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Cannalina from Composite Flour *Canna indica*

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Alternative Healthy Food : Noodles and Cookies Cannalina from Composite Flour *Canna indica* and *Spirulina platensis*

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ABSTRACT

The flour composite from *C. indica* tubers and *S. platensis* namely Cannalina flour (P 00201508315) has prospective to process many kind of healthy food. Cannalina flour from white tubers of *C. indica* contains fructose, stachiose and inulin as a prebiotic and from the red tubers contains maltose, fructose, and sucrose. The Cannalina flour from white tubers success was processed became various kinds of food such as noodles and cookies. The research purposes to find out changes of nutrient content after Cannalina flour from white the *C. indica* tubers is processed into noodles and cookies. Beside that to know respond of respondent for the noodles and cookies specially its color, aroma, texture and taste. The methodology of research was experimental with proximate test and organoleptic test. The result showed Cannalina flour contains carbohydrate 67.607%, protein 17.413 %, lipid 0.29%, fiber 9.54%, water 8.75%. Carbohydrate content in cookies Cannalina is the highest than in flour and noodles, there were 69.395%. Cannalina noodles contains the highest fiber which is 10,75%. Taste of noodle are preferred over cookies. Cannalina noodles and cookies have potential to be a healthy alternative food.

CCS Concepts

• General and reference → General conference proceedings

Keywords

The flour composite; Cannalina flour; Prospective; Healthy food; Cookies and noodles

1. INTRODUCTION

Carbohydrate, protein, lipid, mineral and vitamin are important nutrient for human body. Composition nutrients suggestion for daily consumption are carbohydrate 55-65%, protein 10-15%, lipid 25-35% [1]. Protein requirement of 0.8 g/kg/day needed for structural requirements but not include protein for energy metabolism [2]. The Spanish population (9–75 years old) according Research Anthropometry Intake and Energy Balance in Spain (ANIBES) showed dietary intake for carbohydrate intake about 185.4 ± 60.9 g/day with grains (49%). Lipid intake was 78.1 ± 26.1

g/day, protein 74.5 ± 22.4 g/day from meat and meat products about (33.0%). Saturated fatty acids were mainly (>70%) combined from meat and meat products [3]. Unfortunately fully activities cause limited available time for eating. This condition caused inadequate nutrition supply. Usually snacks consumption became alternatively solution for human with fully activities. The other problem not all people aware or concern to their nutrient consumption. The mistaken choose food for consumption without attention nutrition composition caused decreasing human health quality [4]. Sociodemographic, urbanization, food industry marketing over the past two decades have changed nutrition transition that associated with rising rates of obesity and chronic disease such as cardiovascular disease, cancer [5]. Based on this condition was required ones source of food which contain complete adequate nutrition and easy to find. *C. indica* (Indonesian: ganyong) tubers and *S. platensis* has been improved become flour namely Cannalina flour and content complete nutrient which potential to supply nutrition in the body. *C. indica* distributed in Indonesia as gardening plant and easy to grow in tropical ecosystem. Another variety is *C. edulis* Gawl lives in Himalaya India. *C. indica* was included division Spermatophyta. Sub division Angiospermae, Class Monocotyledoneae, Ordo Zingiberales, Familia Cannaceae, Genus *Canna*, Spesies *Canna indica*. Tuber of *C. indica* contains carbohydrate 88.2%, protein 1.1% lipid 0.5% [6]. Starch content in tuber of *C. indica* was 574-701 g/m². Carbohydrate was the highest in tuber *C. indica* and related with fiber containing [7]. Total fiber of *C. indicar* from red tuber was 2,45% and white tuber was 1,95%. Ability to dissolve fiber in human digestives system was 1,58% in red tuber and white tuber 1,98%, with the result that starch resistant on red and white tuber was 3,54% and 3.8% [8]. Starch resistant specially oligosaccharide has potential as prebiotic that has ability to stimulation growth of probiotic like *Bifidobacterium sp.* Oligosaccharide including of prebiotic are inulin and oligofructose (OF), lactulose, resisten starch (RS), galactooligosaccharides (GOS), transgalactoligosaccharides (TOS), polydextrose [9]. Limited of protein in *C. indica* can substitute by added microalgae. *S. platensis* is one of photosynthetic microalgae which lives in fresh water. *S. platensis* was included division Cyanophyta, Class Cyanophyceae, Ordo: Nostocales, Familia: Oscillatoriaceae, Genus *Spirulina*, Spesies: *S. platensis*. Amount of protein is produced by *S. platensis* its 60% -70 % from biomass with composition essential amino acid as leucine (10.9%), valine (7.5%), and isoleucine (6.8%), 4% -7% lipid (linoleic acid (LA) dan γ -linolenic acid). provitamin A (β -carotene), B12 and mineral such as Fe is the highest mineral containing. Carbohydrate contain 13,6% consist of glukosa, rhamnose, mannose, xylose and galaktosa. *S. platensis*

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doesn't have cellulose on cells wall so easy to digest for absorbing [10]. Carbohydrate production by *S. platensis* 63.09%± 3.43 with phosphorus 1.82±0.16 mg as microelements [11] *S. platensis* rich in protein 60-70% [12].

2. MATERIALS AND METHODS

The research conducted in chemical laboratories Al Azhar Indonesia University (UAI) and Universitas Islam Negeri Syarif Hidayatullah Jakarta Indonesia. The research procedure divided for 3 step: made *Cannalina* flour, proximate test and organoleptic test. Procedure of making flour *C. indica* by sorted and minced of tuber. directly continued to dried in the sunlight. Drying slices tubers *C. indica* was milled and proceed for blending and mixing with *S.platensis* powder. *S. platensis* was found from cultured microalgae in UAI . The composition *C.indica* and *S. platensis* to make Cannalina flour was 10:1 for processing cookies and noodles. Procedure to make noodles by mixed 90 g Cannalina flour and 60 g wheat flour Cakra Kembar added 1 egg whites, 30 ml water, 0.5 spoon tea salt. After that the noodle mixture is boiled and drained. The recipes to make cookies was mixed 125 g Cannalina flour with, 37,5 g margarine, 50 g sugar flour, 1 egg yolk, ¼ spoon tea baking powder. Then the cookies mixture was printed and baked until cooked. The Cannalina flour and both of two kind food it means noodles and cookies were measured carbohydrate, protein, lipid, fiber and water content by proximate tested [13]. Noodles and cookies as control of the treatments was made from wheat flour without mixed with Cannalina flour.

2.1 Protein Assessment (Kjeldahl Method)

A total of 0,1 g sample was put to Kjeldahl 100 mL jar and added with 0,5 g combination assortment Selene (SeO₂, K₂SO₄, CuSO₄.5H₂O and 5 mL H₂SO₄ concentrate and was heated for 2 hour in electric heated or another heated until boiled and solution cleanse and looks greenish. After that added with NaOH 30% 20 mL and distillation for 7-10 minute, and as receiving distillate using 10 mL H₃BO₃ 2% has mixed by indicator (*methyl red* 0,1%), and then was titration with HCl that has knew concentration.

$$\text{Total protein} = \frac{(V_2 - V_1) \times N \times \text{HCl}}{\text{sample weight}} \times 0,014 \times \text{conversion factor} \times 100$$

2.2 Water Total [14]

Thermogravimetric was conducted for test water total with dried 2 g sample on a cup that has knew it's the mass and continued dried in 105° C for 3 hours. After that sample and cup cooler in desiccator and weighed for to know biomass. Water total containing was found by compare mass before and after dried and converse to percentage.

$$\text{Water content (\%)} = \frac{(\text{WB} + \text{material}) \text{ before} - (\text{WB} + \text{material}) \text{ constant}}{(\text{WB} + \text{material}) \text{ constant} - \text{WB} \text{ constant}}$$

Weighting Bottle : WB

2.3 Lipid Total with Method Soxhlet

A total of 2 g sample was wraped on water filter, dried on the oven in ± 80°C for ± 1 hour, continued put on *soxhlet* that connected with lipid jar that has knew the wheight and extracted in n-hexane for ± 3 hours. Lipid production from destillation was dried on was 105°C and cooler in desicator for 30 minute.

$$\text{Lipid (\%)} = \frac{(\text{massa soxhlet flask} + \text{lipid}) - \text{massa empty soxhlet flask}}{\text{sample mass}}$$

2.4 Fiber Test (Southgate)

Gravimetric is methodology to detect the fiber containing in the sample. Residue sample 2 (a) from lipid extraction by method Soxhlet put in Erlenmeyer 600 ml and added with 200 ml H₂SO₄ 1.25% and then cooler for 30 minutes. The result including paper filter was left was filtered washed by boil water. The residue in the water filter and input to Erlenmeyer and added with 200 ml NaOH 1.25% and then boiled for 30 minutes and repeated filtered 30 minutes and repeated through filtered paper thaw has knew it mass (b) g. The filtered paper is washed with K₂SO₄ 10%, water boil, and alcohol 95%. After that paper filtered was dried in the oven until he mass constant, cooler in desiccator, and weight end of mass (c) gram. Formulation to calculated fiber total :

$$\text{Total Fiber (\%)} = \frac{c-b}{a} \times 100 \%$$

a = sample mass (g); b = water filter mass (g);

c = the end of mass (g)

2.5 Carbohydrate Content [15]

Carbohydrate content calculated by formulation (%) = 100% - (Water content + Ash content + Protein Content+ lipid content)

2.6 Organoleptic Test

Organoleptic test conducted to know prediction degree for cookies and noodles and cookies Cannalina flour based on taste, aroma, texture, with 5 degrees there are very like, like, neutral and dislike and very dislike for 75 respondent (20-24 years old).

2.7 Analysis Statistic

Analysis statistic to know significant difference between noodles control and treatment also cookies using Anova one way in SPSS 19.00.

3. RESULT AND DISCUSSION

3.1 Cannalina Flour

The composite flour from white tuber consist of carbohydrate 67.607%, protein 17.413 %, lipid 0.29%, fiber 9.54% and water 8.75%. Increasing of carbohydrate, protein and lipid in Cannalina white flour was compared white tubers *C.indica* influenced by *S. platensis*. *C. indica* tubers contains carbohydrate 22.60%, protein 1 % and lipid 0.11% (Data from Nutrition Directorate of the Ministry of Health Republic Indonesia)

3.2 Cannalina Noodles

Carbohydrate, protein, lipid, fiber and water in Cannalina noodles were showed 44.945%, 13.2%, 7.495%, 10,75% and 24.155% (Figure 1). Significant difference showed p<0.05 between carbohydrate in noodles which content Cannalina flour and wet noodles from wheat flour (control), there were 44.945% and 26.69%. Significant difference p<0.05 in water containing 24,155% compared 27.5% in control, actually Indonesia standard for wet noodles (SNI 2987- 2015) max 35%. Protein content in noodles with Cannalina flour 13.2% and control 18.3 % with significant different p < 0.05. High Protein in noodles control was caused source wheat flour from specific flour wheat with standar protein minimal 13% and also from eggs. Data showed that protein ranged between 10.9% for plantain, cassava or sweet potato noodless with composition 50, 60, and 70% [16]. Significant difference p<0.05 between lipid in Cannalina noodles 7.475% and control 13.795% but lipid in plantain, cassava or sweet potato noodless with composition 50, 60, and 70% from 5.4 to 8.8%. Fiber content 10.75% in Cannalina noodles and control 7.475% showed

no sig. $p < 0.05$. Cannalina noodles compared with instant noodles from wheat flour that content carbohydrate 74.23%, protein 11.07% and fiber 0.4% showed lower carbohydrate and higher protein and fiber in Cannalina noodles [17]. Proximate in hamburger bean with wheat flour content carbohydrate 71.83%, protein 12.05% and fiber 2.49%. Restricting total carbohydrate to < 130 g/day [18]. Cannalina noodles suitable was consumed for healthy human and predicted in Type II Diabetes Mellitus (T2DM) patients. Excess of carbohydrate and sugar intake in T2DM patient related with mortality risk. High fiber intake was associated with a decreased mortality risk [19]. Based on a study conducted in Kyoto hospital against 149 patients with T2DM consisting of 77 males and 72 females aged 40 to 79 year were found to be the following inadequate food intake, especially vitamins and minerals in the sense of low consumption of vegetables and fruit, excess lipid intake of the total energy, excess sweet foods so that complications occurred [20]. The need of nutrition in T2DM patients [21] is equivalent to that found in Cannalina noodles which ranges from 45% of carbohydrate and 15-20% from protein. Fiber needs daily is 20-25 gr can be fulfilled by consuming Cannalina noodles estimated 200 g, because the fiber contained in 100 grams of cannalina noodles is 10.75%. Other studies have been conducted to determine the effect of consuming fiber in T2DM patients. Total 19 patients 65.8 \pm 7.3 years old and 5-9 years suffer T2DM divided 3 groups there were consumed isocaloric breakfast (mean 369.8 \pm SD 9,4 kcal). Group 1 added consumed higher fiber (total fiber 9,7 g included soluble fiber food 5,4 g). Group 2 added consumed supplement from guar gum (total 9,1 g included soluble fiber 5,4 g). Group 3 added consumed normal fiber total 2.4 g included soluble fiber 0.8 g. After breakfast showed incremental area under the curve (AUC) for plasma glucose mg/dL did not differ between high fiber and supplement but them lower than normal fiber. Higher fiber included soluble fiber intake and supplement associated with lower postprandial glucose after breakfast effect than usual in patients with T2DM [22].

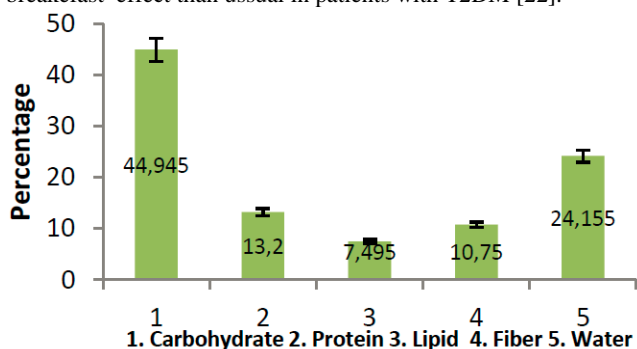


Figure 1. Nutrition and water on Cannalina noodles

The research cross over trail in 14 patients T2DM (7 men aged 65.8 \pm 5.2 year, glycated hemoglobin 6.6 \pm 0.9%, BMI in kg/m^2 27.2 \pm 3.1 treated by breakfast with 4 dietary interventions. Group 1 namely HGI-HF breakfast with high glicemic index (GI) 60.4 \pm 0.1% and high fiber (6.0 \pm 0.3 g). Group 2 namely HGI-LF breakfast with high GI (60.9 \pm 1.7%) and low fiber (2.5 \pm 0.4 g). Group 3 namely LGI-HF breakfast low GI (37.7 \pm 0.1%) and high fiber (6.2 \pm 0.3 g). Group 4 namely LGH-LF breakfast with low GI (39.8 \pm 1.3%) and low fiber (2.0 \pm 0.1 g). The result showed reducing GI and increasing fiber content are strategy to improve postprandial metabolic profile T2DM pateins. This condition also occurred in insulin and ghrelin. Insulin AUC ($\mu\text{U/mL} \times \text{min}$) was higher in patients consumed the HGI-LF meal [65.72 (38.24,

93.19)] compared than the HGI-HF meal [57.24 (32.44, 82.04)] ($P \leq 0.05$). Insulin AUC after the consumption of the LGI-LF breakfast [61.54 (36.61, 86.48)] was higher compared after the LGI-HF breakfast [54.16 (31.43, 76.88)] ($P \leq 0.05$). Ghrelin plasma decreased with baseline in after patients consumed the LGI-HF and LGI-LF breakfasts ($P \leq 0.05$) [23]. Based in the research Cannalina noodles containing 10.75% fiber can be applied in T2DM patiens. When compared with Cannalina flour content there were a decrease in levels of carbohydrate and protein. The reverse is increasing lipid and fiber in canalina noodles compared to Cannalina flour. There are caused by the presence of wheat flour in Cannalina noodles. Lipid contained in Cannalina noodles showed was lower than control and instant noodles. Those containing no trans fatty acid because throughout the process does not cause the effect of trans fatty acid production. Human need double lipid saturated fats is $< 7\%$ and unsaturated fats $< 10\%$, while the lipid content in Cannalina noodles is 7.495%. The study to compared saturated and trans lipid. Saturated lipid intake was not associated with all cause mortality total cardiovascular disease (CVD), Coronary Heart Disease (CHD), ischemic stroke and T2DM. Total trans fat intake was associated with all cause mortality, coronary heart Disease (CHD) mortality, but not ischemic stroke or T2DM. Trans lipid from industrial and ruminant were associated with CHD mortality and CHD. Trans-palmitoleic acid from ruminant was inversely associated with type 2 diabetes (0.58, 0.46 to 0.74) [24].

The vitamins contained in Cannalina noodles are dominated from *S. platensis* which contain vitamin B1, B2, B6 B12, K and various minerals namely Calcium, phosphorus, Iodine, Magnesium and Zinc [25]. Thus consumption of Cannalina noodles as a staple food can be applied in T2DM patients. Cannalina noodles also has potency as healthy food in community. Based on organoleptic test on Cannalina noodles in ones menu showed 57% from 75 respondent like and very like Cannalina noodles (Figure 2) and neutral 27%. It means 85% respondent accepted taste, 83% like and very like aroma of Cananalina noddle. Data showed 44% of respondent dislike and very dislike with Cannalina noodles color because looks greenish. Improving the quality of taste, colour and aroma is needed

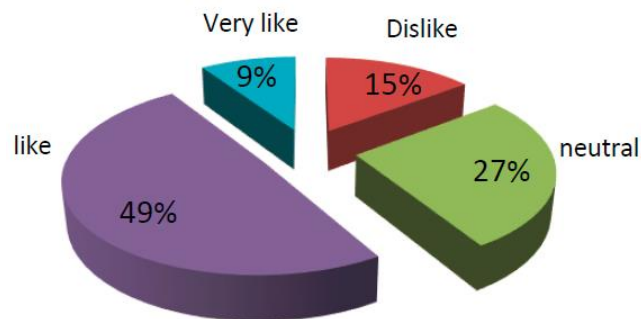


Figure 2. Organoleptic test result for noodles taste.

3.3 Cannalina Cookies

Carbohydrate, protein, lipid, fiber and water in Cannalina cookies showed 69.395%, 9.44%, 13.235%, 1.525% and 4.915% (Figure 3). Carbohydrate content showed no sig. $p < 0.05$ between cookies control 57.21% and Cannalina cookies. Protein, lipid and fiber in cookies control were 6.9%, 14.4% and 0.5%. Based on (SNI 2973-2011) showed that Cannalina cookies included higher protein and fiber. It is suitable as a snack for human with health condition because support with adequate lipid containing. Water content in cookies Cannalina showed sig. with cookies control no significant

difference $p < 0.05$ and included SNI. It means the Cannalina cookies has can be stored until expired date, different with Cannalina noodles that contained 24.155% water.

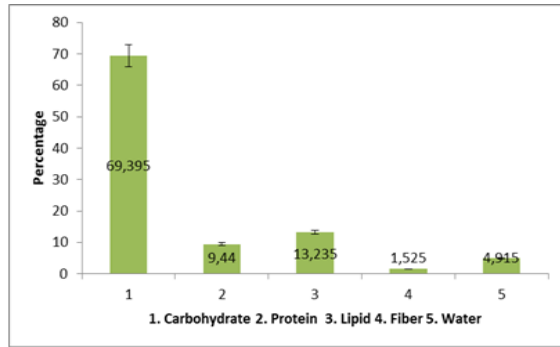


Figure 3. Nutrition and water Cannalina Cookies

Compared to Cannalina flour and Cannalina cookies showed increasing total of lipids due to margarine content. The protein and fiber content in Cannalina cookies shows a decrease compared to Cannalina flour and noodles. Community acceptance showed by organoleptic test. Analysis organoleptic showed 43% from 75 respondent including like and very like 12% with taste of Cannalina cookies and 25% neutral, dislike 14%, very dislike 6% (Figure 4). Cannalina cookies has potential to improve as healthy food for human with health condition. Improving of quality colour, aroma and texture were needed if will be made in industrial scale. On the other hand the content of Spirulina in Cannalina cookies is expected can help to fulfill the needs of microelements in children. The mapping results of the iodine deficiency in children indicated occur in 46,6% countries in Eastern Mediterranean, 44.2% in European and 40.4% in African countries. Found 12 billion children experiencing chronic deficiency will micronutrient such as Iron, Zinc, vitamin A, B included of folic acid and proteins [26]. The other research showed nutritional intake of breakfast from 341 respondents aged 13 to 18 years in Belgium were low for total fat, monounsaturated and polyunsaturated fatty acid. Thereby consumption of whole grain, fruits, and sources of Calcium [27].

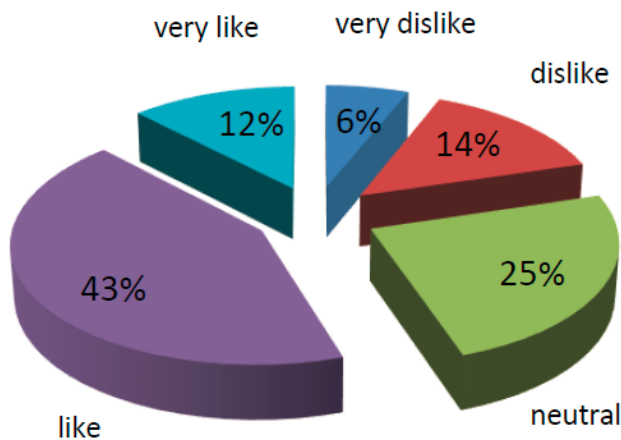


Figure 4. Organoleptic test result for taste cannalina cookies.

Data showed like greenish colour and netral 34%, aroma 38% like and very like, and texture 52% like and very like neutral 30%.

4. CONCLUSION

Nutrient content in Cannalina noodles showed a decrease of carbohydrate and protein but lipid, fiber and water increase if compared with Cannalina flour. Increasing carbohydrate, lipid and fiber occurred when compared with noodle control. The carbohydrate content in cookies Cannalina is the highest compare to flour and cookies control. Cannalina noodles and cookies suitable dietary intake as healthy food and can improve to industrial scale, because supported by acceptance of the taste in respondent.

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