Quality Identification of Dragon Fruit Peel (Hylocereus undatus) Nata with Sucrose Concentration Variation

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ABSTRACT

The dragon fruit plants are being developed in the province of Bengkulu , especially in Kepahiang District. As a byproduct of the dragon fruit (*Hylocereus undatus*) consumption, dragon fruit peel still contains nutritional components that are potential to be material for food processing. In nata processing, sugar was used as a carbon source for *Acetobacter xylinum* bacterial growth. The purpose of this study was to characterize the physical, chemical and organoleptic nata of dragon fruit peel. The experiment was done with two steps : processing of nata of dragon fruit peel with sucrose treatment (2 %, 4 %, 6 %, 8 % and 10 %), then the physical analysis (thick pellicle, pellicle weight and texture), the analysis of chemical properties (fiber content) and analysis of organoleptic to determine the level of hedonic scale for appearance, taste and texture, using 20 trained panelists. The analysis showed that the pellicle weight ranges from 478 g - 752 g, thick pellicle ranges from 0.61 cm - 1.13 cm, the fiber content ranges from 3.63 % - 4.44 % and textures ranges from 3.62 mm/g.second - 3.93 mm/g.second with panelists preference level generally which are not significantly different for all parameters (except the 4 % sucrose treatment) with the grading scale rather like until like.

Key words : Nata, sucrose, dragon fruit peel

INTRODUCTION

Dragon fruit or sweet cactus is now known in Indonesia, even being developed in the country, has a great chance to be disseminated. As a by product of the dragon fruit (*Hylocereus undatus*) consumption, dragon fruit peel still contains nutritional components that potential to be material for food processing. Research showed that the antioxidant activity and the levels of the red dragon fruit peel and white dragon fruit peel are greater than the flesh, and when viewed from the phenol content (Total Phenolic Content), red meat dragon fruit (*H. polyrhizus*) has higher antioxidants than the white flesh dragon fruit (*H. undatus*). Sasina, S., (2012) stated that the total content of phenols in the flesh and peel of a red dragon which amounted to 1049.18 mgGAE / 100g and 561.76 mgGAE / 100g while the total flavonoids of 1310.10 mg CE / 100g and 220.28 mg CE / 100g.

From the composition of its nutritional value, the dragon fruit peel can be potential as the raw material for food processing, including dragon fruit peel syrup, dragon fruit peel marmalade, dragon fruit peel candy and dragon fruit peel nata. Nata is a biomass that mostly consists of cellulose, shaped like jelly and white. This mass is derived from *Acetobacter xylinum* growth on the surface of the liquid medium that is acidic and contains sugar. Nata can be made from raw material of coconut water, and the waste of water treatment of Tofu (Tofu whey). Shape, color, texture, and taste of both types are not much different with nata (Hasbullah, 2009).

Fermentation media that is used in the processing of nata must meet the criteria as a source of energy, growth, motility and biosynthesis of macro-molecules. Therefore, the medium used must contain a complete nutrient components and in accordance with the needs of the microbial which run the fermentation (Lapus et all, 1967). Making nata in a dark room will accelerate the formation of the structure of nata and its layer produced will be thick (Luwiyanti (2001). According to Rahman (2004), as a starter, *Acetobacter xylinum* can grow and develop in the medium of sugar and will convert sugars into cellulose. Sugar serves as a carbon source (energy source). The source of carbon can use glucose, sucrose and maltose, however the nata processing industry usually uses sucrose as the source of

carbon. Besides being easily obtainable, the price of sucrose are relatively lower than other types of other sugar. Sucrose is an important factor in the fermentation process since nata producing bacteria needs a source of glucose for the processes of metabolism.

In the meantime, glucose will enter the cell needed for breeding. The amount of glucose added should be sufficient for the metabolism and the formation of nata (Hidayat, 2006). Without the addition of sugar, nata texture becomes thickless. On the contrary, the addition of too much sugar (glucose concentration is too thick) causing bacteria undergo plasmolysis (death) (Warisno, 2004), which would inhibit the activity of Acetobacter xylinum in the form of cellulose (Nisa *et al.*, 2001). The purpose of this study was to characterize the quality of the dragon fruit peel nata with the addition of sucrose treatment, which includes the weight (grams), thick (cm), fiber content (%), texture (mm/s) and the level of acceptance of the panelists.

MATERIALS AND METHODS

The materials used in this study were dragon fruit peel, *Acetobacter xylinum* , acetic acid, ZA 0.4 % and sucrose. in addition, the experimental design used in this research was completely randomized design (CRD) with one factor (sucrose), 5 treatments and 3 replications . The treatment used is adding 4% of sucrose (S1), 6 % (S2), 8 % (S3), 10 % (S4) and 12 % (S5). finally, the data were analyzed using analysis of variance and if there is a significant difference between the treatments, the study would be continued with DMRT level of 5 % .

RESULT AND DICUSSION

Pellicle Thickness

Measurement results of pellicle thickness of dragon fruit peel nata after being fermented for 7 days in the tray which sizes 35x25x4 cm , are presented in Table 1. The higher of concentration of sucrose given , dragon fruit peel nata produced became significantly different. In the formation of nata pellicle, *Acetobacter xylinum* needs sugar as a source of carbon (C) , which can be derived from glucose, maltose, lactose, sucrose, dextrin or galactose. Previous studies reported that the C source that support optimal growth of *Acetobacter xylinum* is glucose and sucrose. Kinds and levels of added sugar in the media for fermentation greatly affects the thickness and weight of nata formed (Steinkraus, 1983; Gunzalus, 1972).

In the addition of 4 % and 6 % sucrose resulting thinner dragon fruit peel nata pellicle than the addition of 8 % sucrose. It is due to the carbon source in the fermentation medium was still less so that the synthesized cellulose of *Acetobacter xylinum* bacteria was also little. Next, the addition of 10 % and 12 % sucrose produced nata pellicle which thicker than the other treatments, however, this result was not significantly different between the two treatments, so economically the addition of 10 % sucrose was already at the optimum concentration.

Table 1. Pellicle Thickness of Dragon Fruit Peel Nata

Sucrose added (%)	Pellicle Thickness (cm)
4	0.61 ^{d}
6	0.71 ^{cd}
8	0.83 ^{bc}
10	0.93 ^{ab}
12	1.13 ^{a}

Note: Results are the average of three replications. Different notations in the same column indicate significant difference in significance level of 5 % .

Pellicle Weight

Analysis of dragon fruit peel nata pellicle weight was done by weighing each pellicle nata formed, based on each treatment. Table 2, showed significant differences in each treatment. The higher the levels of sucrose were added, the heavier nata pellicle formed.

Table 2. Weight of dragon fruit peel nata

Sucrose (%)	Pellicle Weight (g)
4	478 [e]
6	624 [d]
8	625 [c]
10	707 [b]
12	752 [a]

Note: Results are the average of three replications . Different notations in the same column indicate significant difference in significance level of 5 % .

Sucrose as a carbon source in the fermentation media for *Acetobacter xylinum* provides a very important role in the formation of nata pellicle. The addition of less sugar will produce thickless and heavy nata because the carbon source used to the formation of cellulose was lack. However, excessive use of sucrose will also produce thickless and heavy nata, because the carbon source synthesized by the bacteria *Acetobacter xylinum* was also excessive that the CO_2 produced became high. In the fermentation medium, the high CO_2 will have the higher pressure toward the fermentation liquid so that the CO_2 pressure will reduce cavities contained in the cellulose, so that the cellulose structure will be docked. This would result in the amount of water contained in the cellulose is very little and will affect the thickness and weight of pellicle (Pratiwi, 2002).

Pambayun (2002), revealed that the addition of excessive sucrose in making nata can cause disruption of bacterial activity, much sucrose converted into acid, the reduction of pH drastically and harm the industry of nata. In addition, excessive sucrose can cause browning, dark color, because the media caught in the nata fiber structure is transparent.

Fiber Content

Definition of dietary fiber given by the American Association of Cereal Chemist (AACC, 2001) is the edible part of plants or analogous carbohydrates that are resistant to digestion and absorption in the small intestine with complete or partial fermentation in the large intestine. Kusharto (2006) explains that nata is very well consumed, especially by those who are low-calorie diet or high in fiber. High water content serves to accelerate the body's metabolic processes. Nata fiber in the human body will be binding on all elements of residual combustion products that are not absorbed by the body, then discharged through the anus in the form of feces or bolus.

Results of the analysis of the fiber content of the fruit skin nata as presented in Table 3, indicate that the higher levels of sucrose given, resulting higher nata fiber content. This is in line with the opinion of Hasbullah (2009) which states that apart from a precursor nata, sucrose is also used by *Acetobacter xylinum* as a source of energy for activity and product biosynthesis forming cells, so that the real impact on the formation of cellulose.

Table 3. Fiber Content of Dragon Fruit Peel Nata

Sucrose (%)	Fiber Content (%)
4	3.63 [c]
6	3.78 [b]
8	3.83 [b]
10	4.14 [a]
12	4.44 [a]

Note : Results are the average of three replications .
Different notations in the same column indicate significant difference in significance level of 5 % .

The results showed that the fiber content of dragon fruit peel nata ranged from 3.63 % to 4.44 % , these results are in accordance with ISO standards 01-4317-1996, which requires the fiber content in nata maximum 4.5 % (BSN, 1996) .

Pellicle Texture

Nata is high fiber food so that it becomes one of the recommended food as that serves to maintain digestive health. In terms of appearance, nata has a high aesthetic value, somewhat translucent white in appearance, chewy texture and fresh scent (Misgiyarta, 2007).

Table 4. Pellicle texture of dragon fruit peel nata

Sucrose (%)	Texture (mm/g.s)
4	3.62 [ab]
6	3.60 [b]
8	3.67 [ab]
10	3.73 [ab]
12	3.93 [a]

Note : Results are the average of three replications.
Different notations in the same column indicate significant difference in significance level of 5 % .

Results of measurements of dragon fruit peel nata texture with sucrose treatment variations ranged from 3.62 to 3.93 mm / g.second and statistically , there is no difference between all treatment given.

Organoleptic Properties

Organoleptic analysis performed on the dragon fruit peel nata drinks, to determine the level of 20 trained panelists on parameters of colour, flavour and texture. The test results are presented in Table 5.

Table 5. Organoleptic properties of dragon fruit peel nata

Sucrose (%)	Colour	Flavour	Texture
4	3.30 [a]	2.70 [b]	3.20 [b]
6	3.30 [a]	3.60 [a]	3.55 [ab]
8	3.15 [a]	3.65 [a]	3.75 [a]
10	3.35 [a]	3.60 [a]	3.80 [a]
12	3.30 [a]	3.90 [a]	3.90 [a]

Scale: 5 = strongly like; 4 = like; 3 = rather like ; 2 = dislike ; 1 = strongly dislike
Different notations in the same column indicate significant difference to the level of 5 %

Nata organoleptic test results showed that the hedonic level of dragon fruit peel nata based on the parameters of colour, flavour and texture were generally not significant , except in the treatment of 4 % sucrose, with the scale of assessment between rather like to like. In other words, the product of dragon fruit peel nata organoleptic was accepted by consumers. In addition to having a high aesthetic value, rather translucent white appearance, chewy texture and fresh aroma, nata also has a high fiber content so that it can maintain the health of digestion.

CONCLUSIONS

The dragon fruit peel is highly potential to be processed into nata products, with heavy quality classification of dragon fruit peel nata pellicle ranged from 478 gs / d 752 g , pellicle thickness range from 0.61 cm to 1,13 cm , fiber content ranges from 3.63% to 4.44 % and textures range from 3.62 mm / g.s to 3.93 mm / g.s. Organoleptic tests show that, in general, there are no significant different for all parameters (except in the treatment of 4 % sucrose) with a rating scale between a rather like into like.

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