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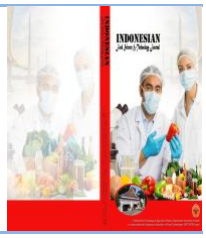

Evaluation of Physical Characteristics, Carbohydrate Content, and Sensory Preference of Suwar-suwir Caisim

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Abstract*— Suwar-suwir is Jember-Indonesia's traditional snack made from cassava fermented (tape) and sugar which give rises to very sweet flavor and sticky texture, causing consumer disfavor. This study aimed to determine the amount of mustard caisim powder added for fixing suwar-suwir texture, color and its sensory preference. This complete randomized controlled design tested effects of 6 level mustard caisim powder addition (Control=K=0, SF1=17, SF2=25, SF3=33, SF4=42, SF5=50%) toward suwar-suwir quality and sensory preference. The result showed that the addition significantly (P<0.05) affected physical properties and carbohydrate level (Fc>Ftab), and sensory liking preference ($X_{2c} > X_{2tab}$). The higher the addition of mustard caisim powder, the lower the texture value, the lower the color, the higher carbohydrate content. Suwar-suwir produced with 17% mustard caisim powder (SF1) has the best color, flavor, and overall performance. This suwar-suwir SF1 having more crunchy dense (163.2±4.80 mm/g.s,) more light green (29.59±0.29), high carbohydrate level (81.59±0.96%), high dietary fiber-TDF (20.8±0.01%), water soluble dietary fiber- SDF (6.29±0.002%) that lower than water insoluble dietary fiber - IDF (14.2± 0.01%). Based on the result analysis, it is recommend that the level addition of mustard caisim powder for improving suwar-suwir quality and image is 17 % from wet blend dough weight which produced suwar-suwir caisim SF1.

***Keywords*— suwar-suwir; mustard caisim powder; physical characteristic; carbohydrate content; sensory preference**

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I. INTRODUCTION

Suwar-suwir, a Jember traditional special snacks, has a sweet flavor and dense texture. The characteristics are form due to the raw materials of fermented cassava and white sugar. In 100 g fermented cassava contains 40.2 g carbohydrate, 2 g dietary fiber [1], and starch in composition of 17-20 g amylose and 80-83 g amylopectin [2]. In suwar-suwir making, cooking of the dough materials using high temperature (80ºC for 30 min) caused gelatinization process in that the starch granule swell forming a gel that play in texture formation. Meanwhile, sucrose in white sugar causes sweetness in food products, and when sugar content at least 31%, as in [3], suwar-suwir is categorized as sweet snack food.

It is unfortunate that until now, suwar-suwir products have not been a favored snack due to their overly sweet flavor sticky texture, and presumption of impact on increased sugar levels . Several solutions can be applied to overcome too sweet taste and the presumption are the use of low glucose ingredient or sugar replacer, and vegetable fiber supplementation. Replacing sugar such as L-arabinose reduces glucose intake from the snacks consumed despite their sweet flavor [4]. This sugar inhibits the hydrolysis of sucrose into glucose and fructose, and replacing sucrose with L-arabinose potentially a good strategy to lower glycemic and insulin responses. [5]. As for vegetable fiber supplementation decrease blood glucose level [6], improves glucose metabolism [7] through its binding property to starch and glucose. Different dietary fibers improve glucose metabolism and intestinal barrier function by regulating gut microbiota [8].

The solution to the texture problem can be done by adding high food fiber ingredients from vegetables, suh as mustard caisim. As mention in [9], that water soluble fiber -

pectin improved essentially hardness, cohesiveness, springiness, gumminess, and chewiness of the snack measured by instrumental texture analysis, Other research [10] has improved the crunchy texture of snacks using food crops such as sweet potato, which is also high in amylose and fibre.

In this study, as its high fiber content, mustard caisim leaves may used in suwar-suwir making. It is known from [1], that the fresh caisim mustard leaves contain by 2.5 g of dietary fiber per 100 g , so it fulfill daily fiber requirement by 8.3 % RDA. Therefore, caisim addition in the right amount is important since it affects on its texture and sweet flavor improvement. As the healthy effects of fibre have been revealed, the addition of mustard leaf powder may alter the perceived increase in sugar levels due to the consumption of suwar-suwir.

Improving suwar-suwir texture, colour, and flavor are valuable for the consumer enjoyment, its acceptability and right and best image. So, the right addition of caisim powder is expected to improve the texture, the sweet, the consumer liking preference, and finally the good image of suwar-suwir caisim. Therefore, this study aimed to determine the right addition amount of mustard caisim powder needed for fixing texture, flavor, and favorability level of the suwar-suwir caisim

II. MATERIAL AND METHODS

A. Materials

All the ingredients for making suwar-suwir, namely tape, sugar, and mustard caisim leaves were bought at Tanjung Market in Jember. The chemicals for analysis carbohydrate content are HCl, NaOH, H_2SO_4, $Na_2S_2O_3$, buffer pH 7, ethanol, acetone pepsin, pancreatin from E Merck. While the Luff Schoorl solution obtained from Nitra Kimia Store. The tools used in this study were oven 50^{o}C, analytic balance, glassware, penetrometer, color-reader, desicator, porcelain cup, furnace, hot plate, water bath, and pH meter.

B. Methods

The experimental design

This study is a completely randomized design (CRD) with one factor, namely the addition of mustard powder added to suwar-suwir products, namely 0 % (K) for suwar-suwir control, 17 for SF1, 25 for SF2, 33 for SF3, 42 for SF4 and 50 % for SF5, in d/w), as shown in **Table 1**. The suwar-suwir quality measured and evaluated in three replications. The levels of mustard caisim powder addition (% dry/wet basis) were :
K: suwar-suwir + 0% (control)
SF1: suwar-suwir made with 17 % of mustard caisim powder
SF2: suwar-suwir made with 25% of mustard caisim powder
SF3: suwar-suwir made with 33 % of mustard caisim powder
SF4: suwar-suwir made with 42% of mustard caisim powder
SF5: suwar-suwir made with 50% of mustard caisim powder

Preparation of Mustard Caisim Powder

Making mustard powder begin with sorting mustard leaves that are green and fresh, then separating its stems from the leaves. The mustard leaves that has been sorted is washed with running water until clean and then air dried for about 15 min, then were dried at 60^{o}C for 24 h until the leaves turned dry and brittle. The dried mustard leaves were pulverized using a blender until they became powder and sieved using a sieve to separate them from the less crushed powder.

Preparation of Suwar-suwir

The ingredient consisted of cassava-tape and sugar were mixed in stainless bowl. Then, adds mustard caisim powder mixed until homogeneous and become dough until well blend. The dough was cooked and kneaded for about 1 hour until smooth and solid. The solid dough is molded on a baking sheet and cooled, The cooled dough can be cut into equal lengths became suwar-suwir.

Texture and Colour of Suwar-suwir

Texture was measured using penetrometer, as according to Ref. [11]. The principle of texture measurement using this tools is the penetration of a needle into the material in a certain time and pressure. Suwar-suwir of the same weight, measured needle penetration in 5 second pressure, at five different points on the surface of the suwar-suwir. The hardness/dense or softness of the sample is calculated with units of mm/g.s.

Color measurement of suwar-suwir is done using a color reader based on the absolute color system of L, a, and b [12]. The L value indicates the degree of brightness, the a value indicates the gradation of red to green, and the b value indicates the gradation of blue to yellow. Suwar-suwir is attached to a device that is placed on a white standard plate so that the L, a, and b values can be determined, and is done at five different points. The parameter of color system were calculated as follows: L value = lightness = 0-100 (blue to white), a* value = -80 - 100 (red to green), b* = -70 - 70 (blue to yellow).

Carbohydrate content

Total carbohydrate content was measured by titration method using Luff Schoorl solution [13]. A total of 1 g of suwar-suwir was put into an Erlenmeyer flask then added 3% HCl as much as 40 ml, boiling for 1 hour. After cooling the solution was neutralized by the addition of 30% NaOH, then lighting in a 100 ml volumetric flask and filtering. Take 10 ml, added with 15 ml of distilled water and 25 ml of Luff-Schoorl solution. Heat at 70^{o}C for 10 minutes, and add 15 ml of 30% Kl solution and 25 ml of 25% H_2SO_4 Titrate with $Na_2S_2O_3$ until light yellow, then add 2 ml of 1% amylum and titrate again until it changes color. Calculation of carbohydrate content is determined by the following formula.

$$x = \frac{\text{V blanko} - \text{V titrasi sampel}}{0{,}1} \times \text{N}\text{N}_2\text{S}_2\text{O}_3 \cdot \cdots\cdots \text{eq.1}$$

$$\text{Carbohydrate content } (\%) = \frac{\text{X.Y}}{\text{a}} \times 100\% \times 0{,}9 \quad \cdots\cdot \text{eq.2.}$$

Description:
X: value in the Luff-Scrhoorl table
Y : dilution factor
a : sample weight (mg)

Dietary fiber content was analyzed using enzymatic gravimetry method [14]. A quantity of 1 g suwar-suwir caisim was added to 20 ml of distilled water and set the pH to 1.5, then add 100 mg pepsin and incubated and agitated for 60 min at 40°C. After that, add 20 ml of distilled water and set the pH 6.8, then add 100 mg of pancreatin and incubate at 40°C for 60 min Set the pH 4.5 and filtered with coarse filter paper of certain weight, then washed with distilled water 2x20 ml. The filtrate volume was equilibrated to 100 ml with distilled water, then added 280 ml of 95% ethanol and precipitated for 1 h. Then filtered with coarse filter paper of certain weight to obtain filtrate and residue. The residue was washed with 2x10 ml of 78% ethanol, 2x10 ml of 95% ethanol, and 2x10 ml of acetone, and dried in an oven at 105°C for 24 h until constant weight, then cooled in a desiccator and weighed. Drying at 500°C in a furnace for approximately 5 h, then cooled in a desiccator and weighed. Blanks for water soluble fiber and water insoluble fiber were obtained in the same way as the procedure for sample. The calculation of dietary fiber content was determined using the following formula.

$$\text{IDF}(\%) = \left(\frac{(D_1 - I_1 - B_1)}{w}\right) \times 100\% \quad \text{...eq 3}$$

$$SDF(\%) = \left(\frac{(D_2 - I_2 - B_2)}{w}\right) \times 100\% \quad \text{...eq 4}$$

$$TDF(\%) = IDF + SDF \quad \text{...eq 5}$$

Description:
IDF: water insoluble dietary fibre (%).
SDF : water soluble f dietary iber content) (%)
TDF : total dietary fiber content) (%)
D : weight after drying (g)
I : weight after powdering

Sensory Quality Evaluation [13]

The sensory evaluation of suwar-suwir was carried out using scalar testing, involving texture, color, aroma, flavor and overall sensory performance. The test conducted by 25 of semi-trained panelists from Agricultural Product Technology students, University of Jember. After consume the suwar-suwir, the panelists were asked to give their favorability toward texture, color, aroma, flavor, and overall by choosing one from five value scales.

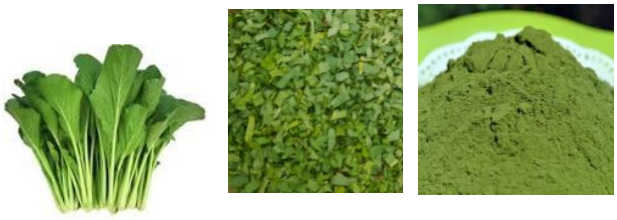
Data Analysis

The effect of mustard caisim addition on the suwar-suwir's physical characteristics (texture and colour) and carbohydrate quality (carbohydrate and food fiber) were analyzed using ANOVA test and were followed by DMNRT post test when the significant difference was presented at p<5%. Meanwhile the addition effect on sensory preference was analyzed using Chi-Square with a test level of 5%.

III. RESULT AND DISCUSSION

A. Mustard Caisim Powder

*Mustard c*aisim (*Brassica chinensis var. parachinensis*) (**Fig.1**) vegetable contains high dietary fiber in amount of 2.5 g in 100 g edible portion [1]. The gravimetry enzymatically analysis done in this study revealed that the content of insoluble dietary fiber (IDF) is higher than the soluble dietary fiber (SDF), namely 26.11 versus 3.88 %. This dietary fiber having health effect in human, as mention in [1]. Besides fibre, caisim also contains chlorophyll [[16]. vitamins and minerals [1].



Vegetable Caisim Dried caisim leaf Caisim Powder
Fig.1 Caisim mustard powder

B. Suwar-Suwir Physical Characteristics

Texture and color are the sensory and functional manifestation of the structural, mechanical and surface properties of foods detected through the senses of vision, hearing, touch and kinesthetics [14]. The suwar-suwir texture is a physical characteristic that determine the hardness/density level of the snack food. The statistical analysis showed that the addition of caisim mustard powder significantly (P<0.05) decreased the suwar-suwir texture value. The suwar-suwir SF5 has the highest dense texture by the lowest value of 146.53 mm/g.s versus control (165.93 mm/g.s) as shown in **Tabel 1**.

TABLE I
PHYSICAL CHARACTERISTICS OF SUWAR-SUWIR WITH SEVERAL LEVELS OF CAISIM POWDER ADDED

Caisim Powder (% d/w)	**Texture (mm/g.s)**	**L***	**a***	**b***
K= 0%	165.93±3.41	44.76±2.94	4.65 ±0.19	17.63±0.63
SF1=17 %	163.2±4.80	32.51±1.71	1.49±0.17	11.51±1.57
SF2=25%	152.47±1.53	29.59±0.29	1.47±0.09	10.01±0.12
SF3 = 33 %	148.33±1.51	28.81±0.51	1.11±0.19	9.33±0.50
SF4= 42%	148.53±1.55	26.39±0.54	1.05±0.08	7.34±0.37
SF5 = 50%	146.53±2.60	25.52±0.21	0.99±0.12	7.31±0.41

Notes: L- lightness, a- redness, b- yellowness

The suwar-suwir texture with enough hardness or dense makes it easy to bite and chew. The decrease in texture value compare to control can occur due to the fiber content in mustard caisim powder added which bind the water and able to disturb the starch gelatinization process, resulting in a harder and dense texture product, as in [9]. Otherwise, an addition of seaweed flour to dodol can increase the texture value because of its low

water content that makes the hard and sticky texture of dodol [10].

The addition of caisim mustard powder causes the suwar-suwir color to become darker green due to the presence of chlorophyll content in mustard greens. The higher the addition, the darker the green color of suwar-suwir (**Fig.2**). Similarly found in other research and food product that the addition of green mustard with a large concentration will affect the color of the product [15].

Fig. 2 Color of suwar-suwir with difference addition level of mustard caisim powder

The lightness (L) of suwar-suwir shows the level of brightness that will produce achromatic colors of white, gray, and black [16]. The results of Anova statistical analysis at the $\alpha \leq 0.05$ test level show that the addition of caisim mustard powder significantly decreased the lightness value. The higher the addition, the lesser of suwar-suwir brightness. The average lightness value of suwar-suwir was between 44.76 and 25.52 (**Table 1**). Control suwar-suwir has the highest L value (44.76), while the suwar-suwir SF5 had the lowest. The caisim mustard powder added caused the suwar-suwir color to become darker , therefore the L value decreased. The decrease could be due to the cooking process that may reduce the L value by brown pigments produced from caramelization reaction at the dehydration or evaporation stage [4]. In addition, the high chlorophyll in mustard greens causes the L value to decrease. The higher the chlorophyll content, the lower the brightness value of the product [16].

The redness value a* in food product show a mixed chromatic colour of red to green with a value range of -80 to 100 [16]. The average a* values of suwar-suwir ranged from 4.65 to 0.99. The suwar-suwir control had highest a* value by 4.65, while suwar-suwir SF5 had the lowest. The results of statistical analysis showed that the addition of caisim mustard powder significantly decreased the a* (redness) value. The decrease was due to the high addition of caisim mustard powder therefore the suwar-suwir colour became green. The greenish colour of suwar-suwir can be caused by the addition of green leaves, so that the a* value decreases which is indicated by the low a* value (redness). The high chlorophyll content in dried caisim powder causes the a* value of suwar-suwir to decrease, result in greenish colour. The high chlorophyll content of green leaves causes a greenish colour, which results in a decrease in the redness of food products [16].

The yellowness (b*) value in suwar-suwir is used to indicate the chromatic color of the blue to yellow mixture with a value range of -70 to 70. The average value of colour b* (yellowness) ranged from 17.63 to 7.31. The results of statistical analysis showed that the addition of caisim mustard powder significant decreased the b* value (yellowness). Suwar- control had the highest value in colour b*, while suwar-suwir SF5 had the lowest. The yellow colour of suwar-suwir control was due to the yellow colour of fermented cassava (tape). As known in [17], cassava that goes through a long fermntation process affects the colour of the tape to yellowish beige. High temperature used in making suwar-suwir damage the chlorophyll in mustard caisim, resulting yellowish colour, as result of the changes in chlorophyll to feophytin [18].

C. Carbohydrate Content

The average carbohydrate content in suwar-suwir is high, ranges from 70–94%, including maltose from taoe and dietary fiber from mustard caisim powder. The dietary fiber in the suwar-suwir dough is able to bind maltose, so that it is not hydrolyzed into glucose, which results in a low sweetness taste. According to [19], cellulose and hemicellulose fiber can be hydrolyzed by cellulolytic and hemicellulolytic enzymes to produce undigested sugars, such as cellobiose and oligo saccharides, that remain sweet but safe,

The dietary fiber consists of water soluble dietary fiber (SDF) and water insoluble dietary fiber (IDF). The average value of total dietary fibre in the suwar-suwir caisim was high, ranged from 15-26 %. In all of the suwar-suwir caisim tested, level of IDF is higher than that of SDF since this fiber type is high in vegetable, such as mustard caisim (**Fig.3**).

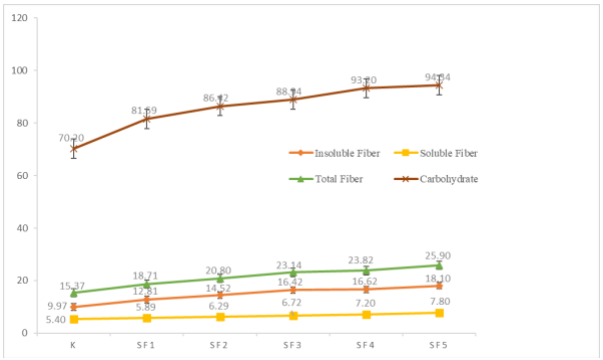


Fig. 3 Carbohydrate content in difference suwar-suwir caisim

Result showed that the addition of mustard caisim powder significantly increase carbohydrate content, including TDF, SDF, and IDF. The higher the addition of mustard caisim powder, the higher the carbohydrate content, TDF, SDF, and IDF in suwar-suwir Therefore, suwar-suwir SF5 had the highest dietary fiber content as well as SDF and IDF because the amount of mustard caisin powder added was the highest (50% d/w), while the control had the lowest. Because of the amount of sucrose used in the suwar-suwir is same, and the content in mustard caisim is small (0.8 g/100g), so the fiber increase in suwar-suwir caisim is not much compare to control. The sucrose in the suwar-suwir increase along with the increase of

the mustard caisim powder added. Although small, the small content affect the sweety taste of suwar-suwir. as mention in other research [18].

The IDF content in suwar-suwir ranges from 10 - 18.1%. The highest increase in IDF levels was due to the highest caisim mustard powder added to the suwar-suwir. In the preparation of the powder, fresh mustard leaves were dried in an oven and then ground, resulting in an increase its IDF in the dry powder basis. Drying at high temperature and long time will make the moisture content of a caisim powder decrease, therefore the fibre content increases. Meanwhile, the SDF content in the suwar-suwir was quite high, ranges from 5.4 to 7.80 %. The SDF increase was due to the increase in the amount of mustard caisim powder added. Caisim contains large amounts of dietary fiber [1] and the addition in high amount can increase dietary fiber content [8], especially the IDF which has health effect in human digestive tract.

D. Sensory Quality Preference

The results of chi-square test showed that the addition of caisim mustard powder significantly affects the sensory preference. namely texture, stickiness, colour, flavor, aroma, and overall sensory performance. Texture of suwar-suwir SF4 received by the highest number of panelist who still like it, only a little (6%)_of the panelist like it. More panelist dislike the texture of control suwar-suwir (29%) compare to suwar-suwir SF4. However, more panelist favor the texture of suwar-suwir caisim SF1, as shown in **Fig. 4.**

The addition of mustard powder can improve the texture because the powdered material contains a fairly low water content make. The texture of the suwar-suwir caisim becomes denser and crunchy. This is in line with the research of [20] that similar food product (*dodol*) with the addition of seaweed flour can improve texture, this is because seaweed flour has a low water content so that it has an effect on the texture of the finished dodol. In addition, caisim mustard also contains high fibre, which can affect the density of suwar-suwir texture. The hardness is due to the fibre content in caisim mustard that can absorb water, so that the resulting product has a dense and sturdy texture. Besides, sucrose content also forms texture [22]. Other study revealed that the purple yam flour substitution gave a significant effect on hardness and color (L*, a*, b*) [23].

Colour is one of the sensory property that determine product acceptability. Sensory evaluation in Fig. 4 shown that colour of suwar-suwir control preferred by the most panelist. Conversely, suwar-suwir SF5 had the lowest color liking. The analysis showed that the higher the caisim powder addition, the darker the green colour of suwar-suwir. The panelists preferred the bright yellow colour of the suwar-suwir compared to the green darker one. The yellow colour in suwar-suwir was due to the ingredient cassava fermented - used which beige or yellow in colour. the length of the fermentation process in cassava affects the colour of the tape from white to beige [17].

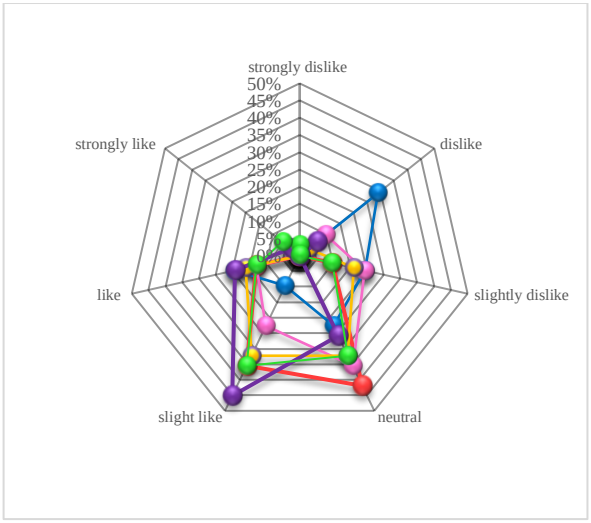
The suwar-suwir sweet flavour comes from the sucrose in fermented cassava and in caisin mustard powder added. In making suwar-suwir using long time heating causes the increase of sucrose converted into glucose and fructose to increase. Sucrose has non-reducing properties because there are no reactive free hydroxyl (OH) groups, but during heating at acid condition, sucrose was hydrolyzed into glucose and fructose [3]. Flavor of suwar-suwir control (K) was preferred by the most panelist. In contrast, suwar-suwir SF5 that produced by highest caisim powder addition, was not favored by many panelists. The flavor of the SF1 was the most favor because of its bitter flavor was still not detected in this level addition.

The addition of caisim powder caused the suwar-suwir to taste slightly bitter. The bitter taste caused by the alkaloids and carpine content of mustard caisim [21] Fortunately. In certain amount, the sweetness from tape and sugar ingredients can mask the bitter. According [15] the addition of mustard greens causes the taste of other snack food product (ice cream) to be slightly bitter, but the presence of other ingredients such as sugar and milk powder makes the taste of mustard greens slightly reduced.

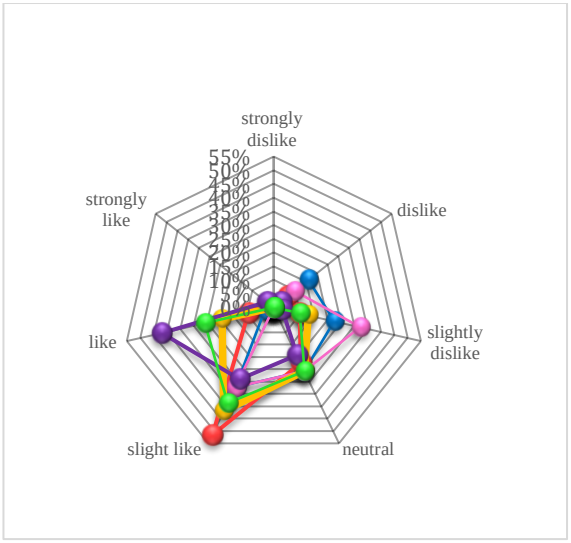
The suwar-suwir has specific aroma due to the presence of sulphur content in caisim [15], creates a unpleasant odour The higher the addition, the distinct the odor that makes disfavor. However, the sensory result analysis revealed that suwar-suwir SF1was preferred by the highest panelist (**Fig.4**). Aroma of suwar-suwir SF1 is favored by more than half of the panelists. In contrast, Aroma of SF5 that added in high amount of mustard caisim powder was not liked by most of the panelists. Meanwhile, the low addition amount caused the flavor accepted, such as the suwar-suwir SF1.

The small amount of addition creates aroma that still can be neutralised by the tape aroma which can cover the languorous smell of mustard powder. Mustard caisim has a distinctive aroma that is slightly languorous, but the addition of other ingredients for making food product (ice cream) can eliminate the languorous aroma of mustard greens.

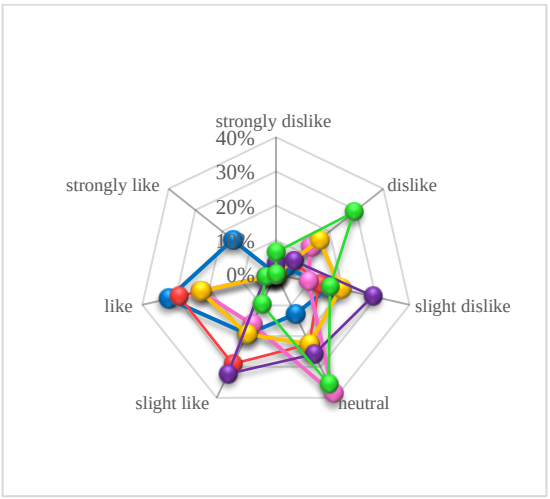
The results of chi-square test revealed that the addition of caisim mustard powder significantly affects the overall sensory properties Suwar-suwir SF1 had the most favorability toward this sensory quality. SF1 suwar-suwir had a light green colour that attracted the panelists and had a texture that was dense, neither mushy not too hard. The flavor and aroma produced by this suwar-suwir was not too bitter and languorous due to the low addition of mustard powder, so there was still a sweet flavor and aroma produced from cassava tape and crystal sugar. The raw materials of cassava tape and crystal sugar can cover the bitter taste and languorous aroma of mustard greens. The addition of mustard greens to the product causes the flavor to be slightly bitter, but the presence of sweet main raw materials can reduce and cover the bitter taste of mustard greens [21]. Suwar-suwir with high addition of mustard powder affects the attractiveness of consumers. This is because the flavor is too bitter and a slightly dark color. The color and taste are among the factors that determine whether a product is acceptable or not to consumers [21]. The most liked overall sensory properties was suwar-suwir caisim SF1.



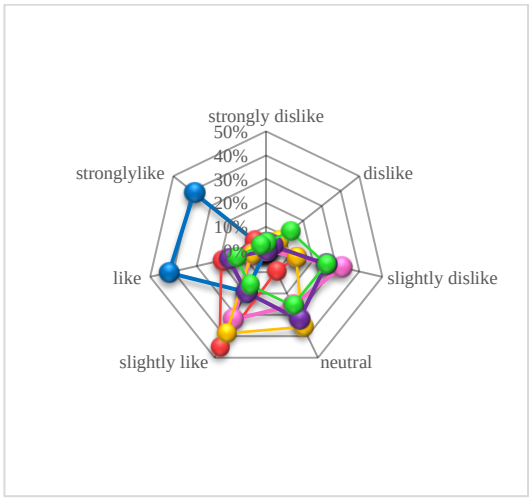
Texture preference



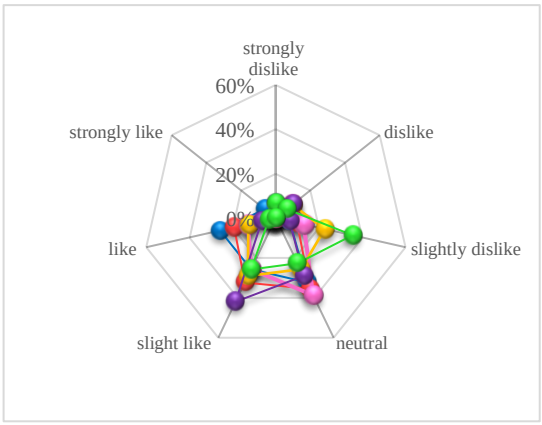
Stickiness



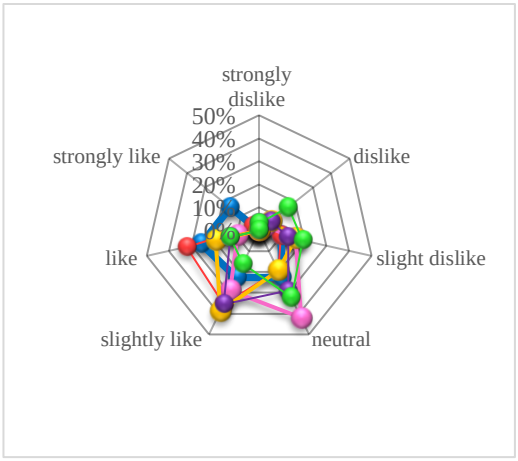
Flavour Preference



Colour Preference



Aroma Preference



Overall Preference

Fig. 4 Sensory preference of suwar-suwir made with several levels of mustard caisim powder

IV. CONCLUSION

The amount of mustard caisim powder that improved the suwar-suwir dense crunchy texture, the light sweety, and was favored is the addition by 17% of dough weight for making suwar-suwir SF1. The texture value of the suwar-suwir (SF1) were 163.2±4.8 mm/g.s. and the colour more light green (L= 32.51±1.71; a= 1.49±0.17. b=11.51±1.57). The carbohydrate content were high (86.42±0.96 %), and the dietary fiber was high (20.8± 0.01%), as well. The IDF level was higher (14.2 ± 0.01 %) than SDF (6.29 ± 0.002%). For all sensory properties of the suwar-suwir caisim, SF1 was the most liking by panelists.

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