 (75:25)	1.89 ± 0.11^{cd}
F7 (70:30)	1.82 ± 0.01^{cd}
F8 (65:35)	1.74 ± 0.06^{d}
F9 (60:40)	1.47 ± 0.27^{d}

Note: different letters following the values in each kolom indicates significantly different

Increasing the mocaf flour on the formulation of analog rice can decrease of the ash content. This is because the mocaf flour has lower ash levels compared with lesser yam flour.

Dietary Fiber of Analog Rice

The results showed that increasing addition of mocaf flour can increase of dietary fiber content in the analog rice. This is because the dietary fiber mocaf flour higher than the lesser yam flour. Total dietary fiber is the total soluble fiber plus the total insoluble fiber (Marsono, 2001). High dietary fiber on analog rice can be used to streamline the process of digestion in the body so that it can improve the health of the body. Average of dietary fiber content on analog rice was presented in Table 4.

Table 4. Dietary fiber content of analog rice

Proportion of lesser yam:mocaf flour (%)	Dietary Fiber (%)
F1 (100:0)	23.22±0.16[f]
F2 (95:5)	23.89±0.34[e]
F3 (90:10)	23.95±0.14[e]
F4 (85:15)	24.69±0.08[d]
F5 (80:20)	25.55±0.19[c]
F6 (75:25)	27.36±0.07[b]
F7 (70:30)	27.54±0.13[b]
F8 (65:35)	27.79±0.086[ab]
F9 (60:40)	28.26±0.059[a]

Note: different letters following the values in each kolom indicates significantly different (p≤0.05)

Starch, Amylose and Amylopectin content

The resuld in this study show that levels of starch, amylose and amylopectin on analog rice from lesser yam tubers substitution with mocaf flour difference on every formulation. Starch, amylose and amamylopectin content amylopectin content on analog rice presented in Table 5.

Table 5. Starch, amylose and amylopectin content of analog rice

Proportion of lesser yam:mocaf flour (%)	Starch (%)	Amylose (%)	Amylopectin (%)
F1 (100:0)	52.95±0.11[f]	12.87±0.04[f]	40.08±0.08[d]
F2 (95:5)	53.29±0.22[f]	13.61±0.05[e]	39.69±0.09[de]
F3 (90:10)	53.42±0.20[f]	14.17±0.04[d]	39.25±0.07[de]
F4 (85:15)	54.56±0.21[e]	16.25±0.04[c]	38.31±0.07[e]
F5 (80:20)	56.69±0.11[d]	16.27±0.05[c]	40.41±0.07[d]
F6 (75:25)	57.81±0.22[c]	16.33±0.07[c]	41.47±0.05[c]
F7 (70:30)	59.72±0.22[b]	17.13±0.04[b]	42.59±0.08[b]
F8 (65:35)	61.82±0.21[a]	17.11±0.05[b]	44.72±0.08[a]
F9 (60:40)	62.29±0.18[a]	18.91±0.02[a]	43.39±0.07[ab]

Note: different letters following the values in each kolom indicates significantly different (p≤0.05)

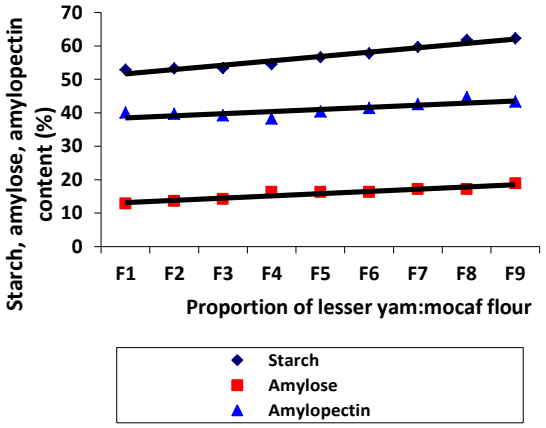

Figure 1. Effect of proportion lesser yam:mocaf flour on starch, amylose and amamylopectin content on analog rice

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Starch content is one of the criteria for the quality of flour, both as food and non-food. Amylopectin content of the material is closely related to adhesion properties of these materials. The higher levels of amylopectin in rice cause the cook rice more closely/sticky. Starch tubers that have high amylopectin content also form the gel stickier compared with low amylopectin when starch is heated (Richana and Titi, 2004).

Consumer preference of analog rice

The quality of food can be determined in three ways: chemical, physical and sensory. The acceptance of food products by consumers is determined by the quality of sensory factor. Sensory properties are the natural of the starting material using human senses such as the sense of sight, smell and taste. The consumer's acceptance of the sensory properties of analog rice from lesser yam tubers is due to the overall quality of taste and texrure.

The results showed that the highest score of consumer preference of taste and texture were the analog rice from lesser yam flour 90% with addition mocaf 10% (Table 6), with score 3.60 and 3.73 respectively.

Table 6. Score of consumer prefference of analog rice

Proportion of lesser yam:mocaf flour (%)	Score of Taste	Score of Texture
F1 (100:0)	2.47^{b}	2.40^{c}
F2 (95:05)	2.60^{b}	2.73^{abc}
F3 (90:10)	3.60^{a}	3.73^{a}
F4 (85:15)	3.27^{ab}	3.67^{ab}
F5 (80:20)	3.40^{ab}	2.87^{abc}
F6 (75:25)	3.40^{ab}	3.60^{ab}
F7 (70:30)	3.07^{ab}	1.73^{c}
F8 (65:35)	3.13^{ab}	1.80^{c}
F9 (60:40)	3.12^{ab}	2.53^{bc}

Note: different letters following the values in each kolom indicates significantly different ($p \leq 0.05$)

CONCLUSION

The results on the research showed that the best formulation was a mixture of lesser yam flour 90% and mocaf flour 10%, which produce analog rice with the following characteristics: yield of 93.91±12.16%, water content 8.69±12.09%, ash 1.47±0.27%, dietary fiber 23.95±0.14%, starch 53.42%±0.20, amylose 14.17±0.04%, amylopectin 39.25±12.07%, the score of taste 3.6 and texture 3.73. Sensory method used in research was hedonic scale scoring

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