http://dx.doi.org/10.22161/ijeab/3.5.49 ISSN: 2456-1878

Processing and Development of Dragon Fruit Wine

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***Abstract*—** *The research project was conducted to establish protocols in the production of dragon fruit wine from unmarketable and surplus harvest of dragon fruits. The products were characterized in terms of physico-chemical and sensory properties. Acceptable semi-sweet dragon fruit wine was produced from fermenting must with 250g sugar and 2t yeast (Saccharomyces cerevisiae) per kg of dragon fruit. Dragon fruit wine produced has moderately clear, moderately brilliant yellow color, moderately complex detectable aroma, fair texture, good balance of a number of detectable flavors and smooth and rich taste that lingers in the mouth after swallowing. The dragon fruit wine was given unanimous acceptable ratings without any negative acceptable rating based on the results of evaluation using 100 consumer-type judges.*

***Keywords*— Dragon fruit, physico-chemical, properties, sensory, wine.**

I. INTRODUCTION

Dragon fruit (*Hylocereus undatus Haw. Britton & Rose)*, also known as pitaya, has been successfully grown in the Philippines and has an average annual production of 25 tons /hectare. The seasonality of fruiting and high rate of loss due to peel damage in dragon fruit are the primary factors which may hinder its development and increased popularity in the country. To maximize the utilization of dragon fruits during peak season, July to October, and to utilize peel-damaged dragon fruits, processing technologies for dragon fruit have been generated [1],[2]. Among the products developed from the fruit are the dragon fruit jam, jelly, juice and puree, which are currently undergoing pilot testing [2].

Being a tropical country, there are wide variety of fruits that are produced in the Philippines, most of which are seasonal which results in oversupply and under utilization during peak season. During such season of abundance, prices for the particular fruit are low which suggests timely processing and preservation of the fruit. Once processed, fruits can be made available even during off-season, especially in areas where supply may be limited or where the fruits are not available at all. Processing of peel-damaged dragon fruits also convert non-marketable raw materials to high-value product like wine .

For centuries, the Philippines had its own tradition of fermenting and drinking wines which are produced in different parts of the country. As there is an abundance of a number of readily available tropical fruits all year round, a variety of fruit wines produced either for home consumption or commercial purposes may be found everywhere, suggesting that Philippine fruit wine industry is highly feasible. In addition, Filipinos have learned and develop the culture of wine drinking, specifically, for high-end members of the society.

Colored fruit wines are gaining much popularity because of their powerful antioxidant activity due to the naturally-occurring pigments. In addition, the pigments in colored fruit wines have potential health effects against cancer, aging, neurological diseases, inflammation, diabetes and bacterial infections. The exotic and well-blended sweet, sour and alcoholic tastes of fruit wine easily curb one's appetite.

In addition to the developed dragon fruit products, wine is considered to be a high-value product which may be produced from dragon fruits. Utilization of dragon fruit in fruit wines can possibly stimulate development of local wine manufacturing and may help reduce importation of alcoholic beverages.

II. MATERIALS AND METHODS

2.1 Research Design

Fully mature peel-damaged but not rotten fruits supplied by Silan Agri Farm, Philippines were used in the production of wine.

http://dx.doi.org/10.22161/ijeab/3.5.48 ISSN: 2456-1878

To determine fruit to sugar to yeast ratio, the experiment was arranged in a 4 x 3 factorial experiment in Completely Randomized Design (CRD) with level of sugar as Factor A and different amounts of yeast as factor B. The experimental units were replicated three times in storage after single preparation.

Factor A, level of sugar (LS) per kilogram dragon fruit

LS1 = 0.25 kg
LS2 = 0.50 kg
LS3 = 0.75 kg
LS4 = 1.0 kg

Factor B, Amount of Yeast (AY) per kilogram dragon fruit

AY1 = 1 tsp
AY2 = 2 tsp
AY3 = 3 tsp

The following treatment combinations were used:

T		LS	Sugar, kg		AY	Yeast, tsp
T1	=	LS1	0.25	x	AY1	1
T2	=	LS1	0.25	x	AY2	1
T3	=	LS1	0.25	x	AY3	1
T4	=	LS2	0.50	x	AY1	2
T5	=	LS2	0.50	x	AY2	2
T6	=	LS2	0.50	x	AY3	2
T7	=	LS3	0.75	x	AY1	3
T8	=	LS3	0.75	x	AY2	3
T9	=	LS3	0.75	x	AY3	3
T10	=	LS4	1.00	x	AY1	4
T11	=	LS4	1.00	x	AY2	4
T12	=	LS4	1.00	x	AY3	4

2.2 Processing of Dragon Fruit Wine

Four kilos of dragon fruits per treatment were used. Fruits were washed in running water and drained in stackable plastic baskets. Each fruit was cut, peel on, into quarters lengthwise and pulp was cut into 1-inch thick slices crosswise before finally peeling off, separating the sliced cubes in a container. Prior to blending, the pulp was diluted with water at 1:2 pulp to water ratio. Pulp was blended until homogeneous mixture is achieved.

The prepared must was allowed to stand for 30 minutes to let pulp to float over juice. The juice was extracted by scooping and separating the pulp. Sugar was added to the extracted juice according to treatments.

Five milliliters of 10% sodium metabisulfite per gallon of must was added to sterilize the mixture, allowing 24 hours holding time. Dry yeast was added according to treatments. Fermentation of must with cotton plug cover was done for 24 hours to allow yeast incubation and multiplication. Fermentation bottles were then closed with fermentation locks. Fermentation was allowed to proceed for 3-4 weeks, until gas formation ceased.

Wine was harvested by siphoning carefully, filtered and clarified, transferred to ageing bottles and allowed to age for 3 months.

Wine was packed in clear wine bottles and pasteurized for 15 min at 75°C.

2.3 Product Evaluation

Soluble solids and alcohol content of dragon fruit wine samples were determined right after fermentation. Total soluble solid content was determined using refractometer and expressed in °Brix. Total acidity was determined by titration method and alcohol content of the distillate was measured using a hydrometer.

Sensory properties of the dragon fruit wine were determined by a trained panel. The wine samples were presented in shot glasses to the panel. Unstructured 5-point scale for blind testing of wines was used (Table 1).

Table.1: Unstructured score sheet for blind testing of wines [3]

ATTRIBUTE	SCORE				
	5	4	3	2	1
Appearance	Clear, appropriate color, brilliance, no off colors				Cloudy, off colors
Aroma	Complex, many detectable aromas, intense				Little or no aroma, off aromas
Body	Perfect texture and weight feel in the mouth				Too little or too much texture or weight feel in the mouth
Taste	Good balance, structure, several flavors detected				Little balance and structure, few flavors
Finish	Flavors linger after swallowing, smooth and rich after taste				Taste and flavors end abruptly, no after taste

http://dx.doi.org/10.22161/ijeab/3.5.48 *ISSN: 2456-1878*

Consumer acceptability of wine samples was evaluated by 100 consumer-type panel using the following scale:

_____ Highly acceptable
_____ Moderately acceptable
_____ Acceptable
_____ Slightly acceptable
_____ Unacceptable

III. RESULTS AND DISCUSSION

3.1 Process Standardization

Based on wine classification [3], fermentation of one kilo of the fruit with the addition of 250g sugar produced semi-sweet wine while addition of 500 g sugar produced sweet wine (Table 2).

Further reduction of added sugar below 250g/kg fruit may indicate that it can probably produce a dry wine, 16-19% alcohol, an alcohol content which is considered much too high for a table wine [4]. At low initial sugar level, the yeast assumes optimum condition for their activity without any inhibition due to very fast conversion rate of sugar to alcohol as a result of very high initial sugar content. At this condition the yeasts can efficiently and completely convert the low initial sugar content into alcohol. The resulting wine should, therefore, contain high alcohol and negligible residual sugar which are the properties of dry wines.

Increasing the initial sugar content of the fermenting must to 750g and 1 kg sugar resulted to a fermented beverage which did not fall to any wine classification due to the resulting very high residual sugar and low alcohol content. The drink was very sweet, hence, was not be classified as wine.

Bread yeast tolerate up to about 5% alcohol. Beyond this alcohol level the yeast cannot continue fermentation. The level of alcohol tolerance by yeast varies from 5% to about 21% depending on yeast strain used in the alcoholic fermentation.

It can also be observed that addition of 2t yeast per kilo of the fermenting must consistently produced wine with both higher alcohol content and soluble solids (T_2 and T_4). This indicates that although alcohol production is high, the fruit wine was able to maintain high sugar content to provide higher flavor intensity to the wine.

Low alcohol production in T_7 to T_{12} can be due to the very high initial sugar concentration that could have inhibited yeast activity during incubation and actual alcoholic fermentation. Very small amount of the sugars was converted to alcohol, hence, very sweet wines, associated to low quality wines, were produced.

Table.2: Wine classification of the different treatments based on soluble solid and alcohol content

TREATMENT	DESCRIPTION (Sugar:yeast Per kg pulp)	SOLUBLE SOLIDS (ºBrix)	ALCOHOL CONTENT (% v/v)	WINE CLASSIFICATION
T1	250g: 1t	7	14.96	Semi-sweet*
T2	250g: 2t	7.1	15.36	Semi-sweet*
T3	250g: 3t	7	13.8	Semi-sweet*
T4	500g: 1t	20	10.35	Sweet**
T5	500g: 2t	25	12.82	Sweet**
T6	500g: 3t	17	11.36	Sweet**
T7	750g: 1t	31.2	6.39	Low quality
T8	750g: 2t	34	5.36	Low quality
T9	750g: 3t	35	5.6	Low quality
T10	1kg: 1t	36	5.04	Low quality
T11	1kg: 2t	36	4.9	Low quality
T12	1kg: 3t	36	1.76	Low quality

* (14-16% alcohol) [4]
** (10-13% alcohol) with residual sugar [4]

3.1.2. Standardized Process

A standard process for the production of dragon fruit wine is described by this study (Table 3).

Washing of fruits should be done with running water with agitation to loosen and remove dirt, soil, dry scales and peels. This can significantly prevent contamination of pulp with microorganisms from the peels. Quartering and slicing of fruits before peeling also prevents further contamination.

Dilution of pulp with water facilitates blending and juice extraction and at the same time provides enough solvent to facilitate dissolving of added sugar to the juice.

Standing of blended juice for 30 min facilitated juice recovery by allowing the pulp to float for easy removal from the mixture.

For the production of semi-sweet dragon fruit wine, 250 g of sugar and 2 t of yeasts must be added per kilo of pulp used. For the production of sweet wine, 500 g of sugar and 2 t yeast must be used.

Addition of five mL of 10% metabisulfite is enough to sterilize a gallon of must in the fermentation jar. This is important to make sure that there would be no contaminant during fermentation. Contaminants may compete with the desirable yeasts in terms of nutritional requirements and other conditions which may result to inefficient alcoholic fermentation.

Upon inoculation, the yeasts must be given initial aerobic conditions for 24 hrs to allow incubation and yeast multiplication. Thereafter, anaerobic condition must be provided to focus yeast activity on converting sugar to alcohol rather than increasing the number of yeast cells. Anaerobic condition is provided by using fermentation locks which allow release of gases produced by alcoholic

http://dx.doi.org/10.22161/ijeab/3.5.48 ISSN: 2456-1878

fermentation but at the same time preventing entry of oxygen.

Wine is harvested by siphoning to prevent sediments form being disturbed so that clearer wine can be recovered. Further filtration produces clear, brilliant wines. The wines are then transferred to another glass container for ageing, a process for aroma and flavor development.

Table.3: Process flow and specifications used in the preparation of dragon fruit wine

PROCESS FLOW	SPECIFICATION
Washing	Wash with running tap water. Drain in stackable plastic baskets
↓	
Slicing and Peeling	Cut into quarters lengthwise. Cut across quarter to 1 inch slices. Separate pulp slices from peels and place in a container.
↓	
Blending	1 part pulp: 2 parts water, 15 sec blending or until mixture is homogenous.
↓	
Juice extraction	Stand blended pulp for 30 min – 1hr to allow pulp to float over juice and then scoop the pulp.
↓	
Addition of sugar	250 g/ L for semi-sweet dragon fruit wine 500 g/ L for sweet wine
↓	
Yeast activation	2 t yeast per kg dragon fruit, 24 hr incubation
↓	
Must preparation	Add 5 mL of 10% sodium metabisulfite per gallon of must in empty fermentation bottle, pour the must half full, stand for 24 hrs
↓	
Addition of starter to must	Ferment covered with cotton plug for 1 day at 25-30oC.
↓	
Fermentation	Ferment 3-4 weeks with fermentation lock in dark fermentation room
↓	
Harvesting	Siphon wine using tygon tubing, filter
↓	
Yeast inactivation	Add 5 mL of 10% sodium metabisulfite per gallon of wine
↓	
Clarifying	Use gelatin
↓	
Ageing	3-4 months
↓	
Bottling	Clean wine bottles, cover with cork and cap seal
↓	
Labeling	

3.2 **Sensory Properties of Dragon Fruit Wine**

No significant differences were observed among the semi-sweet and sweet wines in terms of the sensory attributes evaluated (Table 4). The wine samples were characterized by moderately clear, moderately brilliant yellow color, moderately complex detectable aroma, fair texture, good balance of a number of detectable flavors and smooth and rich taste that lingers in the mouth after swallowing.

Table.4: Mean sensory scores for dragon fruit wine samples

ATTRIBUTE	MEAN SCORE*						AVE
	T_1	T_2	T_3	T_4	T_5	T_6	
appearance	3.3	3.4	3.2	3.4	3.3	3.2	3.3
Aroma	4.2	4.3	4.3	4.3	4.4	4.3	4.3
Body	4.2	4.2	4.4	4.1	4.3	4.2	4.2
Taste	4.7	4.6	4.7	4.8	4.6	4.7	4.7
Finish	4.6	4.7	4.6	4.7	4.8	4.7	4.7

*no significant difference at 5% probability level

Equivalency of scores

appearance: 5 = clear, appropriate color, brilliance, no off colors
1 = cloudy, off colors

aroma: 5 = complex , many detectable aromas , intense
1 = little or no aroma, off aroma

body: 5 = perfect texture & weight in the mouth
1 = too little or too much texture or weight on feel in mouth

taste: 5 = good balance, structure, several flavors detected
1 = little balance and structure, few flavors

finish: 5 = flavors lingers after swallowing, smooth and rich taste
1 = taste and flavors end abruptly , no after taste

3.3 Consumer Acceptability

The consumer acceptability of the dragon fruit wine sample can be considered very promising. The relatively new product received unanimous acceptable ratings without any negative acceptable rating based on the evaluation results of 100 consumer-type judges. The relatively high percentage of evaluators who considered the wine sample as moderately acceptable and highly acceptable can confirm the market potential of the dragon fruit wine (Table 5).

http://dx.doi.org/10.22161/ijeab/3.5.48 *ISSN: 2456-1878*

Table.5: Frequency distribution of scores for general acceptability of dragon fruit wine

ACCEPTABILITY LEVEL	FREQUENCY	PERCENT
highly acceptable	35	35
moderately acceptable	60	60
acceptable	5	5
slightly unacceptable		
highly unacceptable		
TOTAL	100	100
Mean score for acceptability	4.3	

Rating scale = 5 - highly acceptable to 1- highly unacceptable

IV. SUMMARY AND CONCLUSION

Protocols for the production of acceptable dragon fruit wine was established. Initial sugar content of the fermenting must at 250g and use of 2 t yeast per kg of fruit are required in the production of acceptable semi-sweet dragon fruit wine. The use of 500 g sugar and 2 t yeast is required in the production of acceptable sweet dragon fruit wine.

Dragon fruit wines produced by the generated technology has moderately clear, moderately brilliant yellow color, moderately complex detectable aroma, fair texture, good balance of a number of detectable flavors and smooth and rich taste that lingers in the mouth after swallowing. The dragon fruit wines have unanimous acceptable ratings without any negative acceptable rating based on the evaluation results of 100 consumer-type judges.

V. RECOMMENDATION

The generated technology for the production of dragon fruit wine developed new product which are proven to have high consumer acceptability and can provide additional income. Since the study was conducted on a laboratory scale, it is being recommended that pilot testing and studies for process mechanization for dragon fruit wine be conducted prior to commercialization. In addition, further nutritional evaluation of the products should be conducted for nutritional labeling. Also, health benefits of dragon fruit should be verified to support any medicinal of health promotion claims which can be used later as marketing and promotion tools.

REFERENCES

[1] T. F. Tepora, E. DA. Vida, and F. N. Dimero. 2008. "Development of Dragon Fruit Products: Jam, Jelly, Juice and Puree." Unpublished research. 2008. Cavite State University, Indang, Cavite, Philippines

[2] T.F. Tepora, E.DA. Vida, and F. N. Dimero. 2009. "Pilot testing of Dragon Fruit Products: Jam, Jelly, Juice and Puree." Unpublished paper. Cavite State University, Indang, Cavite, Philippines

[3] Wine Country Getaways www.winecountrygetaways.con

[4] Keller, J.B. 2000. Pitaya Wine. http://winemaking.jackeller.net. (viewed 02/04/2009)