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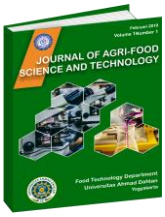

Physicochemical and Sensory Characteristics of "*Terong asam*" (*Solanum ferox* Linn) Dry Sweetmeat at Various Concentrations of Sugar

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ABSTRACT

Solanum ferox Linn *is one of the local agricultural products. Its local name is "terong asam", the plant's shape is like eggplant but the fruit is round, orange with ripe and sour taste. The problem is that the fruit is easily damaged if left in its fresh. One of the innovations to increase the shelf life is to process it into processed dry sweetmeats. However, the amount of sugar that produces the best physicochemical characteristics of "terong asam," dry sweetmeats is currently unknown. This study contribution to obtain the concentration of sugar that produces the best physicochemical and sensory characteristics of "terong asam," dry sweetmeats. The research design used was a randomized block design with one treatment, namely concentration of sugar, which consisted of 4 treatments and 6 replications. Analysis of physicochemical data using ANOVA (Analysis of Variance) and Honest Significant Difference (HSD) Test with a level of 5% significantly. Sensory data were analyzed by Kruskal Wallis test. Determination of the best treatment using the effectiveness index test. The results showed that the production "terong asam," dry sweetmeats is recommended by using a 50% sugar concentration which the best sensory physicochemical characteristics of the sweets, namely water content (13.28%), pH (5.08), yield (26.49%), vitamin C (8.7mg/100g) with sensory characteristics of colour (3.17), taste (2.67), aroma (3.30), texture (3.20).*

1. INTRODUCTION

Solanum ferox Linn, is one of the local agricultural products. Its local name is "*Terong asam*", belongs to the *Solanaceae* family, the stems have fine thorns, and the

community uses the fruit as a cooking flavour (Hazimah *et al.,* 2018). The fruit contains water, carbohydrates, protein, fat, fiber, minerals and vitamins (Abdullah *et al.,* 2012). The difference of fruit between "*terong asam*" and eggplant is the round shape and when it is ripe, it is orange with thick fruit and a slightly sour taste. The problem is that "*terong asam*" if left in fresh is easily damaged and can last only about one week of shelf life. The word 'Sweetmeat' means a food rich in sugar (Alam et al., 2020) and, combined with fruit or milk, is enjoyable, wholesome, nutritious and unique.

The use of "*terong asam*" fruits in the community is generally only processed as a food additive, such as tamarind vegetables and yellow spiced fish. The sour taste of the fruit is similar to star fruit, so it is widely used in Malay cuisine and can also be used as a source of traditional medicine (Supriyani, 2014). Technological innovations to extend shelf life need to be carried out so that diversified products based on "*terong asam*" fruit into sweetmeats are interesting to study.

Sweetmeats is one form of processed food that is much favoured by the community. The sweet taste mixed with the distinctive taste of the fruit used is very suitable to be enjoyed on various occasions (Khotimah *et al*., 2020). Sweetmeats are divided into two types, namely wet sweetmeats and dry sweetmeats. The difference between wet sweetmeats and dry sweetmeats is the production process, shelf life, and appearance. The principle of making sweetmeats is the process of absorbing a sugar solution until the sugar content in the food is high enough. High sugar content produces osmotic pressure in the soaked material and affects the appearance of the resulting product. Preferred sweets are those that are able to maintain the texture of the fruit colour, as well as create new flavours.

According Yadav and Singh (2014), processing fruit into sweetmeats by sugar can extend the shelf life, Sugar is used to preserve fruits, either in syrup with fruit such as apple, pear, peach, apricot, plum or in crystallized form where the preserved material is cooked in sugar to the point of crystallization and the resultant product is then stored dry. This is a consideration in processing "*terong asam*" fruit into sweetmeats. However, until now there has never been a study on this matter. Therefore, this study contributes to obtain the sugar concentration that produced the best physicochemical and sensory characteristics of sweetmeat by "*terong asam*" fruit.

2. MATERIALS AND METHODS

2.1. Materials

The tools used in this study were containers, knives, spoons, jars, cutting boards, gloves, analytical scales, cabinet dryer, porcelain dishes, desiccators, erlenmeyer, dropper pipette, measuring cup, refractometer, titrator, pH meter, oven and funnel. The ingredients for making dried sweets used in this study were physiologically ripe tamarind eggplant, sucrose, water, sodium metabisulphite. Chemicals used for the analysis of aquadest, iodine solution, and starch.

2.2. Methods

The research design used was a randomized block design with one treatment, namely concentration of sugar, which consisted of 4 treatments and 6 replications. Analysis of physicochemical data using ANOVA (Analysis of Variance) and Honest Significant Difference Test with a level of 5% significantly. Sensory data were analysis by Kruskal Wallis test. Determination of the best treatment using the effectiveness index test. Variable to observed are water content (Sudarmadji *et al.,* 1997), yield (Hartanti *et al.,* 2003, vitamin C Sudarmadji *et al.*, 1997), Total soluble solids (Sudarmadji *et al.,* 1997) and sensory test (Rochmawati, 2019).

The process of sweetmeats production refers to the method used by Kusuma

et al. (2020) which was modified, namely by sorting the material and then weighing it, followed by washing and peeling the fruit skin and then reducing the size of the material. The material that had been reduced in size was then soaked in sodium bisulphite for 10 min, then washed again and soaked in sugar solutions at various concentrations for 24 h and dried in a cabinet dryer at 60˚C for 14 h. Then after the sweets were dry, they were stored until analysis.

3. RESULT AND DISCUSSION

The physicochemical characteristics of sour eggplant "*terong asam*" fruit used to make sweetmeats are presented in Table 1.

Table 1. The physicochemical characteristics of "*terong asam*" fruits

Physicochemical Characteristics	Content
Moisture content (%)	74.50
pH	4.09
Vitamin C (mg/100 g)	4.20
Total Soluble Solid (^{o}brix)	7.20

The physicochemical characteristics observed in this study were water content, yield, vitamin C content and total soluble solids. The results of the research on physicochemical characteristics are presented in Table 2.

Table 2. The physicochemical characteristics of "*Terong asam*" sweetmeat at various concentrations of sugar solution for soaking

The concentration of Sugar soaking (%)	Moisture content (%)	Yield (%)	Vitamin C (mg/100 g)	Total Soluble Solid (%)
50	$13.29^{c} \pm 1.21$	$26.49^{a} \pm 2.37$	8.7 ± 0.8	$12.5^{a} \pm 1.0$
60	$12.12^{bc} \pm 1.17$	$28.85^{ab} \pm 1.74$	7.9 ± 0.6	$14.8^{b} \pm 1.2$
70	$11.41^{ab} \pm 1.00$	$31.05^{bc} \pm 2.48$	7.6 ± 0.4	$15.2^{b} \pm 1.3$
80	$10.26^{a} \pm 0.97$	$32.10^{c} \pm 1.97$	7.4 ± 0.4	$18.3^{c} \pm 1.1$
Score	HSD = 1.53	HSD = 2.58		HSD = 1.63

Table 2 shows the results of the analysis of the "*terong asam*" dry sweetmeats having a moisture content of 10.26-13.28%, with the highest value at the addition of 50% sugar soaking solution is 13.28% and the lowest value of water content of sweetmeats at the addition of 80 % sugar soaking solution is 10.26%. The results showed that the water content of dried "*terong asam*" sweetmeats was still in the standard range. According to SNI 01-4443-1998, the water content of dried sweetmeats was a maximum of 25% moisture content. The addition of more sugar can reduce the water content in dried sweets. Palijama (2016) stated that the decrease in water content in confectionery products is closely related to an increase in total sugar, it will be affected to the water balance, then the percentage of moisture content in the product will be decreased. According to Sohibulloh et al. (2013), adding large amounts of sugar can result in osmotic dehydration, so some water will come out of the fruit.

Based on Table 1, the results of the analysis of the yield of dried "*terong asam*" sweetmeat have ranged from 26.49-32.10%. The highest yield of sweetmeat was obtained from the sugar concentration of 80% for soaking, namely 32.10%. Meanwhile, the lowest

yield of sweetmeat was obtained from the sugar concentration of 50% for soaking, namely 26.49%. According to Sohibulloh (2013) the increase in yield is in line with the increase in sugar concentration for soaking due to the mobilization of water from the fruit to the sugar solution and vice versa, which affects the weight of the final product. Diffusion of water out of the fruit occurs because the specific gravity of sugar is greater than the density of water, the sugar in the fruit replaces some of the water, thereby increasing the weight of sweets, which means increasing the yield of sweetmeats.

Based on Table 2, the results of the analysis of vitamin C levels in candied eggplant sour ranged from 7.4-8.7 mg/100 g. The decrease in vitamin C content was due to the high sugar solution used, the higher the concentration of sugar used in soaking, the lower the vitamin C content of candied eggplant. According to Tendean (2016), the factors that cause dried sweets to lose vitamin C are because in the processing of sweets starting from washing, removing the contents of the fruit, cooking with sugar which causes water to come out to the drying process.

Table 2 shows the results of the sugar content of "*terong asam*" dried sweetmeat ranging from 12.5 to 18.3^{o}Brix. The lowest of Total soluble solids value was obtained from soaked sweets with a sugar concentration of 50%, namely 12.5^{o}Brix, while the highest yield was obtained from an 80% sugar concentration for soaking, which was 18.3^{o}Brix. According to Ramdani (2018) the high concentration of sugar solution used for soaking affects the osmotic pressure so that the content is conditioned so that a balance is achieved for the entry of sugar into the fruit. Tampubolon (2006) stated that the higher the sugar solution, the total dissolved solids in the sweets will increase.

In the food industry, sensory testing is very important because it will determine whether a product is liked or not. Sensory test can also be used to determine the level of acceptance of the panelists (like it or not) to a product. In this study, the sensory test carried out was the hedonic test (preferred test) by 30 panelists. Sensory characteristics of "*terong asam*" dried sweetmeat include colour, taste, aroma and texture. In this study, four hedonic scales were used which showed the level of preference including 1 (dislike), 2 (somewhat like), 3 (liked), 4 (liked very much). The data from the Kruskal Wallis test on dried candied sour eggplant are presented in Table 3.

Table 3. The Sensory characteristics of "*terong asam*" Sweetmeat

Concentration of Sugar for Soaking (%)	Colour Score	Taste Score	Flavour Score	Texture Score
50	3.17	2.67	3.30	3.20
60	3.00	3.07	3.07	3.07
70	3.13	3.63	3.03	3.03
80	3.40	3.23	2.90	2.83
Chi 0.05 = 7.82	KW = 4.65	KW = 16.25	KW = 3.79	KW = 2.89

Based on the sensory results of "*terong asam*" dried sweetmeats at various concentrations of soaking sugar, the colour values ranged from 3.17 to 3.40 (like). Based on Table 3, show that the concentration of sugar for soaking the dried candied sour eggplant gave no significant effect on the colour (KW<7,82 i.e., 4,65). The colour has no significant effect on the dried sweetmeats because the colour produced at each concentration is not much different. The yellow colour produced by dried sweetmeats thought to be due to the addition of meta bisulphite compounds in the processing, the purpose of adding chemicals is to prevent discoloration of foodstuffs from turning brown.

The sensory results of "*terong asam*" dried sweetmeats at various concentrations of

soaking sugar, the taste values ranged from 2.67 to 3.63 (like). Table 3, shows that the concentration of sugar has a significant effect on "*terong asam*" dried sweetmeat (KW>7.82 i.e. 16.25). The highest taste value was found in the use of 80% sugar for soaking, which was 3.63 (likes) while the lowest value was found in sweetmeats soaked in 50% sugar solution, which was 2.67 (likes). "*Terong asam*" dried sweetmeats resulting from soaking in 80% sugar concentration were the panelists' preferred product. The taste with a liking value is suspected because the combination of "*terong asam*" with sugar used for soaking gives a dried sweetmeat taste that suits the tastes of panelists as representatives of consumers. The result of taste maybe causes consumer interest in natural products like "*terong asam*" is an ingredient and also maybe this tendency manifests itself of types "functional food". Radia *et al.* (2018) stated that a new concepts of type functional food, vitafood and nutraceuticals, formally expressing the relationship between diet and health.

Based on Table 3 showed that the hedonic test value for the flavour of "*terong asam*" dried sweetmeats ranged from 2.90-3.30 (like), sugar concentration did not have a significant effect on the aroma of "*terong asam*" dried sweetmeats (KW>7,82 which is 3,79). This is in accordance with the stated Sari *et al* (2021), "*terong asam*" fruit has no aroma and no taste specific one but has an attractive colour so that when processed can increase consumer preferences. Sensory results of "*terong asam*" dried sweetmeats at various concentrations of sugar for soaking resulted in texture values ranging from 2.83 to 3.20 (like). Based on Table 3, it shows that the sugar concentration has no significant effect on the texture of "*terong asam*" dried sweetmeats (KW<7.82 which is 2.89. The results of this study indicate that sweetmeats with high immersion sugar concentration produces a hard texture and vice versa. This is in accordance with the statement Athmaselvi, *et al.*, (2012) which stated that the higher the sugar concentration, the higher the hardness value, the hardness value decreased or increased with increasing immersion sugar concentration.

The food quality is that "which the consumer likes best" and that the grades of quality are understood more by the degree of desirable attributes and absence of undesirable characteristics which are primarily detected by the consumer's sensory organs, then a good method of deciding quality of a food is through sensory evaluation (Singh-Ackbarali & Maharaj, 2014). Based on Table 2 and Table 3, data was continued analysis to combine physicochemical and sensory characters using the effectiveness index test (de Garmo, 1984). Based on the variable at Table 2 and Table 3, the variable weighting was carried out on the results of the physicochemical character analysis. The variable weights were colour (1), taste (1), aroma (0.9), texture (0.9), moisture content (0.8), total soluble solids (0.7) and vitamin C content (0.6). The results of testing the effectiveness index value are presented in Table 4.

Table 4. The of effectivity indexs value of "*terong asam*" sweetmeat at various soaking sugar solution

No.	Concentration of sugar (%)	Treatment Value (TV)
1.	50	0.64
2.	60	0.39
3.	70	0.49
4.	80	0,35

Table 4 shows that the best treatment with a TV of 0.64 was found in a 50% immersion sugar concentration which resulted in the physicochemical characteristics of dried candied sour eggplant with water content (13.28%), yield (26.49%), vitamin C (8.7 mg/100g), and the characteristics are sensory colour (3.17), taste (2.67), aroma (3.30),

texture (3.20).

4. CONCLUSIONS

Based on the results of the study, it can be concluded that the use of "*terong asam*" for dried sweetmeats is best when in the manufacturing process using a sugar soaking solution with a sugar concentration of 50%. Physicochemical characteristics of dried candied sour eggplant, namely water content (13.28%), yield (26.49%), vitamin C (8.7 mg/100g) and colour sensory characteristics (3.17) like, taste (2.67) slightly like, smell (3.30) like, texture (3.20) like.

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