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Determination of Suitability of Durian (*Durio Zebethinus*) Seed Gum Extract in Replacing of Xanthan Gum in Fruit Nectar

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Abstract: ***Though Xanthan gum is widely being used in Fruit Nectar as a thickening agent, it is an expensive ingredient for fruit processing industry. Therefore, aim of this study is to replace expensive Xanthan gum from Durian seed gum extract as which is low cost and readily available. Initially raw and blanched Durian seed slices were dried under three drying method; sun dying, hot air drying at 70^0C and cooling with dehumidified air drying (CDD) at 6^0C until moisture content reaches to 7- 8%. Well dried Durian seed slices were ground to get particle size less than 300 micron using laboratory pin mill. 5g of seed powder obtained from blanched and raw seeds from three drying methods were dissolved in 100ml of distilled water to form durian seed gum and viscosity of these gum were measured to determine the best drying method in terms of viscosity. Results revealed that raw seed powder obtained from cooling with dehumidifying drying process was able to secure the highest viscosity of 6 centipoises. Thereafter, 10g of raw seed slices and raw seed powder of CDD were dissolved in 200ml of distill water to form gums and 5ml, 10ml, 15ml, 20ml, 25ml and 30ml of gums were taken from each solution and mixed with 95ml, 90ml, 85ml, 80ml 75ml and 70ml of plain Nectar solutions to get the final volume of 100ml in glass bottles. These bottles were kept under normal environmental condition for 7 days while observing at what level of gum, the layer separation is not taking place; which was for raw seed and raw seed powder of CDD gums at 15ml and 20ml respectively. Finely, 3 Nectar samples in 100ml were prepared using 15ml of raw seed gum, 20ml of CDD gum and 0.5% of Xanthan gum and changes occurrence on organoleptic properties were monitored for a period of 3 months at one month interval including just after preparation too. Sensory evaluation revealed that there was no significant difference between three treatments on the sensory stimuli color, taste, smell, thickness and over all acceptability during the period of three months shelf life, because calculated p value is higher than 0.05 ($p > 0.05$) after analyzing the data statistically using Kruskal -Wallis non parametric ANOVA method. Hence Durian seed gum extracted from CDD drying process is a viable option in replacing of Xanthan gum in fruit Nectar.***

Keywords: Xanthan gum, Durian seed gum, Fruit Nectar, Cooling with dehumidified drying, Durio Zebethinus

1. Introduction

Fruit Nectar is an attractive ready to serve fruit product in the market because it doesn't need further addition of other materials to form the product into ready to serve state. Therefore, fruit Nectar possesses the time saving capacity of the busy life styles while fulfilling the nutritional requirements of the consumer through its natural fruit pulp. However, most of Fruit Nectar in the market is perceived by the consumers negatively due to the defective appearance of layer separation, of which the fruit pulp and liquid in the product being separated when the product is standing in the shelf. Thus the layer separation may inadvertently affect the purchasing decision of the consumer and finally it may compel the buyer to refrain buying the product. Hence most of Fruit Nectar manufactures emotionally compelled to use a thickening agent to make the density of the syrup of Nectar to be par with the fruit pulp (Whister, 1973). The most popular natural thickening agent to accomplish this task is Xantham gum, but it is very expensive and most instances it beyond the reach of small and medium scale fruit processers. Therefore, endeavor of this research study is to find out natural food grade alternative gum sources, still under exploited or not exploited from the local habitat. Since, durian seed is enriched with a strong water soluble gummy material (Tabatababee, Mirhosseani 2012), it will be a productive option to replace commercial scale Xanthan gum in fruit Nectar because, durian seeds are a waste product and completely discarded after consuming the edible flesh. Nevertheless, as durian seed gum is less expensive, highly resistant to the thermal process and shelf stable under acidic condition it may be an ideal thickening agent for fruit processing industries (Amin, 2007). Moreover, since durian plant is growing well in Sri Lanka and fruits of it having a high demand, this plant can be cultivated large scale and raw seed out of that can be utilized in replacing expensive Xanthan gum from fruit Nectar.

2. Methodology

Since, Xanthan gum is an expensive ingredient in fruit nectar manufacturing process, this study exploring the possibility of incorporating Durian seed gum extract as an alternative thickening agent as which is a lucrative and readily available source.

2.1 Determination of a productive drying method to dry the Durian seed while preserving its gumming ability

Raw seeds of full ripen fruits were taken and wash thoroughly to remove flesh and impurities still intact with them. Seed coats of the seeds were removed and the cotyledons (The kernel) were sliced into thin pieces. Raw

Seed slices were divided into two and one portion was blanched using steam at 100^{0}C. The rest portion was kept untreated. These two portions were divided into three and one portion of each was subjected for sun drying, hot air drying at 70^{0}C and cooling with dehumidified air drying at 6^{0}C until safe moisture content of 6-7% was achieved. Well dried Durian seed slices were ground separately using the laboratory pin mill in order to get particle size less than 300 micron. The seed powder obtained from six treatments were packed in double laminate pouches (Low density polyethylene and polyester) and stored in a refrigerator for subsequent use in the study. The best drying method was determined in terms of viscosity of the seed gum solutions while assuming that best drying method will be cable to preserve as much as gum without destruction.

2.2 Determination of viscosity of gum solutions prepared from powdered Durian seeds

Five grams of seed powder obtained from six treatments were dissolved in distilled water at ambient air temperature and kept for 15 minutes until forming of aqueous gum. Thereafter, these gum solutions were filtered using a piece of muzzle cloth and the filtrations were used to measure viscosity by using Brookfield rotational viscometer with the spindle number one. Therein, Beakers were filed with 200ml of gum solutions and allowed to equilibrate to room temperature as rheological properties depend on temperature. The spindle of the meter was immersed into the test gum sample up to the notch cut in the spindle and switch on the meter to rotate five minutes at 600 rpm. When the digital display of the meter at a stable value, reading was recorded. Since highest viscosity of 6 centipoises was obtained from the raw seed powder obtained from cooling with dehumidified drying process, seed powder obtained from this drying process was used for the subsequent trials of this study.

2.3 Preparation of Fruit Nectar with raw seed gum, CDD gum and Xanthan gum

Two samples of fruit nectar were prepared by incorporating15ml and 20ml of fresh and CDD gums to 85ml and 80ml of fruit pulp respectively along with the required amount of citric acid, sodium bicarbonate and ascorbic acid as per the recipe and mixed well. Sugar was dissolved with the required amount of water and heated up to 95^{0}C. The prepared fruit pulp was added to the hot sugar solution and brought the temperature at 95^{0}C again. Sodium metabisulfite (SMS) was added to the mixture and allowed to cool. Similar procedure was followed to prepare Xanthan gum incorporated fruit Nectar; however the dosage was 0.5% according to the commercial recipe. All samples were kept under refrigerator condition at 8^{0}C for a period of 3 months.

2.4 Determination of required gum concentration to prevent layer separation of fruit Nectar

10g of raw seed slices and raw seed powder obtained from CDD process were dissolved in 200ml of distill water, stirred thoroughly and kept for 15 minutes to form gums. 5ml, 10ml, 15ml, 20ml, 25ml and 30ml of formed gums were taken from each solution and were mixed with 95ml, 90ml, 85ml, 80ml 75ml and 70ml of plain Nectar solutions (Without thickening agent) to get the final volume of 100ml in glass bottles. These glass bottles were kept under normal environmental condition for 7 days while observing at what level of gum, the layer separation is not taking place; which was at 15ml and 20ml for raw seed gum and CDD gum respectively.

2.5 Evaluation of organoleptic properties of prepared Fruit Nectar samples

Sensory evaluation was performed for three fresh Nectar samples prepared from raw Durian seed gum, CDD Durian seed gum and Xanthan gum using 10 member trained sensory panel. The panelists were served 30-35ml of prepared Nectar from each type and asked them to indicate their choice over a 5 point hedonic scale using a numerical number on five sensory stimuli namely color, taste, smell, thickness and overall acceptability. Data obtained from the sensory evaluation were analyzed using *Kruskal-wallis* nonparametric ANOVA in order to determine whether there is a significant difference between sensory stimuli of each Nectar solutions. To validate the outcome of each treatment, sensory profiles were drawn using the five sensory stimul

3. Result and Discussion

Scope of this study is to find out an alternative gum source to replace Xanthn gum used in fruit Nectar as a thickening agent with the gum extracted from Durian seed. Therefore, under mention studies pertaining to the research have been carried out.

3.1 Determination of a productive drying method to dry the Durian seed while preserving its gumming ability

Viscosity of raw durian seed gum obtained from three drying processes namely sun drying, hot air drying and cooling with dehumidified air drying is shown in figure 1.

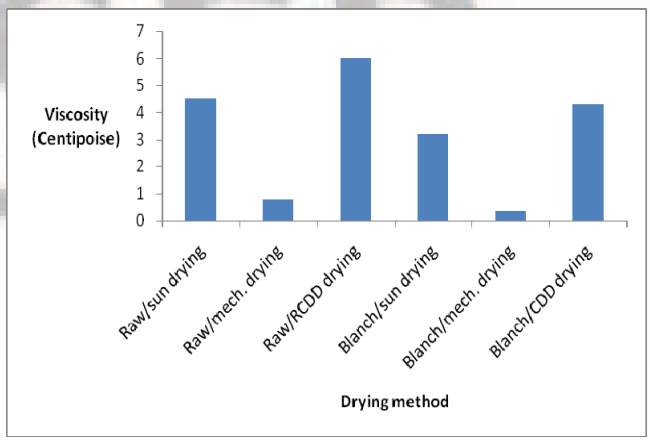

Figure 1: Viscosity of raw durian seed gum extract from three drying process

The graph in figure 1 clearly indicate that best drying method in preserving of Durian seed gum is cooling with dehumidifying drying process, because this drying method was capable to secure highest viscosity of 6 centipoises as against other drying processes. Reason for this consequence is low temperature drying. When durian seeds are dehydrated at high temperature, the main sugars responsible for forming of gum are denatured.

The main sugars in Durian seed gum are rhamnose, Galactose and glucose. However, major constituent in forming of gum in durian seed is L- rhamnose, which is a C-5 polysaccharide (Amiza et al., 2004). In general seed gums are galactomannans. For durian it is an exception. **Galactomannans** are polysaccharides consisting of a mannose backbone with galactose side groups. Galactomannans are often used in food products to increase the viscosity of the water phase.

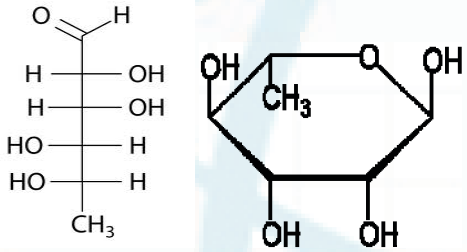

Figure 2: Structure of L-rhamnose

When rhamnose sugar contacts with the water, polysaccharide can form a structure by arresting water molecules. After arresting water molecules by C-5 sugar polysaccharide, a thick gel is formed. When temperature of the gel mass is increased, the viscosity is also gradually decreased. Reason for this phenomenon is that the gel mass gradually becomes weak due to incremental activity of water molecules in the gel mass. In the case of sun drying, which usually take place at moderately high temperature, preferably around 40-45^{0}C. Hence Durian seeds dried in the sun also having a moderately high- gum forming ability.

3.2 Determination of required gum concentration to prevent layer separation of fruit Nectar

The required gum content, obtained from fresh durian seed and CDD drying process to prevent layer separation of fruit Nectar was evaluated and results are given in table 1

Table 1: Layer separation of fruit Nectar at Different Durian gum concentration

Treatment	1	2	3	4	5	6
CDD gum (ml)	5	10	15	20	25	30
Layer separation	Occurred	Occurred	Occurred	No	No	No
Raw seed gum(ml)	5	10	15	20	25	30
Layer separation	Occurred	Occurred	No	No	No	No

It was observed that layer separation was occurred after 2 days in treatment 1, 2 and 3 of CDD gum incorporated fruit Nectar samples at 5ml, 10ml & 15ml respectively, while same consequence was occurred in treatment 1 and 2 of raw seed gum treatments at 5ml & 10ml respectively. Therefore, about 20ml of CDD gum should be incorporated into 80ml of Fruit Nectar sample in order to prevent layer separation. Nevertheless, seed powder obtained from CDD process is a viable option in preserving gum forming ability of Durian seed. Same sentiment has been expressed by Mishra et al., 2009 in drying of different types of gum bearing seeds.

3.3 Evaluation of organoleptic properties of prepared Fruit Nectar samples

Organoleptic properties of freshly prepared Nectar samples using raw seed gum, CDD gum and Xanthan gum with respect to five sensory stimuli namely smell, taste, color, thickness and over all acceptability were evaluated and results were analyzed using *Kruskal-Wallis* non parametric ANOVA. Result revealed that there was no significant difference between sensory stimuli of each treatment because calculated p values pertaining to the rank mean values are higher than 0.05 ($p > 0.05$) as given in table 2. Hence, Durian seed gum is a viable alternative as a thickening agent in preparation of fruit Nectar, particularly gum obtained from CDD treatment.

Table 2: Mean rank values of five sensory stimuli of three fruit Nectar

Treatment	*Color*	*Smell*	*Taste*	*Thickness*	*Over all acceptability*
Raw gum seed	19.8	17.8	15.5	19.3	19.5
CDD gum	14.7	16.7	15.5	16.7	14.6
Xanthan gum	12.1	12.0	15.5	10.5	12.5
p value	0.141	0.294	1.0	0.172	O.184

To further validate this conclusion, sensory profiles with respect to five sensory stimuli of three treatments were drawn using mean value of the response of the respondents which is given in figure 5.

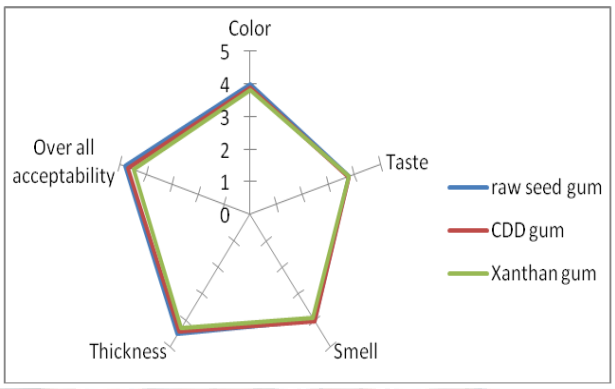

Figure 5: Sensory profiles of three nectar samples just after preparation

Sensory profiles also indicate that there is no difference between sensory stimuli of three Nectar samples prepared from fresh seed gum, CDD gum and Xanthan gum. Hence, durian seed gum can be used as a thickening agent in commercial scale fruit processing industry as expressed by Tabatababee and Mirhosseani, 2005.

4. Conclusion

Cooling with dehumidified drying method (CDD) was the best drying method in preserving of gum forming ability of Durian seeds. Viscosity of gum prepared by mixing of 5g of CDD seed powder in 100ml of ambient water equal to the viscosity of 6cp of Xanthan gum prepared at 0.5%. The layer separation problem of Fruit Nectar can be averted by using gum obtained from CDD process. Hence, Xanthan gum in fruit nectar can be substitute with the gum obtained from CDD process as a thickening agent. No layer separation was occurred in fruit Nectar sample prepared from CDD gum kept under refrigerator condition even after three months. Hence Durian seed gum is a viable option for Xanthan gum in preparing of fruit Nectar because it is cost effective compared to Xanthan gum, which is very expensive in the open market.

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