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Development and Characterization of Pili (Canarium ovatum Engl.) Wine

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ABSTRACT
This study aimed to estimate the potential of pili (*Canarium ovatum* L.) pomace as substrate for the production of fruit wine. The pili fruit wine was characterized in terms of physico-chemical characteristics (pH, TSS and alcohol content) and consumer acceptability level (appearance, taste, aroma, mouthfeel and overall acceptability). It was produced using 5%, 10% and 15% pili pomace as Treatment 1, 2 and 3, respectively. Results showed increase in alcohol content and TSS with increase in concentration of pili pomace while there is decrease in pH as concentration of pili pomace is increased. It was also observed that there is a gradual decrease in total soluble solids and pH and a gradual increase in alcohol content as fermentation time proceeded. Thirty (30) sensory panelists rated pili fruit wine as highly acceptable as commercial wine. Results of the consumer acceptability survey of the pili wine obtained an average rating of 7.71 in overall acceptability which can be interpreted as high liking for the product. Except for appearance, consumer acceptability results of pili fruit wine did not show any significant differences (at 0.05 significance level) in terms of taste, aroma, mouthfeel and overall acceptability when compared to commercial wine.

Keywords: pili fruit wine, canarium ovatum engl., physico-chemical characteristics, consumer acceptability level

I. INTRODUCTION

Canarium ovatum, pili, is a tree that belongs to the genus *Canarium*, family *Burseraceae*. *C. ovatum* is endemic to the Philippines. They are commercially planted in the Philippines for their edible nuts.

C. ovatum fruit is classified as a drupe, usually 4-7 cm (1.6-2.8 in) in length, 2.3-3.8 cm (0.91-1.50 in) wide, and 15.7-45.7 g in weight. The skin (exocarp) is even, thin, glossy, and transforms to purplish black from green when the fruit matures; the pulp (mesocarp) is filamentous, pulpy, and greenish yellow in color, and the hard shell (endocarp) within cushions a dicotyledonous embryo (Segura, 2008).

The species is considered a primary agricultural product of the Bicol region, the principal venue of the pili nut market. In the Philippines, commercial centers are located in the Bicol region especially in the provinces of Sorsogon, Albay, and Camarines Sur; in Southern Tagalog, and in Eastern Visayas. In 1977, the Philippines sold overseas approximately 3.8 tons of pili to Guam and Australia.

In the last few years, the Department of Agriculture pointed out pili as a crop deserving of more intensive research and development activities. Possibilities exist for the emergence of pili as a major crop export that would contend well in the international market. Because of this, several development programs were invoked to aid the Bicol region in the production and processing of pili products. However, what is yet untapped is the mass utilization of the discarded pili pomace.

Utilization of pili pomace in the manufacture of fruit wines can possibly revitalize the local wine industry in the region and may help lessen importation of alcoholic beverages. Moreover, central to its realization is the answer to the issue of usability and versatility of pili which this paper also aims to address.

II. METHODOLOGY

The study employed developmental, quantitative and experimental method of research. It was developmental since it aimed to develop a product utilizing pili abundant in the locality. It was quantitative because the study attempted to quantify the result of the consumer acceptability of the product. It employed experimental method of research since different treatments/formulations were utilized in the production of the product.

The Research and Development Services Building at Catanduanes State University in Calatagan, Virac, Catanduanes was the site of the experiment.

The pili (*Canarium ovatum* Engl.) samples that were collected were from Catanduanes and were collected from only one (1) pili tree. The study utilized three (3) different treatments, namely:

T1- using 5% pili pomace
T2- using 10% pili pomace
T3- using 15% pili pomace

Sensory testing employed thirty (30) sensory panelists. A 9-point hedonic scale was used as sensory evaluation tool for the finished product.

Physico-chemical characteristics of the treatments were analyzed in terms of TSS, pH and alcohol content. Analyses were done in triplicates. Sensory evaluation was also conducted to determine the level of acceptability of the different treatments in terms of appearance, taste, aroma, mouthfeel and overall acceptability when compared to commercial wine.

III. RESULTS AND DISCUSSION

Collected ripe pili (*Canarium ovatum* Engl.) samples were tempered. Pili pomace was then collected and weighed using a top loading balance. Corresponding volume of distilled water and brown sugar were measured using a graduated cylinder and top loading balance, respectively. The mixture was then heated until the mixture reaches 60°C. Temperature was monitored using a food thermometer. Mixture was cooled until it reaches 40°C and 1 tablespoon of wine yeast was added to the mixture. Mixture was covered with cheesecloth for about 2 hours or until the mixture became foamy. Pili pomace was then added to the mixture and allowed to initially aerobically ferment for one (1) day. The mixture was then strained using a cheesecloth and the resulting liquid was transferred to a sanitized fermentation jar with fermentation lock. It was then allowed to anaerobically ferment for 4 months. Once the wine has clarified, the finished product was transferred in sterilized wine bottles and sealed. The entire process of the study is summarized in Figure 1.

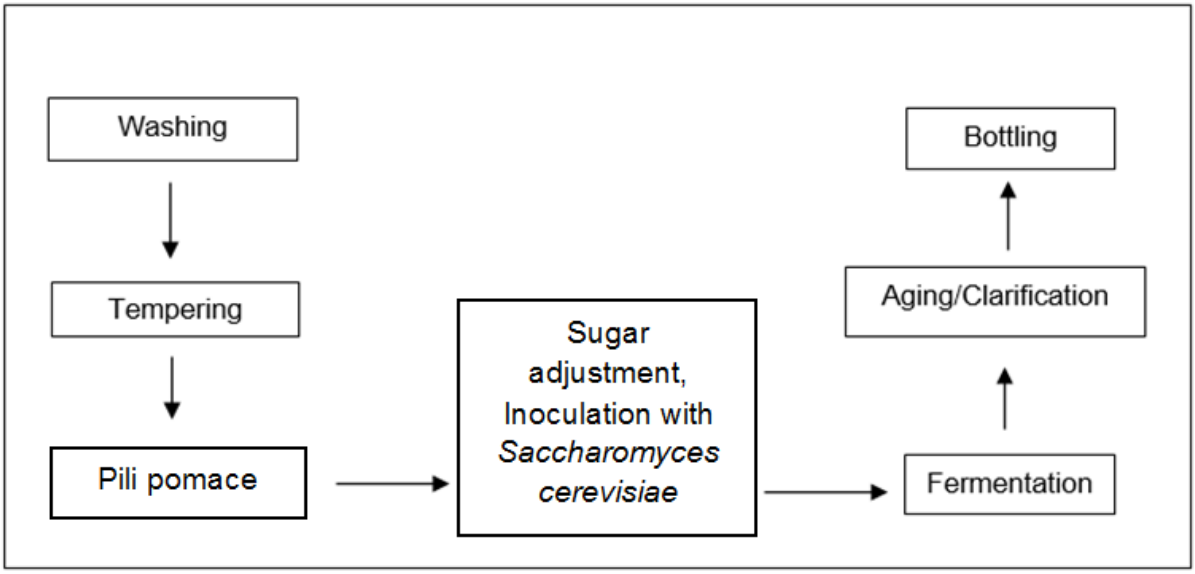

Figure 1: Process flow of the study

3.1 Physico-Chemical Analysis

3.1.1 Total Soluble Solids (TSS)

TSS was measured using a refractometer (Atago 2351 Master 53a-Handheld Refractometer). Distilled water was first used to clean the surface of the refractometer, while the surface was dried using a lint-free cloth. A few drops of pili wine were placed on the lens of the refractometer and were allowed sufficient time for temperature of the samples to equilibriate. The refractometer was then held against a light source and the graduated scale where the dark/light interface crosses is read to obtain the total soluble solids (TSS) of the wine.

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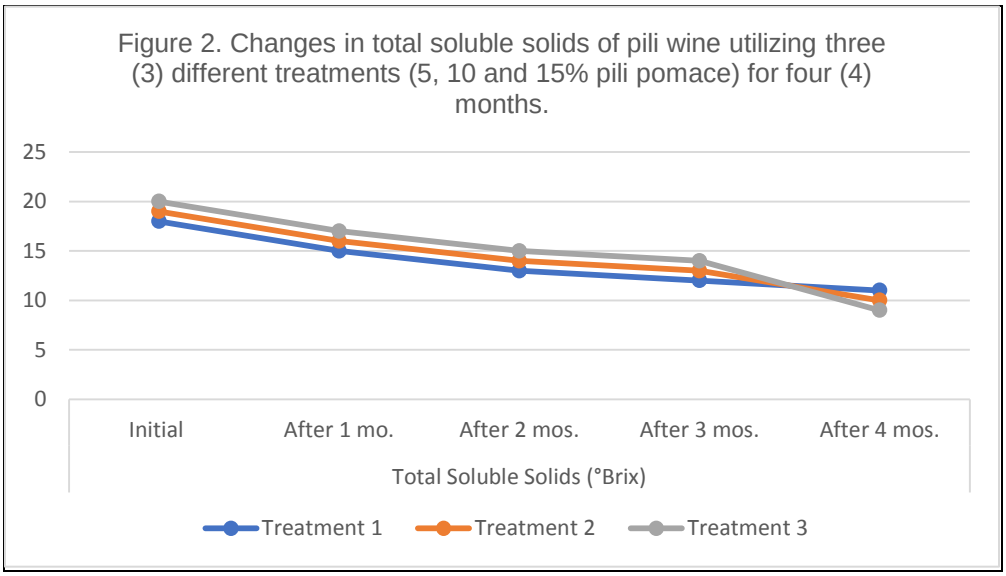
Table 1: Changes in total soluble solids of pili wine utilizing three (3) different treatments (using 5, 10 and 15% pili pomace) for four (4) months

	Total Soluble Solids (°Brix)				
	Initial	After 1 mo.	After 2 mos.	After 3 mos.	After 4 mos.
Treatment 1	18°	15°	13°	12°	9°
Treatment 2	19°	16°	14°	13°	10°
Treatment 3	20°	17°	15°	14°	11°

It was observed that there is an increase in TSS as pili pomace concentration was increased. However, it was also observed that there was a gradual decrease in TSS as fermentation time progressed (see Figure 2).



Total soluble solids (TSS) is a harvest parameter of wines and estimates the density (mass/volume) of all soluble solids present in a solution. Highly significant solids include sugars, organic acids, phenolic compounds, nitrogenous compounds, and structural polysaccharides. Sugars (glucose and fructose) account for 95-99% of the solids, thus TSS is a good measure of the concentration of sugars. TSS gauges the potential alcohol content attainable during fermentation through sugar consumption of yeasts.

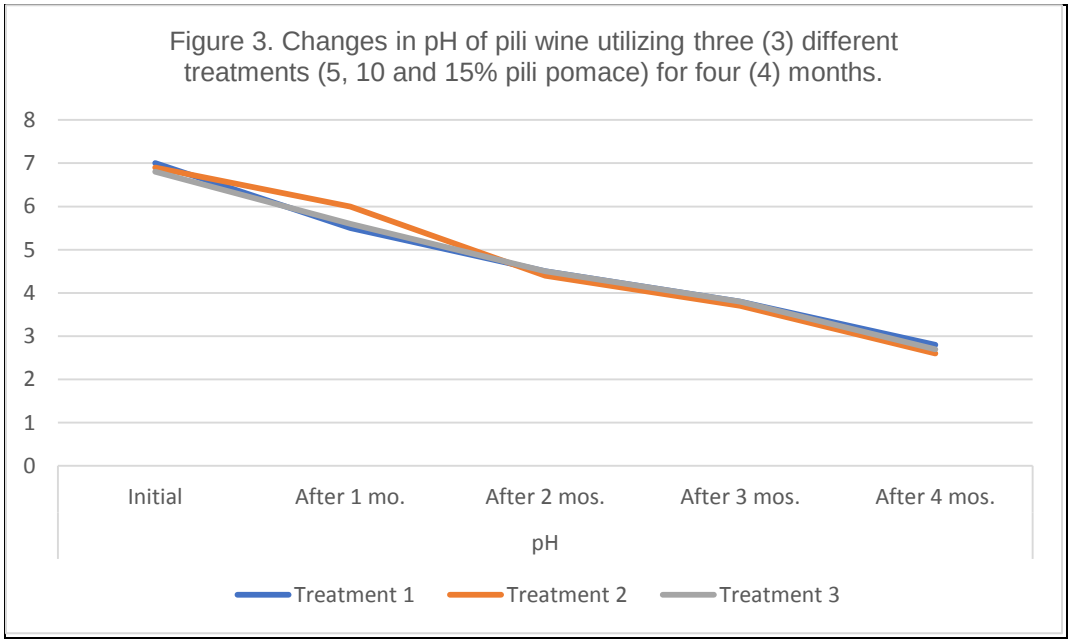
3.1.2 pH

pH of the wine was determined using a digital pH meter (Mettler Toledo 51343054) as described by AOAC. Five (5) mL of sample was measured into a beaker and the glass electrode was immersed in the sample and the reading was taken.

Table 2: Changes in pH of pili wine utilizing three (3) different treatments (using 5, 10 and 15% pili pomace) for four (4) months

	pH				
	Initial	After 1 mo.	After 2 mos.	After 3 mos.	After 4 mos.
Treatment 1	7.0	5.5	4.5	3.8	2.8
Treatment 2	6.9	6.0	4.4	3.7	2.6
Treatment 3	6.8	5.6	4.5	3.8	2.7

It was observed that there is a decrease in pH as pili pomace concentration is increased. There was a gradual decrease in pH in all of the treatments as fermentation time progressed (see Figure 3).



Acidity is an important trait in wine that is essential for its quality. Great wines are commonly well balanced in four basic traits (acidity, tannins, alcohol and sweetness). As wines mature, the acidity serves as a buffer to make the wine last longer. Wines with a higher acid level (lower pH) have better aging potential. pH also affects the growth of bacteria and yeasts in wine.

3.1.3 Alcohol Content

Alcohol content was measured using a wine hydrometer (0-25%). The hydrometer was placed in a 500-mL sample and given a quick twirl to dislodge any air bubbles. Once the hydrometer has settled, the reading at the lowest level of the liquid's surface was taken.

Table 3: Changes in alcohol content of pili wine utilizing three (3) different treatments (using 5, 10 and 15% pili pomace) for four (4) months

	Alcohol content (%)				
	Initial	After 1 mo.	After 2 mos.	After 3 mos.	After 4 mos.
Treatment 1	0	2	4	5	7
Treatment 2	0	3	5	6	8
Treatment 3	0	3	6	7	10

It was noted that there was an increase in alcohol content as concentration of pili pomace is increased and as fermentation time proceeded (see Figure 4).

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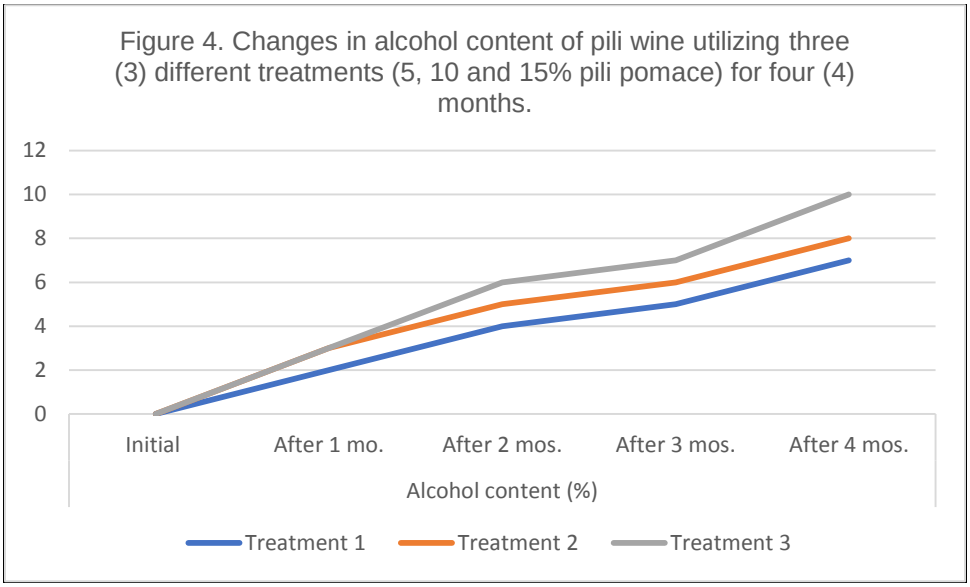
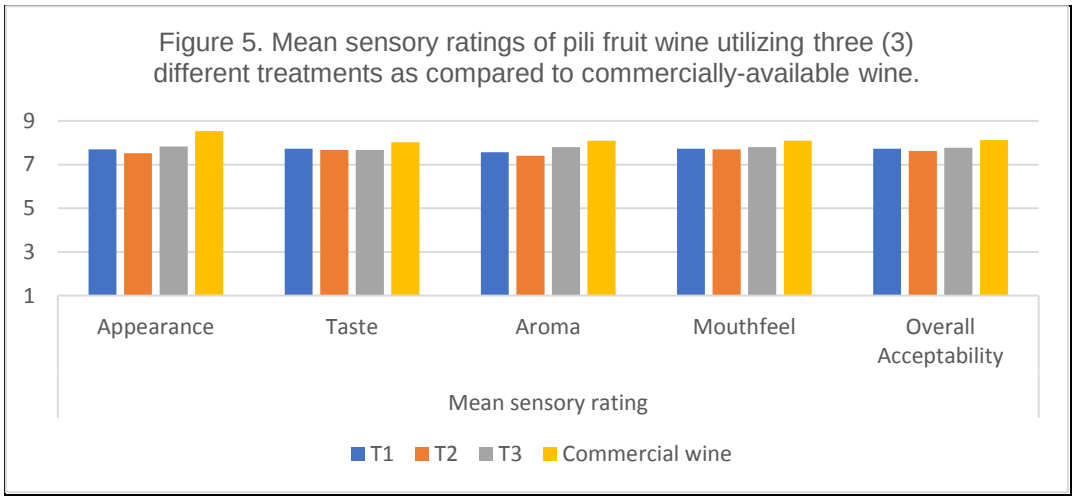


Alcohol content can increase with aging. The alcohol level in a wine influences its aging potential. Wines with higher alcohol content are inclined to age more slowly.

3.2 Sensory Evaluation

Pili fruit wine samples using 5%, 10% and 15% pili pomace were evaluated by thirty (30) sensory panelists in terms of appearance, taste, aroma, mouthfeel, and overall acceptability. Results of the sensory evaluation are shown in Figure 5. This depicts that the amount of pili pomace can affect the level of acceptability of the finished product. Mean sensory ratings for appearance were 7.70, 7.53 and 7.83 for Treatment 1, 2 and 3, respectively, which can be interpreted as high liking of sensory panelists to the pili wine in terms of appearance. Panelists detected significant difference between treatments and the commercial wine sample in terms of appearance (Table 4) due to the more transparent appearance of commercial wine as compared to pili wine samples which are a bit opaque. In terms of taste, mean sensory ratings obtained are 7.73, 7.67 and 7.67 for Treatment 1, 2 and 3 which can be interpreted as high liking for the pili wine samples. Mean sensory ratings of 7.57, 7.40 and 7.80 were obtained for Treatment 1, 2 and 3, respectively, for aroma. This can be interpreted as high liking for the pili wine samples in terms of aroma. In terms of mouthfeel, 7.73, 7.70 and 7.80 mean sensory ratings were obtained. Treatment 1, 2 and 3 obtained a mean sensory rating of 7.73, 7.63 and 7.77, respectively, for overall acceptability. This means that overall, sensory panelists judged the pili fruit wine samples as highly likable products. No significant difference was detected among samples in terms of taste, aroma, mouthfeel and overall acceptability when compared to commercial wine which means that the pili wine samples were just as acceptable and likable as commercial wine.



IV. CONCLUSIONS AND RECOMMENDATIONS

Procedures in the production of pili fruit wine from pili pomace has been successfully accomplished. With the help of research and development, it was established that other unconventional fruits such as pili can be an excellent source of wine. During the experiment, it was observed that there was an increase in TSS and alcohol content as concentration of pili pomace is increased, and a decrease in pH as concentration of pili pomace is increased. It was also observed that there is a gradual decrease in total soluble solids and pH while there is gradual increase in alcohol content as fermentation time proceeded. Results of the consumer acceptability survey of the pili wine obtained an average rating of 7.71 in overall acceptability which can be interpreted as high liking for the product, revealing that the market could be attracted and may now be potentially ready for this kind of innovation.

Based on the results of the study, the following are recommended:

1. Since the research was carried out on a laboratory scale only, it is being suggested that pilot testing and studies for process mechanization be done prior to commercialization.
2. Nutrition facts analysis of the pili fruit wine should be performed for nutritional labeling.
3. Health and wellness benefits of the pili fruit wine should be confirmed with chemical analysis to support any of its health claims, which can be used later as a marketing/advertising tool for the newly-developed product.

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