

Characteristic of Taro (*Colocasia esculenta*) and Seaweed (*Eucheuma cottoni*) Based Analogue Rice Fortified with Fishes Bone Collagen (A Promising Anti-Diabetic Functional Food)

by Siti Susanti

Submission date: 16-Nov-2018 10:56AM (UTC+0700)

Submission ID: 1040073217

File name: es_Bone_Collagen_A_Promising_Anti-Diabetic_Functional_Food.docx (246.04K)

Word count: 3621

Character count: 20277

³
**Characteristic of Taro (*Colocasia esculenta*) and Seaweed (*Eucheuma cottoni*)
Based Analogue Rice Fortified with Fishes Bone Collagen
(A Promising Anti-Diabetic Functional Food)**

¹Y.S. Darmanto, ¹P.H. Riyadi and ²S. Susanti
¹Department of Fisheries, ¹Faculty of Fisheries and Marine Sciences,
²Department of Agriculture, Faculty of Animal Science and Agriculture,
Diponegoro University Semarang, 5027 Central Java, Indonesia

²
Abstract: Recently, approximately 9.1 million people of 237.56 million of Indonesian population suffer diabetes. Such condition was caused by high rice consumption of most Indonesian people. It has been known that rice contains low amylose, high calorie and possesses hyperglycemic properties. We formulate Taro and Seaweed flour based Analogue Rice (AR) that fortified by various Fishes Bone Collagen (FBC) in order to provide an alternative healthy and balanced diet. AR was characterized about its nutritional composition such as proximate analyses, water, dietary fiber and amylose content. Furthermore, its morphological structure was analyzed by using scanning electron microscopy while the level of consumer preferences was performed by hedonic test. Fortification by using various FBC into the AR was significantly different in physical and chemical properties thereby affecting the flavor, aroma and texture. Moreover, addition of milkfish bones collagen into AR was more preferably than others. Taro (*Colocasia esculenta*) and seaweed (*Eucheuma cottoni*) based AR fortified with various FBC showed the different food fiber and amylose contents. This finding was expected as new avenue in functional food discovery especially in the treatment and prevention of diabetic diseases.

Key words: Analogue rice, taro, seaweed, fishes bone collagen, treatment

INTRODUCTION

Currently, it is estimated that of 237.56 million of Indonesia's population, more or less 9.1 million people suffer from diabetes. Such condition has a correlation to the misunderstanding about food nutrition, inappropriate method in food selection, low purchasing power, culture, diet and people education level. In the other hand, rice as an Indonesian staple food possesses the high level of carbohydrate, sugar and calories are not recommended to the diabetic. Therefore, Analog Rice (AR) to replace the rice consumption in diabetic must be contemplated.

In tropical country, tuber has been known as an important source of carbohydrates. Indonesia as one of tropical country has abundant tubers production. One of them is taro (*Colocasia esculenta*), a tropical tuber crop contains 70-80% starch and richingums (mucilage). Small sizes of taro's starch granules make it a highly digestible which is advantaged for various foods (Kaushal *et al.*, 2015).

Viewed from the aspect of nutrition, food is not adequate merely with the low level of carbohydrate, sugar and calories but it should be envisaged dietary

fiber. *Eucheuma cottoni* is one of seaweed families that contain high level of dietary fiber with a composition of 27.8% of water, 8.6% of fat, 3% of fiber and 22.25% of ash (Ask and Azanza, 2002). It also contains enzymes, nucleic acids, amino acids, vitamins and minerals such as nitrogen, calcium, selenium and iron, magnesium and sodium (Anggadiredja *et al.*, 2008). Seaweed contains many soluble fibers that are difficult to be digested, able to slow down the gastric emptiness and maintain the satiety. Farmer (2009) stated that seaweed in the form of extract can lower the blood sugar, cholesterol, anti-microbial, anti-inflammatory, antipyretic, antiglesic and anti-coagulant. Seaweeds produce the carrageen which serves as a food additive, stabilizer and thickener, gelling in industries such as gel, meat canning, bread, ice cream or cheese (Carthew, 2002).

AR is the artificial rice made of taro flour and seaweed using granulation technology and heat and cold extrusion and made in the rice-like shape. It contains low carbohydrate and is rich in fiber. To complete its nutrition, it needs to add with the protein components. Fish Bone Collagen (FBC) is protein processed by deproteinization and demineralization into alanine amino acids, glycine,

¹
Corresponding Author: S. Susanti, Department of Agriculture, Faculty of Animal Science and Agriculture,
Diponegoro University Semarang, 5027 Central Java, Indonesia

arginine, proline and hydroxyproline (Tongchan *et al.*, 2009). Darmanto *et al.* (2010) explained that the collagen added into myofibril-based food will enhance the gel strength and water holding capacity and change the position of monolayer and multilayer water. If heated, collagen changes into gelatin that has a number of physical and chemical properties resembling the collagen (Darmanto *et al.*, 2010). Further, Darmanto *et al.* (2014) explained that if the gelatin is added into the nugget, it will improve the gel strength, water holding capacity, fold test and water activities. Through this study, we formulated Taro and Seaweed flour based Analogue Rice (R) that fortified by various Fishes Bone Collagen (FBC) in order to provide an alternative healthy and balanced diet (FCC, 1975).

MATERIALS AND METHODS

The materials of study consisted of taro, seaweed and collagen from various types of fish bones. Taro was obtained from Semarang City and the seaweed *Eucheuma Cottonii* was obtained from Jepara regency, Central Java Province. Four types of fish bones were catfish, milkfish, snapper and ray fish, taken from TPI (Fish Auction Place) in Semarang.

Preparation of taro and seaweed flour: Taro flour was processed according to the procedure which described earlier (Cahyadi *et al.*, 2012). Briefly, production of taro flour was carried out through a number of phases such as washing, stripping the skin, cutting, soaking in 0.05% metabisulfite for 30 min, drying, smoothing and sieving. In the other hand, production of seaweed flour was performed in several stages such as washing, soaking in KOH 8% within 6 h, drying in an oven of 55°C for 2 days, milling and sieving (Afriwanti, 2008).

Preparation of various fish bone collagen: Various fish bone used in this study derived from several fishes such as catfish, milkfish, snapper and ray fish. The procedure of collagen production as described earlier (Darmanto *et al.*, 2010). Briefly, making of collagen was conducted through several steps: washing, deproteinization, demineralization, drying, milling and sieving.

Production of analog rice: First of all, collagen, taro and seaweed flour were grinded become a nano-particle by using ball milling device (Lekahena *et al.*, 2014). Analog rice was produced according to the food formulation as through taro flour (500 g), seaweed flour (25 g) and each collagen (25 g), 10 g of glyceryl mono stearate (10 g) and

water (125 cc). Mixed formula was steamed for 15 min and then it was formed through the granulation and extrusion technique at temperature of 70°C (Mishra *et al.*, 2012).

Experimental analyses: The proximate analysis was conducted according to the procedure established by AOAC (2007). Dietary fiber was calculated according to the method established by Johansson *et al.* (1983). Dietary fiber is a complex carbohydrate derived from plant tissues that cannot be digested by digestive enzymes. Therefore, the measurement of dietary fiber was done by enumeration the weight of soluble and insoluble fiber.

The hedonic test of rice analogue was conducted by 30 trained panelists to assess the preference towards color, aroma and the stickiness of taste of the super rice analogue using the scale of 1-5 (Meilgaard *et al.*, 1999).

Amylose is an important parameter in determining the hedonic test on the rice texture both on the hardness

and on the adhesiveness. Analysis was measured with the color in tenstias using spectrophotometer (Masniawati *et al.*, 2013).

The analysis on the size of the collagen Nano particle with Scanning Electron Microscopy (SEM) used the 10000x magnification at a voltage of 20 kV. The source of electrons was emitted to the sample to scan the surface of the sample and then the gold metal as a conductor would reflect the electrons to a detector on SEM microscope. Furthermore, the scanning results would be passed by the detector to the monitor (Ruiz-Gutierrez *et al.*, 2012).

1
Statistical analysis: One-way ANOVA was used to identify the effect of different FGW levels. For post-hoc multiple comparisons of group differences, Duncan's multiple range test was used. Statistical analyses were performed using the software package SPSS for Windows (IBM SPSS 64 Bit Version). A value of $p < 0.05$ was considered statically significant (Dawson and Trap, 2001).

RESULT AND DISCUSSION

The proximate analysis is a rough description of various elements in a food material. It includes moisture, protein, fat, ash and carbohydrates. The results showed that the addition of collagen of various types of fish bone had a significant effect ($p < 0.5$) on the results of proximate analysis on the super rice analogue. Table 1 shows the results of proximate analysis on the rice analogue.

The protein content in super rice analogue with the addition of various fish bone collagens showed a different composition. As stated by Darmanto *et al.* (2012), 14 different types of fish bone collagen had the different chemical compositions. Table 1 shows that the protein

Table 1: Proximate analysis of taro and seaweed based analog rice fortified with various fish bone collagen

Analysis (%)	Control	Stingray	Milkfish	Catfish	Snapper
Ash content	3.47±0.50 ^a	9.80±0.01 ^a	7.49±0.03 ^b	9.05±0.06 ^a	7.22±0.02 ^a
Water content	10.43±0.1 ^a	4.86±0.09 ^a	5.29±0.08 ^a	6.87±0.02 ^a	7.36±0.04 ^a
Protein content	3.41±0.06 ^a	6.13±0.06 ^a	6.04±0.06 ^a	6.42±0.05 ^b	6.32±0.06 ^a
Fat content	1.25±0.06 ^b	1.48±0.08 ^a	1.57±0.02 ^a	2.28±0.06 ^a	1.66±0.08 ^a
Carbohydrate	81.1±0.07 ^b	81.28±0.1 ^a	79.69±0.09 ^a	75.37±0.01 ^a	75.87±0.15 ^a

Data were expressed as means±SD. ^aMeans in the same row with different superscripts differ significantly (p<0.05) according to Duncan's multiple-range test

content of super rice analogue by adding collagen analogue of catfish was higher than snapper, stingray and milkfish.

The ash content in super rice analogue was at 3.470% but with the addition of collagen the content level was found at 7.220-9.800%. This was due to the differences in mineral content in each of fish bone

collagens. Marsono and Atanu (2002) stated that collagen in addition to its function as the source of protein contained several mineral elements such as potassium, calcium, phosphorus, sodium and iron. This is also supported by Darmanto *et al.* (2010), stating that the addition of the collagen from tilapia bone could increase the levels of ash in view of the very high mineral content in the bones of tilapia. As shown in Table 1, ash content and protein content varied greatly caused by the difference in concentration of minerals and amino acids of each of different collagen fortificant. Stated by Darmanto *et al.* (2014), the difference in protein and minerals in collagen could affect the WHC (Water Holding Capacity) and gave an effect on the water position (monolayer water and multilayer water) of a material.

Amylose content is essential in the process of making super rice analogue which will determine the functionality and the level of good taste of the rice. Amylose on rice will affect quality as well as the consumer acceptance (Avaro *et al.*, 2009).

Figure 1 shows that the addition of collagen from the different types of fish bone had a significant effect (p<0.05) on the amylose content. The highest amylose content was found in the addition of collagen of stingrays at 19.18% while the lowest one without the addition of collagen was at 13.61%. It was caused by the high levels of ash in the rice analogue with the addition of the collagen of the stingray bone. The higher ash content could make the higher the mineral content inside it. Sarofa and Ardiansyah (2015) mentioned that the mineral content was capable of forming the crosslinks with the amylose and amylopectin in the heating process.

The amylose level of super rice analogue of taro was found in the class with the low level of amylose (10-200/o). The rice with low amylose content after being cooked would produce a sticky rice. While, the one with medium level of amylose would produce the rice with the fluffy texture and other with high amylose content will produce

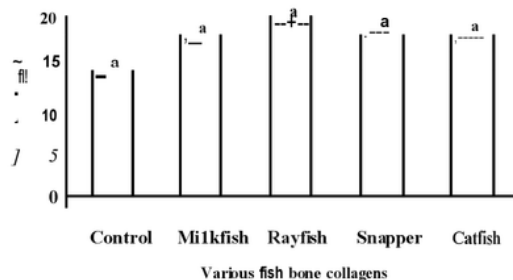


Fig. 1: Level of amylose content in taro and seaweed based analog rice with addition of various fish bone collagen. Amylose contents were expressed as percentage. Data were mean±SD of 4 replicate analyses; ^a Different superscripts above the bar chart show differ significantly (p<0.05) according to Duncan's multiple-range test

dry rice (Kurniawati, 2013). Rice with the high amylose level could make the starch find difficult to experience the gelatinization and more easily combine to form a dense crystalline structure or undergo the retrogradation (Sharma *et al.*, 2008).

The seaweed *L. cottoni* is rich in dietary fiber derived from the cell wall composed of several types of carbohydrates such as cellulose, hemicellulose, pectin and lignin polymer non-carbohydrate such as lignine polymer, a number of gums and musilase (Poedjiadi, 1994). The results of the analysis on the dietary fiber of super rice analogue is presented in Fig 2. Figure 2 shows that the addition of collagen from some types of fish bone has given a significantly different effect (p<0.05) on the content of dietary fiber on the super rice analogue. The highest level of dietary fiber was obtained in collagen of snapper at 18.46% while the lowest one was found at 16.76% without any addition of collagen. Kurniawati (2013) stated that rice analogue commonly has a fiber content of food of 13.3%. The level of the dietary fiber will bring the effect on the activity of digestive enzymes. Additionally, it will provide the longer satiety and inhibit digestion in the gastrointestinal (Sadek *et al.*, 2016).

Scanning Electron Microscopy (SEM) is one of the methods to observe the size and morphology of a material. Principally, the mechanism of SEM is to lead the electrons to the very small particles. The results of SEM analysis on the super rice analogue are shown in Fig 3.

As shown in Fig 3, the rice analogue with the addition of collagen of milkfish had an evenly homogeneous granule size. With the addition of the collagen of milkfish bone, it was seen a smooth surface with a little indentation in the form of lumps and some of pores. Similarly, with the addition of collagen of catfish bone, the surface was smooth with some of pores. While, the addition of collagen of snapper bone, the surface had some lumps and few pores.

Zaidar *et al.* (2013) stated that the morphology with a slight indentation could be caused by the addition of seaweed flour that was less homogenous. However, with

the addition of granule collagen on the super rice analogue it could create a smooth and even surface. Thipayarat and Leelayuthsoontom (2005) stated that the increase of pore size and the thickness of the sponge texture were due to the increasing temperature in the heating process.

The hedonic analysis is the analysis of consumer preferences towards color, aroma, texture and the entirety of super rice analogue. The results of hedonic analysis on the super rice analogue are presented in Table 2. Table 2 shows that the collagen fortification did not give any effects on the color of the super rice analogue. The results

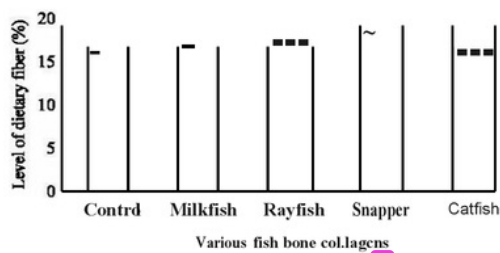


Fig 2 Level of dietary fiber content in taro and seaweed based analog rice with addition of various fish bone collagen. Fiber contents were expressed as %. Data were mean \pm SD of 4 replicate analyses

analogue was in the range of 3.70-3.85, indicating that the panelists preferred the brownish white super rice analogue. Sastro *et al.* (2012) mentioned that the color is one of the important indicators determining the factors of food acceptance by consumers.

The average assessment of the panelist towards the aroma of the super rice analogue was in the range of 2.94-3. Meanwhile, the most favored one without any collagen given among was in the value of 3.45. The results of the assessment on the texture showed that the collagen fortification from the different types of fish bone did not give any effects on the texture of the super rice analogue. Based on the data obtained, the average values

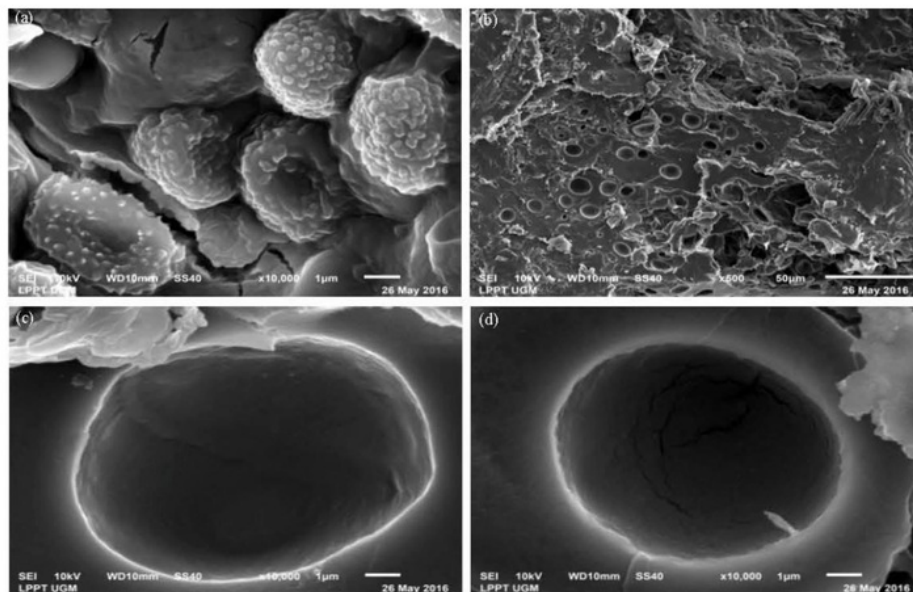


Fig 3 Morphological appearance of taro and seaweed based analog rice with addition of various fish bone collagen by Scanning Electron Microscopy (SEM) analysis; a) Control; b) Milkfish collagen; c) Catfish collagen and d) Snapper collagen

Table 2: Hedonic test of taro and seaweed based analog rice fortified with various fish bone collagen

Various fish bone collagen	Parameters			
	Color	Aroma	Texture	Entire!Y
Control	3.81±0.57 ^a	3.45±0.41 ^b	3.78±0.59 ^a	3.51±0.46 ^a
Milkfish	3.85±0.63 ^a	2.94±0.39 ^a	3.75±0.92 ^a	3.67±0.17 ^a
Rayfish	3.70±0.59 ^a	2.96±0.41 ^a	3.40±0.61 ^a	3.45±0.49 ^a
Snapper	3.81±0.33 ^a	3.25±0.67 ^b	3.55±0.66 ^a	3.55±0.28 ^a
Catfish	3.78±0.41 ^a	3.01±0.39 ^a	3.84±0.71 ^a	3.54±0.44 ^a

Data were expressed as means±SD. ^aMeans in the same row with different superscripts differ significantly ($p<0.05$) according to Duncan's Multiple-Range test

of preference towards the texture of rice analogue were in the range of 3.55-3.84% indicating the preferences of the panelists towards the texture of super rice analogue.

Overall, the sensory of the rice analogue showed that the collagen fortification had significant effects on the entirety of the sensory of the super rice analogue. The average value of preference towards the entirety of the taro flour and seaweed based super rice analogue were in the range of 3.51-3.67% indicating that overall the panelists preferred the super rice analogue.

CONCLUSION

Based on the results of the research, it showed that the super rice analogue with the addition of the collagen from the different types of fish species with the formulation of taro flour and seaweed flour can alter the physical and chemical properties; thus enable to provide it the different flavor, aroma and texture. The panelists preferred the super rice analogue with the addition of the collagen of milkfish bone rather than any other fish. The addition of collagen of different types of fish bones will produce the different food fiber contents and amylase on super rice analogue.

REFERENCES

- 16 AOAC., 2007. Official methods of analysis of the association of official analytical chemist. AOAC International, Washington, USA.
- Afriwanti, M.D., 2008. [Studying the effect of adding wheat eucheuma seaweed cottoni on making rice flour analog of modified cassava flour (Mocaf) (In Indonesian)]. JFB. Fishery, 9: 1-10.
- Anggadiredja, J.T., A. Zalnika, H. Purwanto and S. Istini, 2008. [Seaweed]. 5th Edn., Penebar Swadaya, East Jakarta, Indonesia, (In Indonesian).
- 5 Ask, E.I. and R.V. Azanza, 2002. Advances in cultivation technology of commercial eucheumatoid species: A review with suggestions for future research. Aquaculture, 206: 257-277.
- 10 Araro, M.R.A., L. Tong and T. Yoshida, 2009. A simple and low-cost method to classify amylase content of rice using a standard color chart. Plant Prod. Sci., 12: 97-99.
- Cahyadi, W., S. Neneng and K. Zahra, 2012. [Influence type tubers flour and starch concentration catfish against rice characteristics analog]. Master Thesis, Universitas Pasundan, Bandung, Indonesia.
- 19 (In Indonesian)
- Carthew, P., 2002. Safety of carrageenan in foods. Environ. Health Perspectives, 110: A1 76-A1 77.
- Darmanto, Y.S., T.W. Agustini and F. Swastawati, 2010. [Benefits and Collagen Characters of Different Fish Bone Wastes]. Diponegoro University, Semarang, Indonesia, (In Indonesian).
- 1 Darmanto, Y.S., T.W. Agustini, F. Swastawati and A.I. Bulushi, 2014. The effect offish bone collagens in improving food quality. Intl. Food Res. J., 21: 891-896.
- 11 Dawson, B. and R.G. Trapp, 2001. Basic and Clinical Biostatistics. 3rd Edn., PBL. Lange Medical Books/McGraw-Hill, USA, ISBN: 0838505104.
- FCC., 1975. National research council. Washington Supply Company, Washington, USA
- Farmer, P., 2009. Farming and culture of red seaweed (Kappaphycus). SEAFDEC Aquaculture Department, Tigbauan, Iloilo, Philippines. <http://www.seafdec.org.ph>
- 6 Johansson, C.G., N.G. Asp, H. Hallner and M. Sijestrin, 1983. Rapid assay of insoluble and soluble and dietary fiber. J. Agr. Food Chem., 31: 476-482.
- 13 Kishal, P., V. Kumar and H.K. Sharma, 2015. Utilization of taro (*Colocasia esculenta*) a review. J. Food Sci. Technol., 52: 27-40.
- Kurniawati, M., 2013. [Stabilisas ibekatul and its application m nee analog]. Master Thesis, Bogor Agricultural University, Bogor, Indonesia.
- 20 (In Indonesian)
- Lekahena, V., D.N. Faridah, R. Syarif and R. Peranginangin, 2014. Physicochemical characterization of Nano Calcium bone extraction results Tilapia using bases and acid solution. J. Technol. Food Ind., 25: 57-64.
- Marsono, Y. and W.P. Atanu, 2002. [Pengkayaan Protein Flour Instant Noodles with Tofu]. Gadjah Mada University, Yogyakarta, Indonesia, (In Indonesian)

- Masniawati, A., E. Johannes, A.I. Latunra and N. Paelongan, 2013. [Characterization of Physicochemical Properties At Some Sentra Red Rice Rice Production in South Sulawesi]. Hasanuddin University, Makassar, Indonesia, (In Indonesian).
- 15 Meilgaard, M.C., G.V. Civille and B.T. Carr, 1999. *Sensory Evaluation Techniques*. CRC Press, New York, USA, ISBN9780849302763, Pages: 387.
- 9 Mishra, A., H.N. Mishra and P.S. Rao, 2012. Preparation of rice analogues using extrusion technology. *Int. J. Food Sci. Technol.*, 47: 1789-1797.
- 6 Poedjiadi, A., 1994. *Dasar-Dasar Biokimia*. Penerbit Universitas Indonesia, Jakarta, Indonesia, (In Indonesian).
- 17 Ruiz-Gutierrez, M.G., A. Quintero-Ramos, C.O. Mendez-Pizarro, R. Talamas-Abbud and J. Barnard *et al.*, 2012. Nixtamalization in two steps with different calcium salts and the relationship with chemical, texture and thermal properties in masa and tortilla. *J. Food Process Eng.*, 35: 772-783.
- Sadek, N.F.N., N.D. Yuliana, E. Prangdimurt, B.P. Priyosoeryanto and S. Budijanto, 2016. [Analog rice potential as alternative food Pokokuntuk prevent degenerative diseases]. Master Thesis, Bogor Agricultural University, Begor, Indonesia.
- Sarofa, W.S. and M.I. Ardiansyah, 2015. Addition effect tapioca and Ca (OH)₂ terhadap physicochemical properties and Organoleptik Emping Garut simulation (Maranta arundinacea L.). *J. Food Eng.*, 9: 46-58.
- Sastro, D.Y., AT. Winarni and S. Fronthea, 2012. [Effect of various fish bone collagens on the quality of myofibril fish protein during dehydration process (In Indonesian)]. *J. Technol. Food Ind.*, 23: 1-36.
- 12 Sharma, A., B.S. Yadav and Ritika, 2008. Resistant starch: Physiological roles and food applications *Food Rev. Int.*, 24: 193-234.
- 18 Thipayarat, A. and P. Leelayuthsoontom, 2005. *Textural and morphological change of jasmine rice under various elevated cooking conditions*. Master Thesis, University of Technology Thonburi, Bangkok, Thailand.
- 7 Tongchan, P., S. Prutipanlai, S. Niyomwas and C. Thongraung, 2009. Effect of calcium compound obtained from fish by-product on calcium metabolism in rats *Asian J. Food Agro-Ind.*, 2: 669-676.
- Zaidar, E., R. Bulan, Z. Alvian, R.S. Taurina and DA Lestari, 2013. [Making the Edible Film of Flour Mixes Seaweed (*Eucheuma* sp.) with Glliserol and Chitosan]. Universitas Lampung, Bandar Lampung, Indonesia, (In Indonesian).

Characteristic of Taro (*Colocasia esculenta*) and Seaweed (*Eucheuma cottoni*) Based Analogue Rice Fortified with Fishes Bone Collagen (A Promising Anti-Diabetic Functional Food)

ORIGINALITY REPORT

21%

SIMILARITY INDEX

16%

INTERNET SOURCES

9%

PUBLICATIONS

12%

STUDENT PAPERS

PRIMARY SOURCES

1

Submitted to Universitas Diponegoro

Student Paper

5%

2

waset.org

Internet Source

5%

3

medwelljournals.com

Internet Source

1%

4

Moreno-Rivas, Silvia Carolina, Concepción Lorenia Medina-Rodríguez, Patricia Isabel Torres-Chávez, Benjamín Ramírez-Wong, and Luis Carlos Platt-Lucero. "Changes in the Solubility of Corn Proteins through Interaction with the Arabinoxylans in Extruded Nixtamalized Corn Flour Treated with Xylanase", Plant Foods for Human Nutrition, 2014.

Publication

1%

5

Hurtado, Anicia, Renata Reis, Rafael Loureiro, and Alan Critchley. "Kappaphycus

1%

(Rhodophyta) Cultivation: Problems and the Impacts of Acadian Marine Plant Extract Powder", Marine Algae, 2014.

Publication

6	es.scribd.com Internet Source	1 %
7	Submitted to Mansoura University Student Paper	1 %
8	doaj.org Internet Source	1 %
9	ejurnal.litbang.pertanian.go.id Internet Source	1 %
10	Ambardekar, Amogh A., Terry J. Siebenmorgen, and Tanya Pereira. "Colorimetric Method for Rapidly Predicting Rice Amylose Content", Cereal Chemistry, 2011. Publication	1 %
11	thescipub.com Internet Source	1 %
12	Submitted to Spruce Creek High School Student Paper	1 %
13	Laurent Soulard, Philippe Letourmy, Tuong-Vi Cao, Floriane Lawac, Hâna Chair, Vincent Lebot. "Evaluation of Vegetative Growth, Yield	1 %

and Quality Related Traits in Taro ([L.]
Schott).", Crop Science, 2016

Publication

14

Kaushal, Pragati, Vivek Kumar, and H. K. Sharma. "Utilization of taro (*Colocasia esculenta*): a review", Journal of Food Science and Technology, 2015.

Publication

1 %

15

repository.unika.ac.id

Internet Source

<1 %

16

www.degruyter.com

Internet Source

<1 %

17

onlinelibrary.wiley.com

Internet Source

<1 %

18

Aldrin P. Bonto, Ken Sammuel I. Camacho, Drexel H. Camacho. "Increased vitamin B 5 uptake capacity of ultrasonic treated milled rice: A new method for rice fortification", LWT, 2018

Publication

<1 %

19

Nineteenth International Seaweed Symposium, 2009.

Publication

<1 %

20

jatp.ift.or.id

Internet Source

<1 %

www.scielo.br

21

Internet Source

<1 %

22

academicjournals.org

Internet Source

<1 %

23

www.phytopath.ca

Internet Source

<1 %

24

Robles-Ozuna, L.E., L.A. Ochoa-Martínez, J. Morales-Castro, J.A. Gallegos-Infante, A. Quintero-Ramos, and T.J. Madera-Santana. "Effect of nixtamalization conditions ultrasound assisted on some physicochemical, structural and quality characteristics in maize used for pozole", CyTA - Journal of Food, 2015.

Publication

<1 %

Exclude quotes Off

Exclude matches Off

Exclude bibliography Off