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Potential of *Seriales, Flacourtia jangomas* (Lour.) Raeusch, fruit for wine production

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ABSTRACT

Flacourtia jangomas, locally known as *seriales,* is one of the indigenous tree species in the island of Leyte, Philippines that is neglected and underutilized. To maximize its utilization, the potential of the commodity for wine-making was explored using the Placket-Burman (PB) experiment, which was carried out to identify the most significant factors affecting the quality of the wine. There were seven variables (n=7) identified, namely; fermentation temperature, contact time, sugar level, dilution, microbial strain and two dummy variables with a total of eight runs. Results show that fermentation temperature, contact time, sugar level and microbial culture significantly affected the sensory quality of *seriales* wine.

Keywords: *Seriales*, *Flacourtia jangomas,* Plackett-Burman Design, Wine

INTRODUCTION

Flacourtia jangomas (Lour.) Raeusch, locally known as *seriales* is a less known and an underutilized plant in the Philippines. Parvin et al (2011) reported that *seriales* contains an array of compounds such as terpenoids, alkaloids, flavonoids and tannins, lignans and flavanolignans, glucosides, coumarins, isocoumarins, xanthones, quinones, limonoids and phenazines that make it important in traditional medicine (Singh & Singh 2010). Furthermore, Kermasha et al (1987) reported that it also contains proteins, vitamin C, fructose, α, β glucose, sucrose, calcium, potassium, phosphorus, iron, and magnesium. With such beneficial components, utilization of *seriales* can be maximized by developing a high-value product such as wine. Hence, this study was done, firstly, to assess the potential of the *seriales* fruit for wine production, and secondly, to determine the effects of different factors or variables on the sensory quality of the resulting wine. Results of the study may pave the way for the development of other high-value products from the fruit, and for the conservation of this important native Philippine species.

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MATERIALS AND METHODS

The preliminary study was done to screen variables that affect product formulation and processing of *seriales* wine using the Plackett-Burman design. Table 1 shows the variables assigned with high (+) and low (-) values, which were laid out in a design matrix presented in Table 2. The *seriales* wine was produced following the method of Dizon (2009) (as cited by Belina-Aldemita 2013), with slight modification depending on the factor and level indicated in the 8-run PB design matrix (Table 2).

A sensory quality evaluation was conducted on eight wine sample treatments produced with sensory acceptability as response variables, by 32 Bachelor of Science in Food Technology students of the Visayas State University. The 9-point Hedonic Rating Scale was used. Results were decoded, and sensory acceptability was analyzed using the SAS software. The principal effects of each variable on the sensory acceptability were estimated as the difference between both averages of measurements made at the higher level and the lower level. The significance of each variable was determined.

Table 1. Range of values for the different variables used in the Placket-Burman screening experiment for *seriales* wine

Independent Variables	Range of Values	
	Low (-)	High (+)
Fermentation temperature (°C)	15	35
Skin & Seed Contact time	-	+
Sugar level (TSS)	15°B	25°B
Dilution	1:2	1:4
Microbial strain	*Saccharomyces ellipsoideus*	*Saccharomyces bayanus*
Dummy 1	-	+
Dummy 2	-	+

Table 2. Plackett-Burman experimental design (8-run matrix) for screening of processing conditions affecting sensory quality of *seriales* wine

Runs	Variables						
	V_1	V_2	V_3	V_4	V_5	V_6	V_7
1	+	-	-	+	-	+	+
2	+	+	-	-	+	-	+
3	+	+	+	-	-	+	-
4	-	+	+	+	-	-	+
5	+	-	+	+	+	-	-
6	-	+	-	+	+	+	-
7	-	-	+	-	+	+	+
8	-	-	-	-	-	-	-

RESULTS AND DISCUSSION

Effect of Temperature

As shown in Table 3, the independent variables, namely; fermentation temperature, contact time and sugar level, had significant negative effects on color acceptability. The color of *seriales* wine produced at lower temperature (15˚C) was more preferred than those produced at higher temperature. The color of the wine was principally due to the anthocyanin content of the fruit as well as its derivatives formed during the vinification process (Busse-Valverde et al 2011, Mazza & Francis, 1995 as cited by He et al 2012). These compounds are basically affected by temperature (Fennema 1996). According to Buglas (2011) and Ough (1992), temperature of fermentation has also a considerable effect on product color. This is because anthocyanin degradation is greater with an increase in temperature (Laleh et al 2006), which consequently affects product color and ultimately the respondents' perception of the product. This study clearly revealed that color acceptability was high at low temperatures.

Effect of Contact Time

Aside from temperature, fruit skin and seed contact time (time when the seeds and skin were in contact with the fermenting must) had a significant negative effect to all response variables except aroma acceptability. In a recent study of Cimafranca (2017), it was found that tannins (146.80mg VE·100g^{-1})and anthocyanins (306.69mg GCE·100g^{-1}) were high in *seriales*, with the bulk of these compounds present in the seeds and skin. Higher concentration of these compounds are extracted with longer contact time. When mixed into the wine must, these compounds significantly decreased the acceptability perception of color, taste, flavor, alcohol and general acceptability. This means that reducing contact time may increase acceptability ratings of the aforementioned variables.

The pericarp or "skin" of the fruit primarily contributes to the appealing color of a fruit. The pericarp contains anthocyanins which impart color, as well as phenolics (Reynolds 2010). Previous reports stated that skin contact to the must, increase the levels of phenolics, which impart color, as well as other physiological properties, and improved the sensory characteristics of white wine made from *Vitis vinifera* (Darias-Martin et al 2000, Gomez-Plaza et al 2001). However, the results in *seriales* wine showed otherwise. Every unit increase in the time of contact of skin and seed in the must during fermentation resulted in decreased color acceptability by 0.752 (Table 3), suggesting that skin and seed contact time should be lowered. Extended skin contact can result to decrease in total anthocyanins and greater extraction of other phenolic compounds (Darias-Martin et al 2000, Sipiora & Granda 1998) resulting to undesirable browning of the product. In the study of Sims and Morris (1986), wherein the commercial tannin incorporated into Red Muscadine (*Vitis rotundifolia*) wine did not affect color intensity of the product, but slightly increased browning. Also, non-enzymatic changes leading to browning involving polyphenols is another aspect that must be considered. According to Matthew Mayer and Harel (1979), Parpia (1971) and Vamos-Vigyazo (1981) as cited by Cheng and Crisosto (1981), different aspects of food browning may be attributable to polyphenol

Table 3. Variable screening employing Plackett-Burman Design showing the effects of the independent variables considered in *seriales* wine production

Independent Variables/Factos	Range of Values		Effect Estimates					
	Low (-)	High (+)	Color acceptability	Aroma acceptability	Taste acceptability	Flavor acceptability	Alcohol acceptability	General acceptability
Fermentation temp (˚C)	15	35	-0.485*	0.111^{ns}	-0.244^{ns}	-0.341^{ns}	-0.100^{ns}	-0.370^{ns}
Skin and seed contact time	without	with	-0.752**	-0.156^{ns}	-0.878**	-0.941**	-0.700**	-0.804**
Sugar level (˚B)	15	25	-0.778*	-0.333^{ns}	1.133**	1.489**	1.200**	1.244**
Dilution (*seriales*:water)	1:2	1:4	-0.452^{ns}	0.344^{ns}	0.156^{ns}	0.059^{ns}	-0.000^{ns}	-0.037^{ns}
Microbial strain	*S. ellipsoideus*	*S. bayanus*	-0.181^{ns}	0.022^{ns}	0.578*	0.741**	0.233^{ns}	0.437^{ns}
Dummy 1	-	+	-0.119^{ns}	-0.189^{ns}	-0.011^{ns}	0.059^{ns}	0.067^{ns}	0.063^{ns}
Dummy 2	-	+	0.448^{ns}	0.144^{ns}	-0.144^{ns}	-0.207^{ns}	0.433^{ns}	-0.337^{ns}

reaction. Tannin is an important polyphenol. Although tannin is responsible for the astringent character of wine, it also acts as color stabilizer. Hence, it is necessary to extract it together with the anthocyanin, but the fraction of tannin with respect to the content anthocyanins should also be taken into account since duration of contact time affects anthocyanin and tannin extraction. According to Kennedy and Peynot des Gachons (2003), the maximum amount of color that could be extracted was roughly 50% of what was available, and a balanced wine was achieved when only 15% of tannin was extracted. Furthermore, they observed that tannin extracted slowly than anthocyanin. They found that anthocyanin diffused rapidly in wine during the early stage of fermentation, while an increase in tannin content was observed as fermentation progressed. Thus, increasing the contact time favors more extraction of tannin, compromising the balance between both compounds, resulting to unstable wine color.

Skin and contact time has been reported to affect extraction of aroma compounds (Schmidtz & Noble 1983). This experiment revealed that duration of skin and contact time to the fermenting must had no significant effect on aroma acceptability. This is corroborated by the findings of Ribereau-Gayon et al (2006), that the effect of aroma on varietal wine is much less clear. Increased contact time of skin similar to aroma may contribute to increase astringency of the wine, which probably affects the taste acceptability of the product. This was observed by Aleixandre-Tudo et al (2015) in the production of South African Chenin Blanc White Wine.

Effect of Sugar Content

Sugar content is one of the major contributing factors to the taste, flavor, alcohol and general acceptability of the *seriales* wine. There was a positive response of the aforementioned dependent variables with increase in sugar level. The findings of Malundo et al (2001) and Rossiter et al (2000) is in agreement with this result in *seriales*. These authors found that increasing sugar level also increases the flavor acceptability of kiwi and mango wine, respectively. However, in apple vermouth (Joshi & Sandhu 2000) and Hunter Valley Semillon wine (Blackman et al 2010), lower sugar concentration was most preferred. In terms of alcohol acceptability, Soufleros et al (2001) found that sugar level significantly influenced alcohol acceptability. This corroborates with the findings of this study that sugar level had a significantly positive effect (+1.200) on alcohol acceptability, which means the higher the sugar level (Table 3), the higher is the alcohol acceptability.

Effect of Yeast Strain

The yeast strain *Saccharomyces bayanus* used in the fermentation process enhanced the taste and flavor acceptability of the *seriales* wine. King et al (2010) reported that the microbial inoculum used in the production of Sauvignon Blanc wine affected consumer acceptance, specifically on aroma or flavor attribute, and are thought of as driving the differences in consumer preferences. This could be due to the effect of the activity of these microorganisms in the chemical composition of the wine. In the study of Eglinton et al (2000), wine fermented with *S. bayanus* contained more succinic acid, glycerol, acetaldehyde and SO_2, and less of acetic acid, malic acid and ethyl acetate in comparison with wine made from

Saccharomyces cerevisiae. Volatile compound formation and concentration in mango wine was also reported by Reddy and Reddy (2009) to be dependent on the *S. cerevisiae* strain used.

CONCLUSION

Seriales fruit has a big potential for processing into a high-value product such as wine. Among the different independent factors that affect quality of the wine, the most significant and critical ones are fermentation temperature, contact time, sugar level and the kind of yeast strain used.

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REFERENCES

Aleixandre-Tudo JL, Weightman C, Panzeri V, Nieuwoudt HH & du Toit WJ. 2015. Effect of skin contact before and during alcoholic fermentation on the chemical and sensory profile of South African Chenin Blanc White Wines. *South African Journal for Enology and Viticulture,* 36(3):366-377

Belina-Aldemita MA, Sabularse VC, Dizon EI, Hurtada WA & Torio MO. 2013. Physicochemical properties of bignay [*Antidesma bunius* (L.)] wine at different stages of processing. *Philippine Science Letters*, 6(2):249

Blackman J, Saliba A & Schmidtke L. 2010. Sweetness acceptance of novices, experienced consumers and winemakers in Hunter Valley Semillon wines. *Food Quality and Preference*, 21(7):679-683

Buglass AJ. 2011. Handbook of Alcoholic Beverages: technical, analytical and nutritional aspects. John Wiley & Sons

Busse-Valverde N, Gomez-Plaza E, Lopez-Roca JM , Gil-Muñoz R & Bautista-Ortin AB. 2011. The extraction of anthocyanins and proanthocyanidins from grapes to wine during fermentative maceration is affected by the enological technique. *Journal of Agricultural and Food Chemistry*, 59(10):5450-5455

Cheng GW and Crisosto CH. 1995. Browning potential, phenolic composition, and polyphenoloxidase activity of buffer extracts of peach and nectarine skin tissue. *Journal of the American Society for Horticultural Science*, 120(5):835-838

Cimafranca LC. 2017. Physico-chemical properties, phytochemical components, antioxidant and antimicrobial activities of fresh and processed *seriales* [*Flacourtia jangomas* (Lour.) Raeusch] fruit (PhD Thesis). University of the Philippines-Los Baños, Laguna

Darias-Martin JJ, Rodriguez O, Diaz E & Lamuela-Raventos RM. 2000. Effect of skin contact on the antioxidant phenolics in white wine. *Food Chemistry*, 71(4):483-487

Eglinton, McWilliam LS, Fogarty M, Francis L, Kwiatkowsli M, Hoj P & Henschke P. 2000. The effect of *Saccharomyces bayanus* – mediated fermentation on the chemical composition and aroma profile of Chardonnay wine. *Australian Journal of Grape and Wine Research*, 6(3):190-196

Fennema OR. 1996. *Food Chemistry*. Marcel Dekker, New York
Gomez-Plaza E, Gil-Muñoz R, Lopez Roca JM, Martinez-Cutillas A & Fernandez-Fernandez JI. 2001. Phenolic compounds and color stability of red wines. Effect of skin maceration time. *American Journal of Enology and Viticulture*, 52(3):266-270
He F, Liang NN, Mu L, Pan QH, Wang J, Reeves MJ & Duan CQ. 2012. Anthocyanins and their variation in red wines I. Monomeric anthocyanins and their color expression. *Molecules*, 17(2):1571-1601
Joshi VK and Sandhu DK. 2000. Influence of ethanol concentration, addition of spices extract, and level of sweetness on physico-chemical characteristics and sensory quality of apple vermouth. *Brazilian Archives of Biology and Technology*, 43(5):537-545
Kennedy JA and Peyrot Des Gachons C. 2003. Phenolic extraction in red wine production. *Practical Winery & Vineyard*, July/August 2003:1-5
Kermasha S, Bathakur NN, Mohan NK & Arnold NP. 1987. Chemical composition and proposed use of two semi-wild tropical fruits. *Food Chemistry*, 26(4):253-259
King ES, Kievit RL, Curtin C, Swiegers JH, Pretorins IS, Bastian SEP & Francis IL. 2010. The effect of multiple yeasts co-inoculations on Sauvignon Blanc wine aroma composition. Sensory properties and consumer preference. *Food Chemistry*, 122(3):618-626
Laleh GH, Frydoonfar H, Heidary R, Jameei R & Zare S. 2006. The effect of light, temperature, pH and species on stability of anthocyanin pigments in four Berberis species. *Pakistan Journal of Nutrition,* 5(1):90-92
Malundo TMM, Shewfelt RL, Ware GO & Baldwin EA. 2001. Sugars and acids influence flavor properties of mango (*Mangifera indica*). *Journal of American Society for Horticultural Science*, 126(1): 115-121
Ough CS. 1992. Wine making basics. *Food Product Press*. New York
Parvin S, Kader A, Sarkar GC & Bin Hosain S. 2011. In-vitro study of antibacterial and cytotoxic properties of *Flacourtia jangomas*. *International Journal of Pharmaceutical Sciences and Research*, 2(11):2786-2790
Reddy LV and Reddy OVS. 2009. Production, optimization and characterization of wine from mango (*Mangifera indica* Linn.). *Natural Product Radiance*, 8(4):426-435
Reynolds AG. 2010. Managing Wine Quality:Viticulture and Wine Quality. Woodhead Publishing Limited, United Kingdom
Ribereau-Gayon P, Dubourdieu D, Doneche B & Lonvaud A. 2006. Handbook of Enology, The Microbiology of Wine and Vinifications (2nd edn). John Wiley & Sons Ltd, England
Rossiter KL, Young H, Walker SB, Miller M & Dawson DM. 2000. The effects of sugars and acids on consumer acceptability of kiwifruit. *Journal of Sensory Studies*, 15(3):241-250
Schmidt JO and Noble AC. 1983. Investigation of the effect of skin contact time on wine flavor. *American Society for Enology and Viticulture*, 34:135-138
Sims CA and Morris JR. 1986. Effects of acetaldehyde and tannins on the color and chemical age of red muscadine (*Vitis rotundifolia*) wine. *American Journal of Enology and Viticulture*. January 1986. 37:163-165
Singh AK and Singh J. 2010. Evaluation of anti-diabetic potential of leaves and stem of *Flacourtia jangomas* in streptozotocin-induced diabetic rats. *Indian Journal of Pharmacology*, 42(5):301

Sipiora MJ and Granda MJG. 1998. Effects of pre-veraison irrigation cut off and skin contact time on the composition of color and phenolic content of young cabernet sauvignon wines in Spain. *American Journal of Enology and Viticulture*, 49(2):152-162

Soufleros EG, Pissa I, Petridis D, Lygerakis M, Mermelas K, Boukouvalas G & Tsimitakis E. 2001. Instrumental analysis of volatile and other compounds of Greek kiwi wine; sensory evaluation and optimization of its composition. *Food Chemistry*, 75(4):487-500