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Different Aspects Affecting To Production Of Dragon Fruit (*Hylocereus Undatus*) Nectar

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Abstract.

The fruits of *Hylocereus undatus* have greatly increased its popularity worldwide due to its attractive colours, sweet, juicy pleasant taste**.** It is one of the most popular commercial fruits available in Vietnam. In order to enhance its added value, this study focused on production and preservation of dragon fruit nectar. The effect of pH, sugar supplementation, temperature and time of pasteurization to sensory score of dragon fruit nectar; changes of total soluble solid, acidity and microbial load in dragon fruit nectar during storage were examined. Results showed that dragon fruit nectar had the best quality by adjusting at pH 4.2, sugar supplementation 8%, 95^{o}C in 1.0 minutes, storage at 4 ± 2 ºC in glass bottle.

Keywords: *Hylocereus undatus, supplementation, pasteurization, storage, nectar, acidity*

I. INTRODUCTION

Hylocereus undatus belongings to the family of Cactaceae. This fruit survived in the dry tropical climate and can withstand temperature as high as 40^{o}C (Ortizhernández and Carrillo-salazar, 2012) It is well known under the name of "dragon fruit" or "pitaya". There are three different species of Pitaya fruit which include *Hylocereus undatus* or white-pulp with red fruit extract Pitaya fruit.[1] The fruit of *Hylocereus undatus* is large in size, oval shape, weighing about 280-5060 grams, 33-36 cm diameter and 14-16 cm long. The fruit has delicate and sweet flesh with intense white color of the flesh and red-purple color of fruit extract.[2] The fruits often consumed fresh or make into juices, cordial, jams and ice cream, sherbets, yogurt, candy and pastries.[3, 4] It has a lot of tiny black seeds, which are rich in essential fatty acids.[5] The Hylocereus undatus fruit are rich in fiber, vitamins, calcium, phosphorus, magnesium, phytochemicals and antioxidants.[2, 6, 7, 8] Betanin, phyllocactin, hylocerenin, and betacyanin with 5–*O*-glycosides or 6-*O*-glycosides have been discovered in many species of the Cactaceae family.[9, 10] Phytochemical screening of the white dragon fruit showed the presence of triterpenoid, alkaloid, flavonoid and saponin.[11] *Hylocereus undatus* extract was found to decrease the duration of catalepsy significantly.[12] *Hylocereus undatus* fruit is also known to possess medicinal and pharmaceutical properties that could prevent diabetes, cancer and neutralizes toxins in body.[13] It is even helpful in reducing blood sugar levels in Type 2 diabetic patients.[14]

There were several studies mentioned to the processing and preservation of dragon fruit (*Hylocereus undatus).* The proximate composition of dragon fruit (*Hylocereus undatus*) was analyzed to develop dragon fruit jelly.[15] Studies on preparation and storage of jelly from dragon fruit (*Hylocereus undatus*) was examined.[16] Quality of pitaya fruit (*Hylocereus undatus*) as influenced by storage temperature and packaging was studied.[17] Production of a novel fruit-yoghurt using dragon fruit (*Hylocereus undatus* L.).[18] Effects of blanching and drying on fber rich powder from pitaya (*Hylocereus undatus*) peel was examined.[19] The albedo powder of dragon fruit could be used for food coloring.[20] The rheological behavior of reconstituted spray-dried mucilage isolated from the cladodes of pitahaya (*Hylocereus undatus*) was examined.[21] A research aimed to investigate different factors influencing on the production of dragon fruit wine.[22] A study investigated the use of heat treatments for postharvest rot control on dragon fruit.[23]

Dragon fruit (*Hylocereus undatus* is an interested agricultural product since its antioxidative activity from its fruit pigments, betalains group. In order divesify different products from dragon fruit (*Hylocereus undatus),* objective of this search focused on the effect of pH, sugar supplementation, temperature and time of cooking to sensory score of dragon fruit nectar; changes of total soluble solid, acidity and microbial load in dragon fruit nectar during storage.

II. MATERIALS AND METHOD

2.1 Material

We collected dragon fruit (*Hylocereus undatus)* fruits in Tien Giang province, Vietnam. They must be cultivated following VietGAP to ensure food safety. After harvesting, they must be conveyed to laboratory within 4 hours for experiments. They were washed thoroughly under tap water to remove dirt, dust and adhered unwanted material. Besides dragon fruitp (*Hylocereus undatus)* we also used other materials during the research such as sugar, citric acid. Lab utensils and equipments included cooker, refactometer, digital weight balance, refrigerator, grinder, pH meter, thermometer.

Figure 1. White dragon fruit (*Hylocereus undatus)*

2.2 Researching procedure

2.2.1 Effect of pH during pasteurization to sensory score of Hylocereus undatus nectar

Dragon fruit pulp was finely scrubed, measured pH. The pH of scrubbed dragon fruitp will be adjusted by citric acid in 4 different levels 4.0, 4.1, 4.2 and 4.3. All samples were blanched at 90^{o}C in 1.5 minutes. The appropriate pH for pasteurization was based on sensory evaluation.

2.2.2 Effect of sugar supplementation to sensory score of Hylocereus undatus nectar

Dragon fruit pulp was finely scrubed, measured pH. The pH of scrubbed dragon fruitp will be adjusted by citric acid to 4.2. Sugar was added at different ratio (4%, 6%, 8%, 10%). All samples were blanched at 90^{o}C, 1.5 minutes. The appropriate sugar for pasteurization was based on sensory evaluation.

2.2.3 Effect of temperature and time of pasteurization to sensory score of Hylocereus undatus nectar

Dragon fruit pulp was finely scrubed, measured pH. The pH of scrubbed dragon fruitp will be adjusted by citric acid to 4.2. Sugar was added at 8%. All samples were blanched at different condition (100^{o}C, 0.5 minute; 95^{o}C, 1.0 minutes; 90^{o}C, 1.5 minutes; 85^{o}C, 2.0 minutes. The appropriate temperature and time for pasteurization was based on sensory evaluation.

2.2.4 Effect of storage condition to jam quality

The glass bottles containing dragon fruit nectar after cooling were stored for 3 months at both ambient (28 ± 2 ^{o}C) and refrigerated temperature (4 ± 2 ^{o}C). The microbial load (*coliform*, cfu/ml), organoleptic evaluation of stored dragon fruit nectar were carried out at an interval of 0, 30, 60, 90 day's storage.

2.3 Physico-chemical and biological analysis

Moisture was estimated in dragon fruit juice by AOAC (2005). The titratable acidity was determined by the titrimetic method. The ascorbic acid content in the products was estimated by titrimetic method. Total soluble solid (TSS) was determined with the help of refractometer AOAC (1990). Panelists were required to evaluate the odour, colour, taste, sweetness and overall acceptance using the 9-point hedonic scale (1 = dislike extremely, 9 = like extremely). 3M-Petrilm was used to analyze *Coliform* (cfu/ml).

2.4 Statistical analysis

The experiments were run in triplicate with three different lots of samples. Data were subjected to analysis of variance (ANOVA) and mean comparison was carried out using Duncan's multiple range test (DMRT) Statistical analysis was performed by the Startgraphics.

III. Result & Discussion

3.1 Nutritional composition of dragon fruit (*Hylocereus undatus)* juice

Nutritional composition of *Hylocereus undatus* juice was examined. Results were mentioned in table 1. These findings were noted that this fruit had high content of soluble solid as well as ascorbic acid.

Table 1. Nutritional composition of *Hylocereus undatus* juice

Parameter	Moisture (%)	Titratable acidity (%)	TSS (^{o}Brix)	Ascorbic acid (mg/100g)
Value	83.68±0.03	0.54±0.02	12.57±0.00	11.29±0.01

Note: the values were expressed as the mean of three repetitions;

The edible part of dragon fruit (64.50 % of total fruit wt.) contains moisture 82.5-83 %, protein 0.16-0.23 %, fat 0.21-0.61 %, calcium 6.3-8.8 mg, phosphorus 30.2-36.1 mg, iron 0.5-0.61 mg, vitamin-C 8-9 mg. It also contains nutrients, such as carbohydrate, flavonoid, thiamine, niacin, pyridoxine, glucose, and polyphenol.[21] The dragon fruit contains beta-carotene, lycopene and vitamin E, with average concentrations of 1.4 mg/100 g, 3.4 mg/100 g and 0.26 mg/100 g of edible portion, respectively.[25]

3.2 Effect of pH during pasteurization to sensory score of dragon fruit (*Hylocereus undatus)* nectar

Dragon fruit pulp was finely scrubed, measured pH. The pH of scrubbed dragon fruitp will be adjusted by citric acid in 4 different levels 4.0, 4.1, 4.2 and 4.3. All samples were blanched at 90^{o}C in 1.0 minutes. The appropriate pH for pasteurization was selected which was based on sensory evaluation. Results were depicted in table 2. From table 2, dragon fruit nectar had the best sensory score at pH 4.2 so this value was selected for further experiment.

Table 2. Effect of pH to sensory score of dragon fruit nectar

pH	4.0	4.1	4.2	4.3
Sensory score	4.20±0.02^d	5.79±0.00^c	7.22±0.02^a	6.25±0.03^b

Note: the values were expressed as the mean of three repetitions; the same characters (denoted above), the difference between them was not significant (α = 5%).

An experimental study aimed to investigate antioxidants of the red dragon pulp jelly and the red dragon juice jelly mixing at the temperature 60°C, 70°C and 80°C, using the DPPH assay. Antioxidant levels between the red dragon pulp jelly and the red dragon juice jelly were compared at the same temperature. Consequently, the sensory testing of the product was conducted.The results revealed that, at the temperature 60°C, 70°C and 80°C, the antioxidants in red dragon pulp jelly were 79.19%, 78.40%, and 72.77%, respectively, and the antioxidants in red dragon juice jelly were 57.59%, 57.12%, and 54.30%, respectively. Comparing at the same temperature, the red dragon pulp jelly contained higher antioxidants than the red dragon juice jelly statistically significant ($p < 0.05$). The highest antioxidant of each formula was the jelly mixed at the temperature 60°C. The results of sensory evaluation including color, smell, flavor and overall acceptability were at moderate level. The optimum temperature used to make the red dragon jelly is 60°C because red dragon jelly will be contained highly antioxidant activity.[26]

3.3 Effect of sugar supplementation to sensory score of *Hylocereus undatus* nectar

Dragon fruit pulp was finely scrubed, measured pH. The pH of scrubbed dragon fruitp will be adjusted by citric acid to 4.2. Sugar was added at different ratio (4%, 6%, 8%, 10%). All samples were blanched at 90^{o}C, 1.5 minutes. The appropriate sugar for pasteurization was selected which was based on sensory evaluation. Results were depicted in table 3. From table 3, dragon fruit had the best sensory score at 6% sugar supplementation so this value was selected for further experiment.

Table 3. Effect of sugar supplementation to sensory score of dragon fruit nectar

Sugar addition (%)	4	6	8	10
Sensory score	7.03±0.02^{d}	7.15±0.00^{c}	7.76±0.03^{a}	7.29±0.01^{b}

Note: the values were expressed as the mean of three repetitions; the same characters (denoted above), the difference between them was not significant (α = 5%).

One research developed nectar based on papaya pulp and passion fruit juice, enriched with the vitamin C present in acerola pulp, optimizing the formulation using sensory consumer tests and a response surface statistical methodology. The nectar produced with 37.5% papaya pulp, 7.5% passion fruit juice, and 5.0% acerola pulp, added of 15% sucrose.[27]

3.4 Effect of temperature and time of pasteurization to sensory score of *Hylocereus undatus* nectar

Dragon fruit pulp was finely scrubed, measured pH. The pH of scrubbed dragon fruitp will be adjusted by citric acid to 4.2. Sugar was added at 8%. All samples were blanched at different condition (100^{o}C, 0.5 minutes; 95^{o}C, 1.0 minutes; 90^{o}C, 1.5 minutes; 85^{o}C, 2.0 minutes. The appropriate temperature and time for pasteurization were selected which was based on sensory evaluation. Results were depicted in table 4. From table 4, dragon fruit nectar had the best sensory score by pasteurization at 95^{o}C, 1.0 minutes so these values were selected for further experiment.

Table 4. Effect of temperature and time of pasteurization to sensory score of dragon fruit nectar

Pasteurization	100^{o}C, 0.5 minutes	95^{o}C, 1.0 minutes	90^{o}C, 1.5 minutes	85^{o}C, 2.0 minutes
Sensory score	7.13±0.02^{d}	8.71±0.00^{a}	7.94±0.01^{b}	7.57±0.03^{c}

Note: the values were expressed as the mean of three repetitions; the same characters (denoted above), the difference between them was not significant (α = 5%).

A research was analyzed for its nutritional composition with standard method. The three samples contained more or less similar nutritional compositions. The products were stored at ambient temperature (27 ^{o}C to 34^{o}C) for a period of 6 months and quality parameters were assessed. During storage the changes in color, flavor, odor, TSS and pH was observed. No special change of ingredients was found during first 4 months of storage and a little change of pH was observed after 4th months. A taste panel consisting of 10 panelists adjudged the acceptability of the samples. The consumer preferences were measured by statistical analysis. Among the samples jelly containing 1.5% pectin secured the highest score for color, flavor, turbidity and overall acceptability.[15]

3.5 Effect of storage condition to nectar quality

The glass bottles containing dragon fruit nectar after cooling were stored for 3 months at both ambient (28 ± 2 ºC) and refrigerated temperature (4 ± 2 ºC). The microbial load (*coliform*, cfu/ml), organoleptic evaluation of stored dragon fruit nectar were carried out at an interval of 0, 30, 60, 90 day's storage. From table 5, dragon fruit nectar had the best sensory score by preservation at 4 ± 2 ºC.

Table 5. Effect of storage condition to dragon fruit nectar quality

Storage (days)	Sensory score		*Coliform* (cfu/g)	
	Ambient (28 ± 2 ºC) temperature	Refrigerated (4 ± 2 ºC) temperature	Ambient (28 ± 2 ºC) temperature	Refrigerated (4 ± 2 ºC) temperature
0	8.71±0.00^{a}	8.71±0.00^{a}	1.9 x 10^{1}	1.9 x 10^{1}
30	8.55±0.03^{b}	8.68±0.03^{b}	5.7 x 10^{1}	2.0 x 10^{1}
60	8.42±0.02^{bc}	8.65±0.00^{c}	7.3 x 10^{1}	2.6 x 10^{1}
90	8.36±0.00^{c}	8.61±0.01^{d}	8.8 x 10^{1}	3.2 x 10^{1}

Note: the values were expressed as the mean of three repetitions; the same characters (denoted above), the difference between them was not significant (α = 5%).

The prepared jelly from 1000 ml fruit extract, 550 g sugar and 11 g of pectin was found to be best during organoleptic quality. And this was an ideal recipe for excellent quality of jelly making from dragon fruits. The prepared jelly was bottled in pasteurized PET bottles (500 ml capacity) and stored at ambient (30 ± 2 ºC) as well refrigerator (5 ± 2 ºC) temperature conditions upto 90 days. During storage study of jelly TSS, titratable acidity, reducing sugars and total sugars were increased, whereas moisture content, ascorbic acid and organoleptic quality was slightly decreased with increased storage period. While microbial growth was slightly increased at both storage conditions. The microbial growth in jelly was under the limit up to the end of storage period. The prepared jelly was safe and suitable for consumption up to 3 months.[16]

IV. CONCLUSION

There are three varieties of pitaya namely white-flesh pitaya with yellow peel (*Selenicereus megalathus*), white-flesh pitaya with red peel (*Hylocereus undatus*) and red-flesh pitaya with red peel (*Hylocereus polyrhizus*). *Hylocereus undatus* are being prevailed globally because of its rich source of polyphenolic components and their antioxidant activity. A wide ranging of phytochemicals of betalains, polyphenolic compounds and carotenoids are discovered to possess chemo-protective properties against oxidant stress in the body as well as maintain optimum equilibrium between antioxidants and oxidants for the enhancement of human health. Dragon fruit has potential for use as a source of functional ingredients to provide

nutrients that may prevent nutrition related diseases and improve physical and mental well-being of the consumers. We have successfully found appropriate condition for production and preservation of dragon fruit nectar. By this approach, there is a possibility to enhance added value of dragon fruit as well as contribute to the poverty reduction and hunger elimination for farmer in the Vietnam.

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