

The Effect of Packaging Types on The Organoleptic Properties of Instant Ganyong Yellow Rice

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Abstract—The effect of packaging types: aluminium foil (Al foil), nylon, and oriented polypropylene combined with vacuum metallized oriented polypropylene (OPP-VMOPP) on the organoleptic properties of instant *ganyong* yellow rice was analyzed. The results showed that the type of packaging produced different effects on the organoleptic properties during 12 weeks of storage (color, shape, and aroma), as well as in preferences of consumers. It was reported that the best packaging for instant *ganyong* yellow rice was aluminium foil.

Keywords—Instant *gayong* yellow rice; Al foil; Nylon; OPP-VMOPP; organoleptic properties

I. INTRODUCTION

Yellow rice is a yellow-colored rice made from turmeric extract, a distinctive flavor derived from the spices used and has a savoury taste. According to [1] yellow rice is cooked rice by using coconut milk, salt, *salam* leaves, and turmeric. The coconut milk has a sense of fat and is used as a tasting flavor, so the cuisine becomes savoury [2]. In this study yellow rice is made from a mixture of rice and *ganyong* tubers (*Canna edulis*, Ker). Based on sources from the Directorate of Nutrition Department of Health, every 100 grams of *ganyong* consists of 95.00 kcal; 22,60 g carbohydrate; 1.00 g protein; 0.11 g fat; 75,00 g water; 21.00 g calcium; 75,00 g phosphorus; 1.90 mg of iron; 0.10mg Vitamin B1; 10.00mg Vitamin C. *Ganyong* tubers contains 11.70% inulin and puree *ganyong* contains 23.63% inulin [3].

Advantage, making yellow rice is able to cover the brown color of the tubers. Further [4] mentions turmeric containing 2.5-6% orange yellow curcumin pigment. Curcumin in addition to having an orange yellow color also contributes to the character of spiciness that is soft on the spice. The liquid used in making yellow rice is coconut milk. Coconut milk gives a savoury flavor, combined with the flavor of seasoning makes delicious yellow rice different. However, the use of coconut milk can cause easily damaged yellow rice. Futher [2] mentions that coconut milk is usually survived less than ten hours at room temperature 25 -30 °C and can withstand more than twenty-four hours in the refrigerator.

Efforts are made by making instant *ganyong* yellow rice for extending its shelf life. According to [5] instant rice product has been growing rapidly in developed countries such as the USA and Japan, among others *Sage V food* the ripening

time of 5 minutes with hot water brewed; *cup rice* from Nissin Foods Company, which is a 5-minute ripening instant rice with *uncle's* trademark *Ben* ripening of 1.5 minutes in the microwave. Instant rice *uncle's Ben* is not as instant rice in general that through the process of freezing and drying but this rice as regular rice is preserved then heated in the microwave if it will be consumed.

Instant products require specified packaging to keep products easily stored and distributed. There specified packaging namely aluminium foil, nylon (plastic) and oriented polypropylene OPP) with vacuum metallise oriented polypropylene (OPP-VMOPP). The aluminium foil packaging is made from metal in the form of solid and thin aluminium sheets with a thickness of ≤ 0.15 mm is hermetic, flexible, and opaque. The thickness of the material determines its protective properties, if thin the packaging can be traversed by the gas and steam, aluminium foil can not be passed gas and water vapour at a thickness of more than 25.4 μm . The aluminium foil packaging has a lower water vapour and oxygen transmission rate and is more heat resistant than the PP and LDPE types [6].

Bioriented polyamide (BOPA) better known as Nylon Bioriented (BO-Ny) or nylon (ONY). Properties and characteristics: density 1.15 g/cm³, general thickness 15 μm , good transparency, very soft and flexible, good resistance against puncture and friction, stable to temperature changes, good as gas and aroma retardant, good resistance and low temperature, against abrasion and impact, absorb water vapor, resistant to oil and chemicals, and a good barrier to scent. Protective properties (Barrier) a plastic material, because the metal foil is not transparent and the glass is not flexible for *flexible packaging* commonly used plastic materials (polymer). All materials, except glass and metal, drivable (*permeable*) by steam, air and other gases. Criteria for *High Barrier Material*: OTR <1cc/100inch²/day or OTR <15.5 cc/m²/day. The definition of "OTR (oxygen transmission rate) is the speed of oxygen gas penetrates through the film on conditions of temperature and relative humidity, under conditions steady state. The value is expressed in cc/m²/24hr. The standard test conditions are 23°C, 0% RH [7].

Oriented polypropylene (OPP) derived from propylene polymerization reaction with the appropriate conditions and catalysts. The main key in the process of making OPP is the process of withdrawal and stretching to form the molecular

orientation. OPP characteristics are resistant to the organic solvent, however, solvent aromatics, such as toluene and benzene, can cause OPP to expand (swell). High temperatures can improve the elongation properties of OPP due to the thermoplastic properties of the material. OPP properties are highly transparent, the excellent barrier for moisture, good temperature resistance, good mechanical properties, and cheaper price than other films. VMOPP is an OPP that undergoes the metallizing process. Metallizing purpose; metallized films can improve penetrating resistance to water vapour, aroma and gas, as decoration, and light resistance. VMOPP has a water vapor transmission rate (WVTR) of $3\text{g/m}^2/\text{day}$ and OTR (oxygen transmission rate) of $300\text{cc/m}^2/24\text{hr}$. This study aims to determine the effects of this type of packaging on the organoleptic properties of instant *ganyong* yellow rice, including color, shape, aroma and favourite level and nutritional content of instant *ganyong* yellow rice.

II. METHODS

A. Materials

The materials used in the making of yellow rice: rice Kingfish Catfish branded packed by CV. The Earth Imagery from Indonesia, *ganyong tubers* (*Canna edulis* Kerr), coconut milk, spices: salt, turmeric, salam leaves, lime leaves, lime juice and lemon grass. Three types of packaging, including aluminium foil (Al foil), Nylon and the combination of oriented polypropylene (OPP) and vacuum metallise OPP (OPP-VMOPP). Packed aluminum foil bag, PE /ALU /SPE-50 type, WxH = $80 \times 120\text{mm}$. Type of Nylon structure: Nylon/SPE70, WxHxD = $95 \times 250 \times 60\text{mm}$. The combined packaging used was bag, Tras-Met type, W x H = $130 \times 210 \text{ mm}$, front structure: OPP / SPE-70, and rear structure: VMOPP/SPE-70. All packaging brand K pack with code 07 was obtained from Toko Kemasan Kita Surabaya Indonesia.

B. Equipment

Equipment used were the equipment for making instant *ganyong* yellow rice consist of rice cooking utensils, freezer, dryer cabinet, as well as organoleptic test equipment.

C. Making of Instant *Ganyong* Yellow Rice

Making instant *ganyong* yellow rice refer to [8]. *Ganyong* tubers were washed and then boiled for 45 minutes. *Ganyong* tubers were peeled and shredded into 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. It was called instant *ganyong* yellow rice.

III. RESULT AND DISCUSSION

A. Color of Instant *Ganyong* Yellow Rice

The average value of the organoleptic test of instant *ganyong* yellow rice color with 3 different types of packaging during 12 weeks storage ranged from 1.71-4.00 with the criterion of yellow dull, slightly yellow dull, yellow enough and yellow. Average of instant *ganyong* yellow rice color values with Al foil, Nylon and OPP-VMOPP packaging were respectively 3.36, 2.74 and 2.80. The average instant *ganyong* yellow rice color value packed with 3 different packaging materials at room temperature storage for 12 weeks was presented in Fig.1.

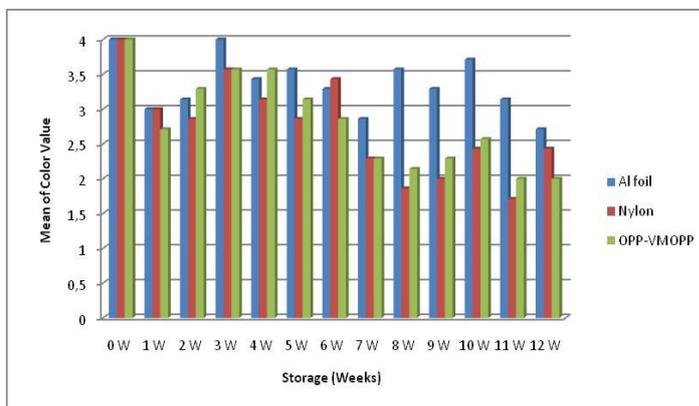


Fig. 1. Average of instant *ganyong* yellow rice color values with 3 types of packaging during 12 weeks storage at room temperature

The value of significance of each type of packaging was 0.007; 0,000 and 0,000. Further test results *Multiple Comparison Test* to determine the differences in types of packaging material effect on the color instant *ganyong* yellow rice during 12 weeks of storage were presented in Table 1.

Table 1. shows instant *ganyong* yellow g rice packed with Al foil at 0 weeks storage until 11 weeks had a yellow color, and began to change at 12 weeks storage, becoming quite yellow. Instant *ganyong* yellow rice packed with Nylon at 0 weeks to 6 weeks storage has a yellow color, and 7-week storage starts turning slightly dull yellow. Instant *ganyong* yellow rice packed with OPP-VMOPP at 0 weeks to 6 weeks storage had a yellow color and began to turn slightly dull yellow at 7 weeks storage.

The existence of the color difference of instant *ganyong* yellow rice packed with Al foil, Nylon and OPP-VMOPP showed *ganyong* the difference in packaging ability to hold oxygen. The presence of oxygen in the pack is related to the oxidation activity of the phenolase enzyme that causes the brownish color derived from the use of puree *ganyong*. Puree *ganyong* has a greyish white color until brownish, due to the activity of phenolase enzyme in fresh *ganyong* tubers. When the puree *ganyong* mixed with the rice in the making of yellow rice, the color became slightly dull yellow. According to [8] the transmission rate of oxygen gas (OTR) in Nylon 90 ($\text{cm}^3/\text{m}^2/\text{day}$), while the OTR Al foil value is $0-1 \text{ cm}^3/\text{m}^2/\text{day}$. OPP packaging has

an oxygen transmission rate (OTR) higher than that of Nylon, but when combined with VMOPP it is thought to be capable of inhibiting oxidation by oxygen from the air greater than nylon.

Yellow color changes allegedly related to the influence of light that can penetrate on the packaging. The curcumin found in turmeric as yellow rice spice has a heat stable property, but will become pale by light.

Friedman test results indicate the type of packing Al foil, Nylon and OPP-VMOPP gave effect to the form of instant *ganyong* yellow rice during 12 weeks storage at room temperature. The value of significance of each type of packaging is 0.007; 0.008 and 0.030. Further test results of Multiple Comparison Test to determined differences in the effect of types of packaging material to shape instant *ganyong* yellow rice during 12 weeks of storage were presented in Table 2.

TABLE I. MULTIPLE COMPARISON TEST OF INSTANT GANYONG YELLOW RICE COLOR WITH 3 TYPES OF PACKAGING FOR STORAGE 12 WEEKS AT ROOM TEMPERATURE

Storage Duration	Al foil			Nylon			OPP-VMOPP		
	Average	Total Ranking	Notation	Average	Total Ranking	Notation	Average	Total Ranking	Notation
0 Week	4.00	68	bc	4.00	82.5	e	4.00	82	e
1 Week	3.00	40	a b c	3.00	54	abcde	2.71	50	abcde
2 Weeks	3.14	41	a b c	2.86	52.5	abcde	3.29	64	bcde
3 Weeks	4.00	68	c	3.57	72	de	3.57	54	a
4 Weeks	3.43	52.5	a b c	3.14	61.5	bcde	3.57	72.5	de
5 Weeks	3.57	55	a b c	2.86	54	abcde	3.14	59.5	abcde
6 Weeks	3.29	47.5	a b c	3.43	68	cde	2.86	50	abcde
7 Weeks	2.86	35.5	a b c	2.29	38.5	a b c d	2.29	32	ab
8 Weeks	3.57	55	a b c	1.86	22.5	a	2.14	26	a
9 Weeks	3.29	47.5	a b c	2.00	27.5	ab	2.29	32	ab
10 Weeks	3.71	59	a b c	2.43	40.5	a b c d	2.57	41.5	a b c d
11 Weeks	3.14	40.5	a b c	1.71	23	a	2.00	27	a
12 Weeks	2.71	27.5	a	2.43	40.5	a b c d	2.00	27	a

Further [9] mentions turmeric containing 2.5-6% pigment curcumin orange yellow. In addition to curcumin having an orange yellow color also contributes to the character of spiciness that is soft on the spice. Curcumin is stable against heat but becomes pale quickly due to the influence of light. This is consistent with the results of the study, that Al foil packaging is an opaque package, while Nylon and OPP-VMOPP can be penetrated light so yellow *ganyong* rice instantly packed Al foil yellow is more resistant to 11 weeks storage, followed by packaging OPP- VMOPP and Nylon. OPP-VMOPP is a package that only one side can be penetrated light, while Nylon all sides can be penetrated by light.

B. Shape of Instant Ganyong Yellow Rice

The average value of organoleptic test of instant *ganyong* yellow rice with 3 different types of packaging during 12 weeks storage ranged from 2.57-4.00 with the criteria of shape assessment there are 4 levels, namely: not rolled (between grains sticking together and forming big blobs), many are broken; less grassy (between the grains sticking together and forming small clumps), slightly broken, the shape was quite grained (between the grains slightly stuck but not clot), quite intact and unbound (between grains not sticking together) and whole. The average value of instant *ganyong* yellow rice form with the packaging of Al foil, Nylon and OPP-VMOPP respectively 3.58; 3.43 and 3.36. The average instant *ganyong* yellow rice color value packed with 3 different packaging materials at room temperature storage for 12 weeks was presented in Fig. 2.

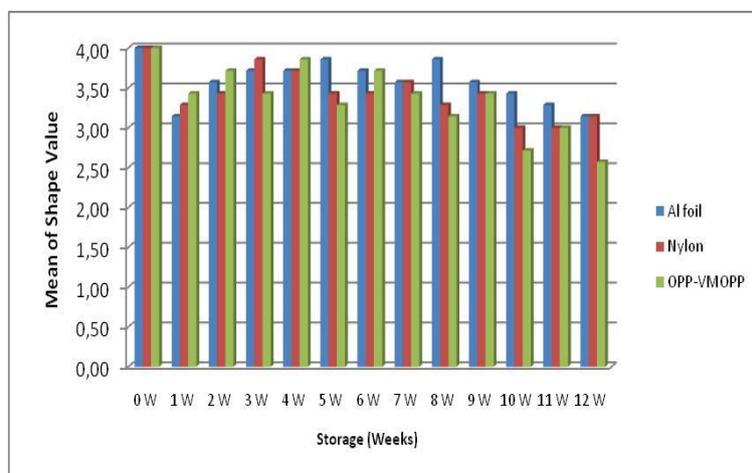


Fig. 2. Average of instant *ganyong* yellow rice shape value with 3 types of packaging during 12weeks storageat room temperature

Table 2. Shows instant *ganyong* yellow rice packed with Nylon at 0 weeks storage had a grainy shape (between grains not sticking together) and whole. Starting from 1 week to 12 weeks of instant *ganyong* yellow rice had the same shape, just a roll (between the grains slightly sticking but not clot), and quite intact. Instant *ganyong* yellow rice packaged with OPP-VMOPP had the same shape as Nylon packaging. On a weekly grain-shaped storage (between grains not sticking together) and intact, the storage of 1 to 12 weeks is fairly rounded (between the grains slightly attached but not clump)

TABLE II. MULTIPLE COMPARISON TEST RESULTS OF INSTANT *GANYONG* YELLOW RICE SHAPE WITH 3 TYPES OF PACKAGING FOR STORAGE 12 WEEKS AT ROOM TEMPERATURE

Storage Duration	Nylon			OPP-VMOPP		
	Average	Total Ranking	Notation	Average	Total Ranking	Notation
0 week	4.00	70	b	4.00	70.5	e
1 week	3.29	43	ab	3.43	52.5	abcde
2 weeks	3.43	49.5	ab	3.71	61.5	bcde
3 weeks	3.86	66	ab	3.43	49.5	de
4 weeks	3.71	60.5	ab	3.86	67.5	cde
5 weeks	3.43	47.5	ab	3.29	47.5	abcde
6 weeks	3.43	47.5	ab	3.71	61.5	cde
7 weeks	3.57	54.5	ab	3.43	49.5	bcde
8 weeks	3.29	43	ab	3.14	38	abcde
9 weeks	3.43	49.5	ab	3.43	52.5	abcde
10 weeks	3.00	32.5	a	2.71	29.5	a b c
11 weeks	3.00	34	ab	3.00	37	abcde
12 weeks	3.14	39.5	ab	2.57	21	a

and intact enough. However, judging from the average value of instant *ganyong* yellow rice form larger on Nylon packaging compared with OPP-VMOPP packaging.

This showed the ability to resist the nylon greater impact than the packaging OPP-VMOPP. According to [7] Nylon (ONy) has a resistance to abrasion and impact (impact).

Instant *ganyong* yellow rice packed with Al foil had an average value of 3.14-4.00, based on Friedman test showed no difference. Criteria shape of instant *ganyong* yellow rice with Al foil packaging was grainy (between grains not stick together) and whole. The average value of instant yellow *ganyong* with packed Al foil is bigger than nylon and OPP-VMOPP. This indicated that Al foil packaging has the ability to withstand impact from outside higher than nylon and OPP-VMOPP so that the shape of instant *ganyong* yellow rice was packed relatively stable up to 12 weeks storage.

C. Aroma of Instant Ganyong Yellow Rice

Average test value of organoleptic aroma of instant *ganyong* yellow rice with 3 different types of packaging during 12 weeks storage ranged from 1.43 to 4.00 with the scoring criteria there were 4 levels, namely: not typical yellow rice (distorted, somewhat rancid); less typical flavored yellow rice; quite typical flavored yellow rice and flavored typical yellow rice. The average value of instant *ganyong* yellow rice aroma with the packaging of Al foil, Nylon and OPP-VMOPP respectively; 3.86, 3.36 and 3.24. The average value of instant *ganyong* yellow rice aroma packed with 3 different packaging materials at room temperature storage for 12 weeks was presented in Fig. 3.

Friedman test results show the type of Al foil packaging, did not give effect to the aroma of instant *ganyong* yellow rice during 12 weeks storage at room temperature, while the packaging of Nylon and OPP-VMOPP gave effect to the instant *ganyong* yellow rice aroma during 12 weeks storage at room temperature. The significance value of the Nylon and OPP-VMOPP packaging types was 0.000. Further test results Multiple Comparison Test to determine the differences in types of packaging material influence on the aroma of instant *ganyong* yellow t rice during 12 weeks of storage were presented in Table 3.

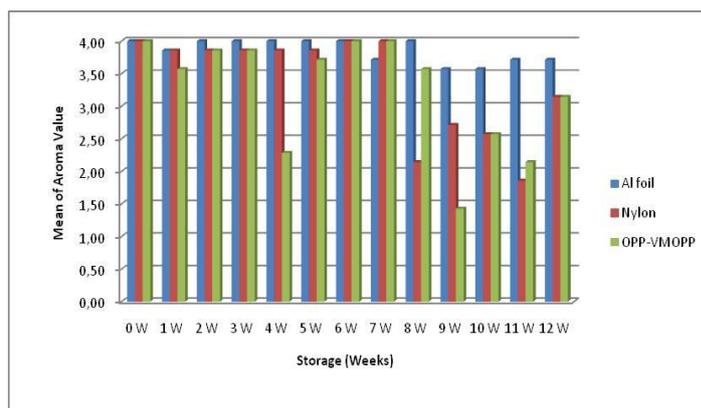


Fig. 3. Average value of instant *ganyong* yellow rice aroma with 3 types of packaging during 12 weeks storage at room temperature

Table 3. shows instant *ganyong* yellow rice packed with Nylon at 0 weeks storage until 7 weeks of typical yellow rice aroma, and the aroma changes from 8 weeks storage, to a less distinctive flavour of the yellow rice. Instant *ganyong* yellow rice packed with OPP-VMOPP at 0 weeks storage up to 8 weeks of flavoured yellow rice and aroma changed from 9 weeks storage to less yellow-colored flavour typical. According to [8] mentions OTR (*oxygen transmission rate*) Nylon 90 cc/m²/4hr, while OPP 1,500 cc/m²/24hr. The combination of OPP with VMOPP proved able to withstand gas and maintain the aroma of the product so that the aroma of instant *ganyong* yellow rice could be stable up to 8 weeks storage.

Instant *ganyong* yellow rice packed with Al foil up to 12 weeks' storage had an average scent value of 3.57-4.00, there is no difference. The aroma of instant yellow *ganyong* rice were packed with Al foil with a distinctive aroma of yellow rice. This indicated that the Al foil packaging was capable of holding the oxygen gas penetrating into the packaging so that the product aroma was stable up to 12 weeks storage. The oxygen from the air entering the package will oxidise the fat/oil from the yellow rice, so the fat is broken and smelly. According to [7] OTR (*oxygen transmission rate*) of 0-1 cc/m²/24hr, is very small.

TABLE III. MULTIPLE COMPARISON TEST RESULTS OF INSTANT YELLOW RICE AROMA WITH 3 TYPES OF PACKAGING FOR STORAGE 12 WEEKS AT ROOM TEMPERATURE

Storage Duration	Nylon			OPP-MVOPP		
	Average	Total Ranking	Notation	Average	Total Ranking	Notation
0 week	4.00	68	ghi	4.00	69	ghi
1 week	3.86	63.5	defghi	3.57	60.5	cdefghi
2 weeks	3.86	63.5	efghi	3.86	64.5	fghi
3 weeks	3.86	63.5	fghi	3.86	64	efghi
4 weeks	3.86	63	bcdefghi	2.29	23	ab
5 weeks	3.86	63	cdefghi	3.71	61.5	defghi
6 weeks	4.00	68	hi	4.00	69	hi
7 weeks	4.00	68	i	4.00	69	i.
8 weeks	2.14	16	a	3.57	53.5	bcdefghi
9 weeks	2.71	28	abcdef	1.43	11	a
10 weeks	2.57	22.5	a	2.57	31	abcdef
11 weeks	1.86	14	a	2.14	21.5	ab
12 weeks	3.14	36	abcdefghi	3.14	39.5	abcdefghi

D. Preferences of Yellow Ganyong Instant Rice

The average value of the organoleptic test in the preferences of instant *ganyong* yellow rice with 3 different types of packaging during 12 weeks storage ranged from 1.71-4.00 with the criteria of assessment of preferences there are 4 levels, namely: dislike; do not like it much; Quite like and like. The average value of instant *ganyong* yellow rice with packed Al foil, Nylon and OPP-VMOPP were 3.75; 3.04 and 3.14. The average value of instant *ganyong* yellow rice preference packed with 3 different packaging materials at room temperature storage for 12 weeks was presented in Fig. 4.

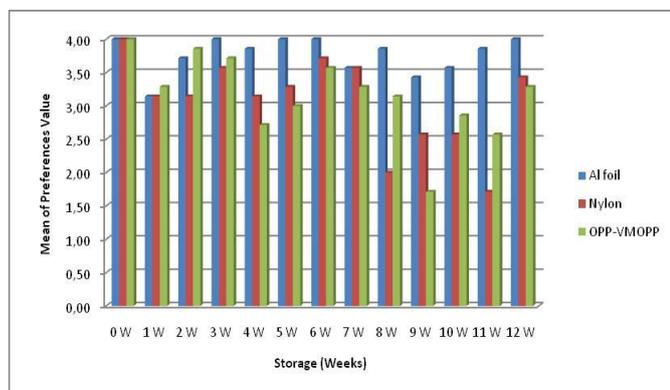


Fig. 4. Average preferences value of instant *ganyong* yellow rice with 3 types of packaging during 12 weeks storage at room temperature

Friedman test results show that Al foil packaging type did not give effect to instant *ganyong* yellow rice preference during 12 weeks storage, while Nylon and OPP-VMOPP packaging had an effect on instant *ganyong* yellow rice preference during 12 weeks storage at room temperature. The significance value of the Nylon and OPP-VMOPP packaging types is 0.000. Further test results Multiple Comparison Test to determine differences in the effect of types of packaging material on instant *ganyong* yellow rice during 12 weeks of storage are presented in Table 4.

Table 4. show that instant *ganyong* yellow rice packed with Nylon on storage 0 weeks to 7 weeks had preference levels of likes, and the level of preference changed from storage 8 weeks, to less like, but at 12 weeks storage of instant *ganyong* yellow rice became like. Instant *ganyong* yellow rice packed with OPP-VMOPP at 0 weeks to 8 weeks storage had a preference level with the criteria for change from 9 weeks storage to less, but at 12 weeks storage the preference level of instant *ganyong* yellow rice was preferred. Instant *ganyong* yellow rice packed nylon and OPP-VMOPP up to 12 weeks of storage were both preferred. The distinguishing characteristics of packaging were, transparent nylon packaging so that the packaged product could be viewed from two sides, while OPP-VMOPP could be viewed from one side, in addition to the packaging price. Further [7] mentions in terms of cost Nylon has a high price, while the OPP is classified. Price in nylon packaging market per sheet Rp 980.00 and OPP-VMOPP Rp 340.00 per share.

TABLE IV. MULTIPLE COMPARISON TEST RESULTS OF INSTANT YELLOW RICE PREFERENCES WITH 3 TYPES OF PACKAGING FOR STORAGE 12 WEEKS AT ROOM TEMPERATURE

Storage Duration	Nylon			OPP-MVOPP		
	Average	Total Ranking	Notation	Average	Total Ranking	Notation
0 week	4.00	68	ghi	4.00	69	ghi
1 week	3.86	63.5	defghi	3.57	60.5	cdefghi
2 weeks	3.86	63.5	efghi	3.86	64.5	fghi
3 weeks	3.86	63.5	fghi	3.86	64	efghi
4 weeks	3.86	63	bcdefghi	2.29	23	ab
5 weeks	3.86	63	cdefghi	3.71	61.5	defghi
6 weeks	4.00	68	hi	4.00	69	hi
7 weeks	4.00	68	i	4.00	69	i.
8 weeks	2.14	16	a	3.57	53.5	bcdefghi
9 weeks	2.71	28	abcdef	1.43	11	a
10 weeks	2.57	22.5	a	2.57	31	abcdef
11 weeks	1.86	14	a	2.14	21.5	ab
12 weeks	3.14	36	abcdefghi	3.14	39.5	abcdefghi

IV. CONCLUSION

This type of packaging gives a different effect on the organoleptic properties of instant *ganyong* yellow rice during 12 weeks storage, including color, shape, aroma and product's preference level. The best packaging was aluminium foil, with the organoleptic criteria of instant *ganyong* yellow rice: the color was quite yellow, the grainy shape (between grains not sticking together and whole), flavoured yellow rice and preferred. Nutritional content of instant *ganyong* yellow rice, i.e. 6.48% protein, 0.66% fat, 6.42% water, 0.98% ash, 36.11 mg/100 g calcium, 31.24 mg/100 g iron, 14.81% fiber and 4.82% inulin.

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