Effects of Packaging Types on Moisture Content, Microbe Total and Peroxide Value of Instant Ganyong (*Canna edulis* Kerr) Yellow Rice

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Abstract—The effects of packaging types on moisture content, microbe total and peroxide value of instant ganyong yellow rice during storage were investigated. Instant ganyong yellow rice was packed in three different packaging types; aluminium foil (Al foil), nylon and the combination of oriented polypropylene (OPP) & vacuum metalize OPP (OPP-VMOPP) and stored at room temperature for 8 weeks. The results showed that samples in the Al foil had lower moisture content than other packaging materials, but until storage 8 weeks moisture content of three packaging types was not different. Microbe total on samples showed significance. Samples in the packaging of nylon material had highest microbe total compared to other packaging materials, but all of the packaging types had microbe total below the acceptable level of the microorganism (6 log CFU/g) during storage 8 weeks. Peroxide value of three packaging types increased during storage, but they were not different until 8 weeks storage. They were below peroxide value for oil 1 mg oxigen/100g oil or fat. Based on the microbe total and peroxide value, instant ganyong yellow rice were packed with all three types of packaging showed safe to eat up to 8 weeks of storage at room temperature.

Keywords— instant ganyong yellow rice, microbe total, moisture content, packaging material, peroxide value.

INTRODUCTION

Indonesia has culinary variety, several regions in Indonesia have different typical food. Yellow rice is one of the traditional food which well known in almost all regions in Indonesia, both in Java and outside Java. In Manado, there is yellow rice village called Kampung Kodo selling Manado special yellow rice. In East Kalimantan, there is a village of rice which sells Samarinda special yellow rice, which is open from the evening until early morning.

Yellow rice can be served on various occasions meal time, breakfast, lunch or dinner, or at special events (parties). Yellow rice can be consumed by children and adults. In society, much yellow rice found as snack food sold to the public packed in a plastic box and came with the side dish.

Yellow rice made of cooked rice with coconut milk, salt, salam leaf, lemon, lemongrass and turmeric. The use of spices and coconut milk make yellow rice distinctive taste, savoury and delicious, so appeals to consumers. However, the use of coconut milk causes yellow rice damage, so the shelf life of yellow rice is short. Generally, yellow rice can durable less than 24 hours. Therefore it is necessary to develop technology to extend the shelf life and to ease the cooking yellow rice in order to eat immediately. The product is called instant yellow rice.

In this study, instant yellow rice made from rice mixed with puree ganyong by proportion (70% and 30%) results of the study [1]. Puree ganyong is a paste prepared from the ganyong tuber which is boiled and mashed. Use of puree ganyong can reduce the amount of rice and add to the nutritional value of products. Ganyong tubers based on the source of the Nutrition Directorate of the Ministry of Health, every 100 grams of ganyong consists of 95.00 kcal; 22,60g carbohydrates; 1,00g protein; 0,11g fat; 75,00g water; 21,00g calcium; 75,00g phosphorus; 1,90mg iron; 0,10mg vitamin B1; 10,00mg vitamin C. Ganyong tubers were not only superior in calcium and phosphorus but also potential as prebiotic food. Puree ganyong contains 23.63% inulin [2].

Inulin consists of fructose units of high dietary fiber. Reference [3]) said that inulin-type fructans are plant carbohydrates that, because of the b- (2) 1) configuration of the fructosyl-fructose glycosidic linkages, resist digestion in the upper gastro-intestinal tract but are fermented in quantitatively the colon. They are thus undoubtedly part of the dietary fiber complex, and they must be labeled as dietary fiber in consumer food products. The average daily consumption has been estimated to be between 3 and 11 g in Europe and between 1 and 4 g in the United States.

The study on the instant yellow rice with puree ganyong have been done [4]. The best products based on the organoleptic properties obtained of 20% the puree ganyong with drying time 3 hours at 60°C. Nutrient content of best instant ganyong yellow rice per 100 g weight of water is 6.09%, 4.76% protein, 6.69% fat, 3.92% fiber, 7.775% ash, 24.05% inulin and 48.72 % carbohydrates.

The instant ganyong yellow rice produced [4] has not been packaged and observed shelf life. In this study, instant ganyong yellow rice packaged using three different types of packaging material, they were the aluminum foil (Al foil), nylon and the combination of oriented polypropylene (OPP) & vacuum metalize OPP (OPP-VMOPP). The shelf life of instant ganyong yellow rice observed by calculating the water content, total microbial and peroxide value during storage at room temperature.

MATERIALS AND METHODS

A. *Materials*

The materials used in making of yellow rice: rice brand King Catfish packed CV. Hasil Bumi Citra, ganyong (*Canna edulis* Kerr), coconut milk, spices: salt, turmeric, salam leaves, lime leaves, lime juice and lemongrass. Three types of packaging, including aluminium foil (Al foil), nylon and the combination of oriented polypropylene (OPP) & vacuum metalize OPP (OPP-VMOPP). Al foil shaped bag, the type PET/ALU/SPE-50, w x h = 80 x 120mm. Structure of nylon: Nylon/SPE70, w x h x b = 95 x 250 x 60. Combination packaging shaped bag, the type: Transmetz, w x h = 130 x 210 mm, front structure: OPP/SPE-70, and back structure: VMOPP/SPE-70. All packaging branded K pack with 07 code was obtained from the store Our Packaging, Surabaya.

B. *Making of Instant Ganyong Yellow Rice*

Making instant ganyong yellow rice refer to [4]. Ganyong tubers were washed and then boiled for 45 minutes. Ganyong tubers were peeled and shredded into a puree ganyong. Rice and all materials were washed. Coconut and turmeric were grated, mixed and took milk coconut. Comparison of oil and water was used (1:1). All the ingredients were mixed and boiled, then rice was inserted and stirred until coconut milk absorbed (called "aron" rice). "Aron" rice removed and closed for 15 minutes. "Aron" rice was steamed for 30 minutes and ganyong yellow rice was obtained. Then, ganyong yellow rice was frozen for 24 hours. Frozen yellow rice left at room temperature for 10 minutes while separated granular. Ganyong yellow rice grains were dried at 60°C for 4 hours.

C. *Moisture Content Analysis*

Testing the water content used a Kett Science of Sensing USA Near infrared analyzer, moisture balance, FD-610. Test steps as follows: The tool was plugged and pressed on. Pressed tare button to normalize the size. Arranged temperature 130°C. The sample tube was opened and placed the sample, and then closed. The tool will automatically measure the water content of the sample, the measurement finished was indicated with lights off automatically.

D. *Total Microbe Analysis*

Petri dishes, test tubes, erlenmeyer, tongs, spatulas, Media Plate Count Agar (PCA), and all the utensils and materials used were washed, dried and wrapped in paper

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straw, then sterilized in an autoclave at a pressure of 15 dyne / cm 3 (1 atm) and a temperature of 121°C for 30 minutes. A sample of 5 grams of crushed and dissolved with 45ml sterile distilled water. Sample solution diluted 101 in a test tube. Samples were cultured in 1ml pour plate in media PCA (45°C), petri dishes were shaken in a circle and kept harden. Then the petri dishes wrapped in paper straw, then it was reversed and incubated at room temperature for 24 hours. The number of colonies that grow was calculated by colony counter.

E. Peroxide Value Analysis

The sample was weighed as much as 1g, crushed and put into erlenmeyer, then added 50ml ethanol and stirred for 30 minutes. The solution was added 50ml distilled water and 10ml of 20% KI solution, stirred for 30 minutes, then added 1 ml starch indicator. The solution was titrated with 0,01N sodium thiosulfate solution until the color disappeared. The results are expressed in milligram of oxygen per 100g of oil or fat [5].

RESULT AND DISCUSSION

A. Effects of Packaging Type on Water Content of Instant Ganyong Yellow Rice

The water content affects the quality of food during storage. The water content of food should be reduced at a certain level so it can inhibit the activity of microbial and chemical reaction causes damage to the product during storage. The water content of the instant ganyong yellow rice packed with 3 different types of packaging materials (Al foil, nylon and OPP-VMOPP) during 8 weeks of storage at room temperature ranging between 4.97% - 10.63%. The average moisture content of instant ganyong yellow rice packaged Al foil was lower than nylon packaging and the combination of OPP-VMOPP. The highest water content was shown in instant ganyong yellow rice which is packed with a combination of OPP-VMOPP. The average moisture content of instant ganyong yellow rice packaged with 3 different types of packaging material at room temperature storage for 8 weeks was presented in Figure 1.

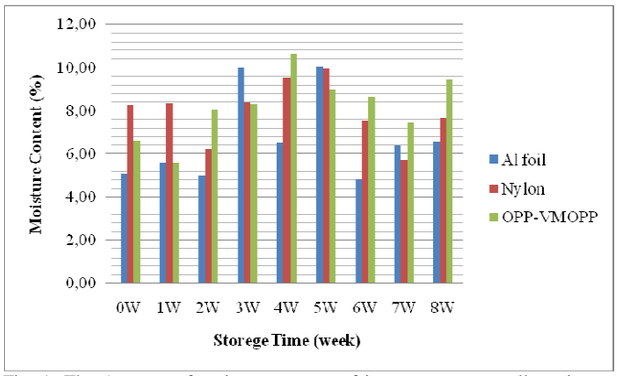

Fig. 1. The Average of moisture content of instant ganyong yellow rice was packed with 3 kinds of packaging materials for 8 weeks

The ANOVA test of the moisture content of instant ganyong yellow rice packed with Al foil, nylon and combination of OPP-VMOPP at room temperature indicated a difference in water content in the storage 0 weeks (significance value 0.006), 4 weeks (significance value 0.034) and 6 weeks (the significant value of 0.034). The differences in the water content of instant ganyong yellow rice showed the differences in the permeability three types of packaging Al foil, nylon and combination of OPP-VMOPP to gases, water vapor either coming into or out packaging. Duncan test of influence the type of packaging materials to water content of instant ganyong yellow rice during storage of 8 weeks are presented in Table 1.

Table I. The Duncan Test of Moisture Content of Instant Yellow Rice with 3 Type Packaging Materials during Storage 8 Weeks at Room Temperature (%)

Storage Time (week)	Packaging Materials		
	Al foil	Nylon	OPP-VMOPP
0W	5,07[a]	8,27[c]	6,63[b]
1W	5,60	8,37	5,60
2W	4,97	6,23	8,03
3W	9,97	8,40	8,30
4W	6,50[a]	9,50[b]	10,63[b]
5W	10,03	9,93	8,97
6W	4,83[a]	7,53[b]	8,63[c]
7W	6,40	5,70	7,47
8W	6,60	7,67	9,43

[a, b, c] Notation on the same line indicates significant differences (Sig.> 0.05)

Duncan test showed that the water content of instant ganyong yellow rice packed with Al foil different from nylon and combination of OPP-VMOPP. Lowest moisture content during storage was shown in Al foil packaging with an average value of 6.66%. The water content in the packaging nylon and OPP-VMOPP were same relative, respectively 7.96% and 8.19%. Products with the water content of 6.66% contain type II water and have optimum stability. Reference [6] states that if type II water eliminated entirely, the water content of the material will range between 3-7%, the optimum stability of food will be achieved, unless the products that can oxidized due to their content of unsaturated fat. When most of the type II water eliminated, microbial growth and chemical reactions that destructive materials food such as browning reactions, hydrolysis or oxidation of fat will be reduced.

Products with the water content of 7.96% and 8.19% also contain type II water, so it has optimum stability, and product damage is slow. These were supported by the water content of the products in the storage for 8 weeks did not show any difference. Reference [6] expressed that a water content of material ranges between 12-25% if the type III water is evaporated entirely. Type III water is water that is physically bound in a matrix material such as tissue membrane, capillaries, fibers and others. Type III water is often called free water. This type of water is evaporated and can be utilized for a medium for microbial growth and chemical reactions. Reference [7] declared that generally mold grows on rice during storage with moisture content above 15% and storage temperature 26-30°C.

The drying process of instant ganyong yellow rice could evaporate most of the rice water between 85.63-88,32%. In general, rice contains 57% water [7], while the average moisture content of instant ganyong yellow rice with 3 types of packaging for storage 8 weeks from 6.66 to 8.19%. The water content of instant ganyong yellow rice was lower compared to other instant rice, instant rice IRSOYBEAN contains 39.7%water [8], instant rice cooked processed by boiling, steaming and pressure cooking 9,08 to 9,15% [9] and instant "uduk" rice (Indonesian traditional food) 12.23% [10].

The average moisture content of instant ganyong yellow rice in Al foil packaging was lowest compared to another packaging, these indicated that the Al foil has a greater ability to inhibit water vapor into the packaging. The results of the study [11] describe the value of the water vapor permeability (WVTR) on the aluminium foil with a thickness of 50µm is 0.5749 g/m2/24 h, the thickness of 80µm and 100µm respectively 0.1298 g/m2/24 h and 0.0768 g/m2/24 h. Aluminium foil with a thickness of 80µm and 100µm have a greater ability to blocked the amount of water vapor into the packaging material. The thicker the aluminium foil packaging the less amount of water vapor can penetrate packaging materials. Generally, aluminium foil (ALU 7) has a WVTR between 0-1g/m2/24hrs [12].

Reference [13] mentions aluminium foil are widely used in coating, its low on gas permeable and water vapor, odor or light. Aluminium foil is widely regarded as the most effective barrier in flexible packaging material, giving almost perfect protection against light and suppressing any transport of matter. The main reason for using aluminium

foil in flexible packaging lies in the need to completely suppress migration or permeation through the package and the packaged good shield from the environment in the most suitable way [14].

The average moisture content of instant ganyong yellow rice in nylon was higher than Al foil but lower than OPP-VMOPP. Reference [12] states that nylon has the character; good transparency, soft and flexible, good barrier to gas and aroma, resistant to oil, resistant to abrasion and impact, but absorbs water vapor. Nylon packaging has a rate of water vapor transmission rate (WVTR) 260 g/m2/day and Al foil has WVTR 0-1 g/m2/day. WVTR is the speed of the water vapor penetrates the film at temperature and humidity conditions specified.

Packaging material combinations used OPP in the front part and VMOPP in the back part. OPP packaging has the character; transparency and good glossy, scratch-resistant, very good barrier to water vapor, the price is cheaper than others, but gas barrier unfavorable and no frost resistance. OPP has WVTR 7 g/m2/day. The aim of metalizing like VMOPP to improve resistance against penetration moisture, aroma and gas, as the decor and resistance to light. VMOPP has WVTR 3 g/m2/day [12].

Instant ganyong yellow rice which was packed with a combination of OPP and VMOPP packaging containing highest water, 8.19%. But, moisture content up to 8 weeks of storage showed no difference in the three types of packaging. These showed that the barrier properties to inhibit water vapor of Al foil, nylon and OPP-VMOPP was same.

B. *Effects of Packaging Type on Microbe Total of Instant GanyongYellow Rice*

Microbe total of instant ganyong yellow rice with 3 different packaging materials stored 8 weeks range between 0,968- 1,974 (log CFU/g). The average total microbe of instant ganyong yellow rice packaged Al foil was lower than nylon and OPP-VMOPP packaging. The highest of microbes total were shown by instant ganyong yellow rice packed with nylon packaging materials. The longer storage the more growing microbes. The average of the amount of microbes growing packed with 3 different types of packaging material at room temperature storage for 8 weeks is shown in Figure 2.

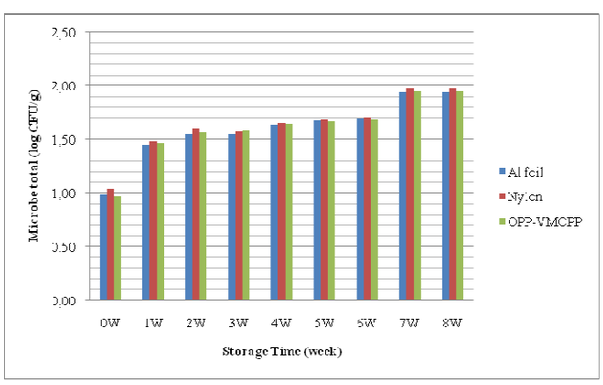

Fig. 2. The average of microbe total in instant ganyong yellow rice packed with 3 kinds of packaging materials for 8 weeks (log CFU/g)

The ANOVA test of microbe total in instant ganyong yellow rice packed with materials Al foil, nylon and OPP-VMOPP at room temperature indicated difference total microbes on the storage of 2 weeks (significance value 0.005), 7 weeks (significance value 0.022) and 8 weeks (significance value 0.022). The differences in microbe total of instant ganyong yellow rice showed the differences of the three types of packaging in permeable to gases, water vapor both incoming and outgoing packaging that affected microbial growth. Duncan test of the differences influence the type of packaging material on the microbe total of instant ganyong yellow rice during storage of 8 weeks are presented in Table 2.

Table 2. The Duncan Test of Total Microbe of Instant Ganyong Yellow Rice with 3 type Packaging Materials during Storage 8 Weeks at Room Temperature (log CFU/g)

Storage Time (Week)	Packaging Materials		
	Al foil	Nylon	OPP-VMOPP
0W	0,98	1,04	0,97
1W	1,45	1,48	1,47
2W	1,54[a]	1,60[b]	1,57[a]
3W	1,56	1,58	1,58
4W	1,64	1,66	1,65
5W	1,68	1,69	1,67
6W	1,70	1,71	1,69
7W	1,94[a]	1,97[b]	1,95[a]
8W	1,94[a]	1,97[b]	1,95[a]

[a, b] Notation on the same line indicates significant differences (Sig.> 0.05)

Duncan test results showed that the average of microbe total of instant ganyong yellow rice packed with Al foil and OPP-VMOPP relatively similar, but differ with nylon packaging on storage for 2, 7 and 8 weeks. The average of microbe total during storage for 8 weeks in Al foil packaging and OPP-VMOPP, were 1.60 and 1.61 log CFU/g respectively. The highest value was indicated in the nylon packaging with an average of 1.633 log CFU/g. Nylon has the character to absorb water vapor, the possibility of water vapor that is in nylon packaging able to provide a medium for microbial growth.

Each package has a different permeability to oxygen. The speed oxygen gas penetrated packaging at a certain temperature and humidity is called the oxygen transmission rate (OTR). The oxygen that is in the packaging can be used for microbial growth. Nylon has the oxygen gas transmission rate (OTR) 90 (cm3/m2/day), the value of OTR Al foil 0-1 cm3/m2/day, while OTR of OPP and VMOPP 1500, 300 cm3/m2/day, respectively [12].

Microbe total of instant ganyong yellow rice packed with all of the packaging materials was still lower than the limit on the total microbes on rice, dried or instant foods. ISO 7388: 2009 states limit the number of microbes $1x10^6$ (colonies/g) or 6 log CFU/g.These indicated that the instant ganyong yellow rice safe for consumption up to 8 weeks of storage at room temperature. Durability instant ganyong yellow rice was not only due to the use of packaging material but also the drying process can be decreased moisture content of the product so that can inhibit the activity of microbial growth.

C. *Effects of Packaging Type on Peroxide Value of Instant Ganyong Yellow Rice*

The peroxide test carried out on instant ganyong yellow rice to determined the level of damage on the product because it used coconut milk that contained high fat. Reference [15] mentions that the coconut milk is a thick white liquid produced from the coconut pulp that grated and then squeezed after addition water. Coconut milk has a fatty taste and is used as flavoring, so the dishes to be savory. Commonly, shelf life of coconut milk less than ten hours at room temperature 25^o-30^oC, but can be extended more than twenty-four hours in the refrigerator. Coconut milk contains three major nutrients are 88.3% fat, 6.1% protein and 5.6% carbohydrates.

Peroxide value is the most important value to determine the degree of damage to the oil or fat. Unsaturated fatty acids can bind oxygen at double bonds to form peroxides. In a period of time long, peroxide could cause the destruction of several kinds of vitamins in fatty foods. Peroxide can also accelerate the raising of rancidity flavor and undesirable flavor in food[16].

Peroxide value of instant ganyong yellow rice with 3 different packaging materials during storage of 8 weeks ranged from 0.01 to 0.15 (mg oxygen/100g oil or fat). The average peroxide value of instant ganyong yellow rice increased during storage in Al foil, OPP-VMOPP and PP, respectively. The average peroxide value of instant ganyong yellow rice packaged with 3 different types of packaging materials at room temperature storage for 8 weeks are shown in Figure 3.

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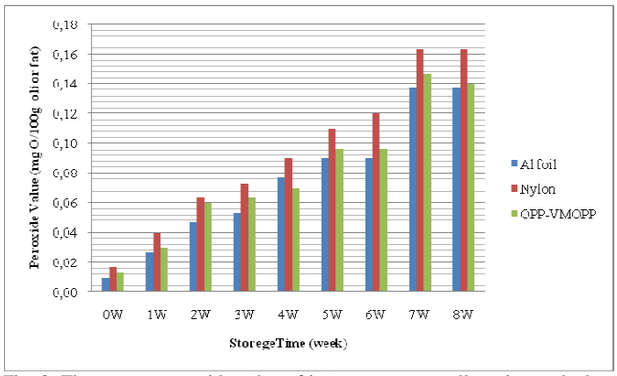

Fig. 3. The average peroxide value of instant ganyong yellow rice packed with 3 kinds of packaging materials for 8 weeks (mg oxygen/100g oil or fat)

The ANOVA test of peroxide value on instant ganyong yellow rice are packed with Al foil, nyon and OPP-VMOPP at room temperature storage for 8 weeks showed no effect. But, there was effect on peroxide value of instant ganyong yellow rice stored 6 weeks with a significance value of 0.014. The average peroxide value of instant ganyong yellow rice during storage for 8 weeks at all of packaging Al foil, nylon and OPP-VMOPP were 0.07; 0.08 and 0.09 (mg oxygen/100g oil or fat) respectively. Duncan test to determine differences in the effect of packaging material to peroxide value of instant ganyong yellow rice during storage of 8 weeks are presented in Table 3.

Table 3. Duncan Test of Peroxide Value on Instant Yellow Rice with 3 Type Packaging Materials During Storage 8 Weeks at Room Temperature (mg oxygen/100g oil or fat).

Storage Time (Week)	Packaging Materials		
	Al foil	Nylon	OPP-VMOPP
0W	0,01	0,02	0,01
1W	0,03	0,04	0,03
2W	0,05	0,06	0,06
3W	0,05	0,07	0,06
4W	0,08	0,09	0,07
5W	0,09	0,11	0,10
6W	0,09[a]	0,12[b]	0,10[a]
7W	0,14	0,16	0,15
8W	0,14	0,16	0,14

[a, b] Notation on the same line indicates significant differences (Sig.> 0.05)

Duncan test results showed that the average peroxide value of instant ganyong yellow rice packed with Al foil and OPP-VMOPP were same but different with nylon packaging on storage 6 weeks. Peroxide value of instant ganyong yellow rice packed with Al foil and OPP-VMOPP were lower than nylon.These showed that the peroxide value in Al foil and OPP-VMOPP lower than nylon. Peroxide can be formed by the unsaturated fatty acid that binds with oxygen in the carbon double bond.

The results showed that Al foil and OPP-VMOPP packaging have the same oxygen permeability, smaller than nylon packaging. The oxygen gas transmission rate (OTR) in nylon is 90 (cm3/m2/day), while the value of OTR Al foil 0-1 cm3/m2/day[12]. OPP packaging has the oxygen transmission rate (OTR) higher than nylon, but when combined with VMOPP capable of inhibiting the oxidation by oxygen in the air is the same as the Al foil.

The average peroxide value of instant ganyong yellow rice packed in Al foil, nylon and OPP-VMOPP were 0.07, 0.08 and 0.09 mg oxygen/100g of oil or fat, respectively for storage 8 weeks. The peroxide value of all of the packaging materials was still below acceptable level of peroxide value for oil. Based on the SII-92 limit for oil peroxide value is 1 mgO/100g. These indicated that instant ganyong yellow rice safe for consumption and didn't show rancidity up to 8 weeks of storage at room temperature.

All packaging Al foil, nylon and OPP-VMOPP able to inhibit the fat of the product. Fat was not absorbed in the packaging so that oxidation due to contact with the oxygen of the air didn't occur. Reference [6] mentions if the packaging material can absorb fat, so absorbed fat will be oxidized by air that fat is broken and off flavor. The flavor of the fats broken will be absorbed by the fat contained in the package that caused all the fat is broken.

The oxidation process in all packaging was running slow, the increase was so small that the product did not change either aroma or color. Reference [16] mentions oxidation reactions will produce rancidity in oils and fats. Oxidation begins with the formation of peroxide and hydroperoxide. The next stage, fatty acids decompose accompanied by the conversion of hydroperoxide to be aldehydes, ketones and free fatty acids. Rancidity is formed by aldehyde, not by peroxide. So the increase in peroxide value (PV) as an indicator and a warning that oil would soon become rancid.

CONCLUSIONS

The study effects of the type packaging material on moisture content, microbe total and peroxide value found that products in packaging Al foil had water content was the lowest compared with nylon and OPP-VMOPP, 6.66%, 7.96% and 8, 19%, respectively, but up to 8 weeks of storage moisture content showed no difference in the three types of packaging. Total microbial product showed the difference. The products packed with nylon had the highest total microbes (1.633 log CFU/g) compared to nylon and OPP-VMOPP, that are 1.60 and 1.61 log CFU/g, respectively. Total microbes in all types of packaging were still below the limit of the number of microbes for rice, dry food or instant, ISO 7388: 2009 states 1x106 colonies/g or 6 log CFU/g. Peroxide value of products packaged in all three types of packaging increased during storage but did not show a difference of up to 8 weeks of storage. Average peroxide value in packaging Al foil, nylon and OPP-VMOPP 0.07, 0.08 and 0.09 mg oxygen /100g oil or fat, respectively. Fat of product was below the oil peroxide value, that is maximum of 1 mgO/100g (SII-92).

Instant ganyong yellow rice packed with all three types of packaging up to 8 weeks of storage at room temperature showed that was still safe to consume, based on the total microbes and peroxide value. Each package has a value of different properties, that followed by the price difference. Furthermore, to select the type of packaging suitable for instant ganyong yellow rice products need to consider the value of properties and the price of packaging.

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REFERENCES

[1] Sulandari, L and Pangesthi, L.T., "Exploration of Ganyong (Canna edulis Kerr) as a source of inulin in the production of various ganyong rice for diversification of a healthy prebiotic food ", unpublished.
[2] Sulandari, L, "Exploration of inulin content of ganyong tuber," Proceedings of the National Seminar on Research and Community Service (PPM), Surabaya, LPPM Unesa, October 2015.
[3] Roberfroid, M.B, "Inulin-type fructans: functional foods ingredients," J.Nutrition. pp. 2493S-2502S, [American Society for Nutrition. [Digests ORAFTI 5th Research Conference: Inulin and Oligofructose: Proven Health Benefits and Claims'. Harvard Medical School, Boston, MA, September 28 to 29, 2006].
[4] Arifiani, R and Sulandari, L, "Effects of ganyong tuber puree (Canna edulis Kerr) substitution towards the organoleptic properties of instant yellow rice," e-journal Boga, vol 5, no. 1, pp. 248-257.
[5] Munadjim, Ways of Chemical Analysis. Surabaya: The Ministry of Industry, Industry Research Center, 2001.
[6] Winarno. F.G, Food Chemistry and Nutrition, Jakarta: PT Gramedia Pustaka Utama, 1997.
[7] Astawan, M, Nutritional Content of Foods, Jakarta: PT Gramedia, 2004.
[8] Pamungkas, B, "Test of the physical and chemical properties of instant rice (IRSOYBEAN) substituted soybean (Glycine max) solution", J. of Tropical Agricultural Engineering and Biosystems, vol 1 no. 3, pp 213-233, October 2013.
[9] Ali, M.A, Hasan, S.M.K, and Islam, M.N, "Study on the period of acceptability of cooked rice," J. Bangladesh Agril. Univ. 6 (2). pp. 401-408, 2008

[10] Kurnia, A, " Effects of drying on the quality of instant “uduk” rice," Thesis, Bogor: Bogor Agricultural Institute, 2012.
[11] Setyawan, N, Dewandari, K.T and Herath, H, "Influence of the thickness of aluminium foil on the physicochemical characteristics of carrot chips during storage", "Proceedings of the National Seminar on Technology Innovative Agricultural Postharvest III, pp. 454-465.http: //pascapanen.litbang.deptan.go.id, 2012.
[12] Sampurno, B, "Application of polymers in the packaging industry," Indonesian Journal of Materials Science, Special Ed. Pp. 15-22, 2006.
[13] Purnomo, H and Adiono. Food sciences. Translation. Jakarta: UI-Press, 1985.
[14] Schubert, G, "Adhesion of Aluminum Foil to Coatings - Stick With it," European 2003 TAPPI PLACE Conference, Rome, May 12-14, 2003.
[15] Srihari, E, "The effect of the addition of maltodextrin in the manufacture of coconut milk powder,” Journal of Chemical Engineering Department, Surabaya: Faculty of Engineering, University of Surabaya, 2010.
[16] Ketaren, S, Introduction to Technology Oils and Fats Food, Jakarta: UI-Press.