ISSN 2348-1218 (print)
International Journal of Interdisciplinary Research and Innovations ISSN 2348-1226 (online)
Vol. 3, Issue 3, pp: (49-54), Month: July - September 2015, Available at: www.researchpublish.com

# Characterization of Wine Parameters of the Locally Produced Wines in the Bicol Region, Philippines

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***Abstract:*** **Characterization of wine parameters pH, volatile acidity, titratable acidity, ethanol content, methanol content and total soluble solids and comparison with the Philippine National Standard for tropical fruit wines, distilled wines and tuba was made to the wine samples. The pH by glass electrode, gas chromatography for EC and MC, titration for TA as tartaric acid and VA and refractometry for TSS. Mean pH was 3.78 ± 0.28 for tropical fruit wines, 3.55± 0.29 for distilled wines and 3.87 ± 0.11 for tuba. Mean TA was 0.52 ± 0.31% for tropical fruit wines, 0.50 ± 0.45% for distilled wines and 0.031 ± 0.0003% for tuba. Mean VA was 0.25 ± 0.15% by vol. for tropical fruit wines, 0.29 ± 0.14% by vol. for distilled wines and 0.12 ± 0.005% by vol. for tuba. Mean EC was 12.44 ± 3.34% by vol. for tropical fruit wines, 23.43 ± 6.08% by vol. for distilled wines and 3.80 ± 0.07% by vol. for tuba. Mean TSS was 9.34 ± 3.33 °Brix for tropical fruit wines, 8.25 ± 1.72 °Brix for distilled wines and 3.8 ± 0.007 °Brix for tuba. There was no detection of methanol for all the wine samples. There was deviation in the VA, TA and TSS from the standard and no deviation in the pH and EC. Variations in the EC, TSS, TA and VA in the tropical fruit wines and distilled wines came from the deviation from the standards. A wine catalog featured the wine parameters, description and information of the manufacturer. Further studies is recommended to check the conformity of the wine parameters to the standards.**

***Keywords:*** **Characterization, Wine parameters, Bicol Region, Philippine National Standards.**

## I. INTRODUCTION

The Bicol region is known for its sweet pineapple, bignay, lipote, pomelo, hagis, igot or baligang,makopa, guyabano, mango, papaya, passion fruit, pomelo, tamarind and other fruits. Most of the fruits growing in the region have been subjected to wine making, the method passed from old folks and improve by new technology. The quality of the wines must conform to the requirements set by the Philippine National Standard (PNS) and Food and Drug Administration (FDA) PNS/FDA 30:2010 – Tropical Fruit wines specification and the PNS/BAFPS 47:2011 - Distilled fermented coconut sap (Coconut lambanog). The wine manufacturers were grouped into tropical fruit wine makers, distillers of nipa (*Nypa fruticans* Wurmb.) and coconut (*Cocos nucifera* Linn.) and producers of tuba (coconut sap wine). There were six tropical fruit wine makers located in Tabaco City, Albay; Pili, Camarines Sur; Naga City, Camarines Sur; and San Lorenzo Ruiz, Camarines Norte. The distillers were situated at Polangui, Albay and Vinzons, Camarines Norte. The tuba makers were found in the province of Masbate, particularly in Masbate City, Mandaon, Masbate, Mobo, Masbate and Pawa, Masbate.

The fermentation of fruit wines and distillation process produces methanol as a by-product [1]. The Bureau of Food and Drug Administration issued Memorandum Circular No. 18 Series of 1989 which modified the previous regulation of delimiting the methanol content of 0 ppm [2]. Instead the present rule allowed methanol in alcoholic drinks provided that it shall be derived from the natural alcohol fermentation process and not added. Last September 16, 1999 the Bureau of Food and Drugs (BFAD) issued a health advisory stating seven lambanog samples bought from local stores along Pitogo,

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Unisan and Tayabas Quezon were found to contain high levels of methanol. Another article claimed that some tropical fruit wines contain methanol [3].

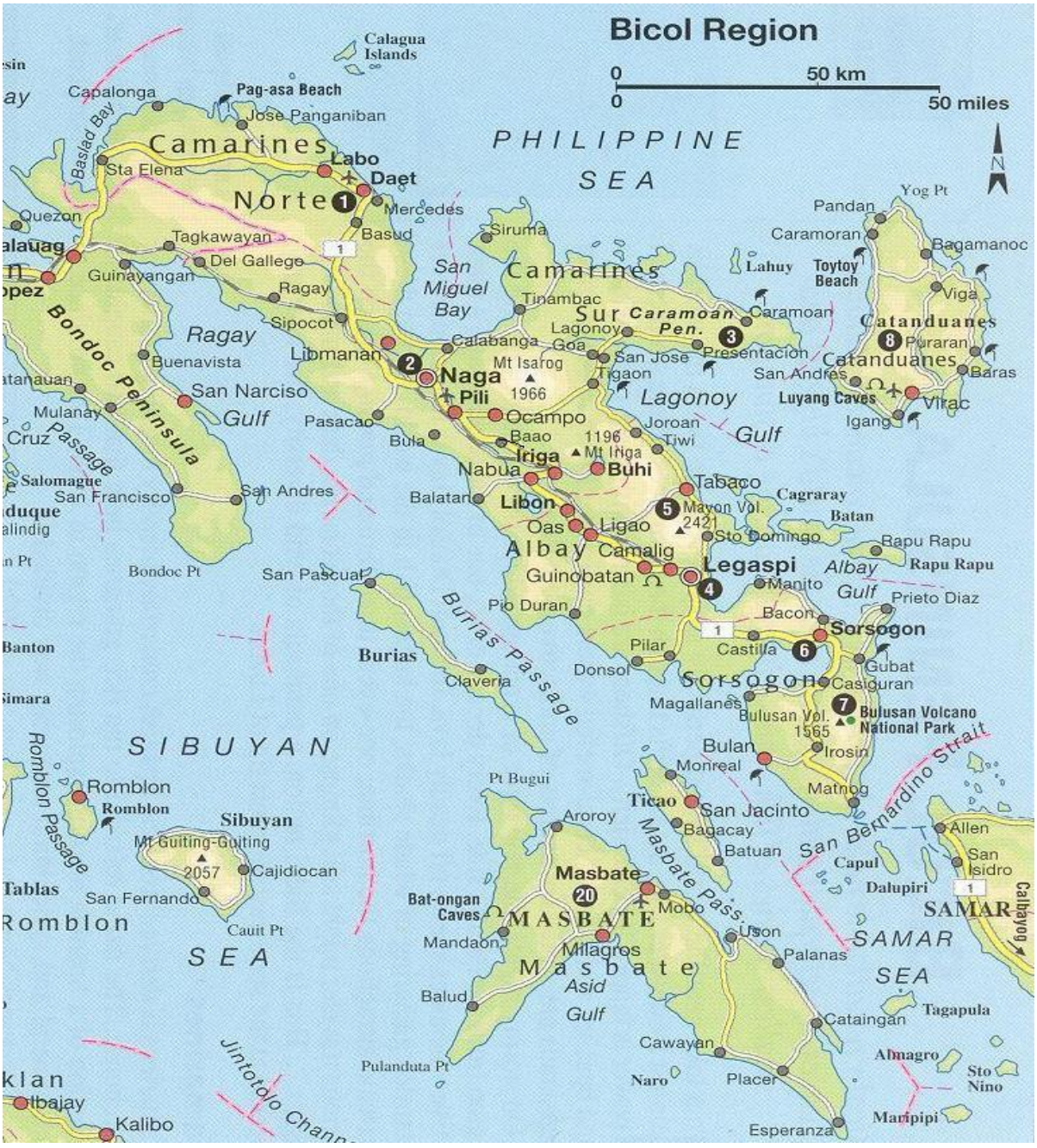


**Figure 1. Map of the Bicol Region Showing the Sources of the Locally Produced Wines in the Province of Albay, Camarines Sur, Camarines Norte and Masbate. Retrieved from https://okbikol.files.wordpress.com/2012/06/bicol-map.jpg**

The pH must be 3.0 to 4.0 for tropical fruit wines. The pH signifies the intensity or degree of acidity of a food material. The ethanol content must be 7 to 24% by volume for tropical fruit wines and 18 to 30% by volume for distilled wines like lambanog and nipa wine. The methanol may be present provided it shall be derived from natural alcoholic fermentation and not added. The volatile acidity is the amount of steam-distillable acids present in the wine which is attributed to the growth of acetic acid bacteria and sometimes of yeasts; used as an indicator of spoilage and expressed as grams acetic acid per 100 mL of sample. The volatile acidity (expressed as acetic acid) shall not exceed 0.14 *g/100* mL or 0.14% by volume for all types of wine. The titratable acidity or total acidity is the sum of all titratable acidities of the wine when it is titrated to pH 7 against a standard alkaline solution using phenolphthalein indicator, it is amount of organic acids derived from the raw materials or produced during alcoholic fermentation, and expressed as grams of acid per 100 mL of

sample. The accepted value is 0.6 to 0.9% for tropical fruit wines and a maximum of 0.3% for distilled wines. The total dissolved solids corresponds to the concentration of sugar in syrup corresponding approximately to the concentration of solutes expressed in percentage as measured with a refractometer or hydrometer and expressed in degree Brix ($^{o}$Bx). The total soluble solids of tropical fruit wines shall not be less than 8.0 % *m/m*, as determined by a refractometer at 20 °C, uncorrected for acidity and read as °Brix on the International Sucrose Scales [4], [5], [6]. The alcohol content of tuba is from 2 to 4%, the total soluble solids from trace to 0.03% and titratable acidity of 0.09% [7].

The tropical fruit wines were categorized as sweet, semi-sweet and dry wine. From the blog of joysofwine sweet wine have fruity, intense flavors and the residual sugar is 5.0% or higher. A semi sweet or medium sweet wine has some sweetness in the taste and aroma. The residual sugar for a medium wine ranges from 1.5 to 4.9%. A semi dry wine is also called off dry or medium dry. A semi dry red or white wine has a level of 0.5 to 1.49% residual sugar. A semi dry wine has a hint of sweetness and more of a 'fruity' taste than a dry wine [8]. From the point of view of food scientists dry wine contains a maximum of either 4 g/l sugar or 9 g/l or when the level of titratable acidity (expressed in grams of tartaric acid per liter) is not more than 2 g/l less than the sugar content. Semi-dry has sugar content of more than 9 g/L up to a maximum of 18 g/l when the content in titratable acidity is fixed according to the first definition above. Semi-sweet wines have sugar content of more than 18 g/l to a maximum of 45 g/l. While sweet wines have a minimum sugar content of 45 g/l [9]. The distilled wines were dry wines while tuba was sweet. A wine catalogue was made to inform the drinking public of the wine and its parameters.

## II. METHODS AND METHODOLOGY

***Wine samples:*** Twenty four (24) wines were identified from fourteen (14) wine manufacturers, three bottles for each wine sample were bought except for the tropical fruit wines of BUPC that was limited to one bottle each due to the unavailability of the wine samples when we visited the school and the tuba from Masbate province that was sold in "Mineral Water bottles" at 4 L each bottle. The wine samples were kept in a cool, dark place to prevent oxidation. One bottle was sent to Intertek Services Laboratory, Makati City Philippines for the methanol content while the second bottle was sent to DOST, STD, ITDI, Taguig City to quantify the ethanol content, volatile acidity, titratable acidity and total soluble solids and the last bottle was kept at Bicol University Tabaco Campus, Tabaco City for pH determination and storage study. The wines from BUPC and the lambanog from Masbate province were divided into three parts and transferred to sterilized wine bottles and was sent to the same place as the other wines.

***Analyses of Wine Parameters:*** Sampling followed the standards set by FAO/WHO Codex Alimentarius Sampling Plans for Prepackaged Foods – CAC/RM 42- 1969, Codex Alimentarius Volume 13, 1994 [10]. The pH was determined following Annex C of PNS/FDA 31:2010 [11]. Titratable or Total Acidity was determined using Annex E of PNS/FDA 31:2010 [12]. Volatile acidity was determined using Annex D of PNS/FDA 31:2010 [13]. Total Soluble Solids was determined using Annex F of PNS/FDA 31:2010 [14]. Ethanol Content was determined using Annex G of PNS/FDA (31:2010) by Specific Gravity Method. [15] Methanol content was determined by Direct Injection Gas Chromatography.

***Categorization of Wine Samples:*** The wines were categorized according to the Standards Administrative Order No. 357 series 1978 using the data from the ethanol content the wines are typed as sweet (7 to 9%), semi-sweet (10 to 13%) and dry (14 to 16%).

***Formulation of Wine Catalog:*** The data from the questionnaire featuring the social, technical and business aspects of the wine manufacturers and the documentations made on the wine bottles were consolidated in the formulation of the wine catalog.

## III. RESULT AND DISCUSSION

***Profile of the wine:*** The social, business and technical aspects of the wine were tabulated indicating the business name, owner, contact details, history of business, products, availability and price, average monthly sales, processing, packaging and handling of wines.

***Characterization of the Type of Wine according to Standards Administrative Order No. 357 s. 1978:*** The wine parameters pH, ethanol content, methanol content, total soluble solids, titratable acidity and volatile acidity and the characterization of the tropical fruit wines, distilled wines and tuba are listed in Table 1, 2 and 3.

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**Table 1. Characterization of Tropical Fruit Wines**

| Wine Sample | pH | Ethanol Content (%v/v) | Titratable acidity as Tartaric acid (%v/v) | Volatile acidity as acetic acid (%v/v) | Total Soluble Solids ($^{o}$Brix) | Methanol Content (%v/v) | Type of Wine |
|---|---|---|---|---|---|---|---|
| Standard | 3 - 4 | 7 - 24 | 0.4 – 1.5 | Not more than 0.14 | Not less than 8 | Not added | |
| A | 3.78 | 6.3* | 0.340* | 0.140 | 11.60 | ND | Sweet |
| B | 3.78 | 6.3* | 0.340* | 0.142* | 12.50 | ND | Sweet |
| C | 3.74 | 17.9 | 0.111* | 0.107 | 7.95* | ND | Dry |
| D | 4.41 | 12.2 | 0.310* | 0.120 | 8.90 | ND | Semi-dry |
| E | 3.19 | 8.8 | 0.220* | 0.120 | 12.50 | ND | Sweet |
| F | 3.62 | 10.0 | 0.251* | 0.152* | 7.89* | ND | Semi-dry |
| G | 4.11 | 11.4 | 0.360* | 0.170* | 8.90 | ND | Semi-dry |
| H | 3.80 | 11.7 | 1.270 | 0.497* | 15.00 | ND | Semi-dry |
| I | 3.80 | 14.6 | 0.501 | 0.264* | 3.82* | ND | Dry |
| J | 3.80 | 14.3 | 0.889 | 0.198* | 7.75* | ND | Dry |
| K | 3.80 | 10.6 | 0.669 | 0.402* | 11.60 | ND | Semi-dry |
| L | 3.83 | 13.0 | 0.515 | 0.335* | 8.50 | ND | Semi-dry |
| M | 3.40 | 14.7 | 0.500 | 0.264* | 3.82* | ND | Dry |
| N | 3.81 | 14.6 | 0.501 | 0.264* | 3.82* | ND | Dry |
| O | 3.81 | 17.5 | 0.414 | 0.119 | 10.10 | ND | Dry |
| P | 3.45 | 13.0 | 1.130 | 0.623* | 12.50 | ND | Semi-dry |
| Q | 4.09 | 14.6 | 0.501 | 0.264* | 11.60 | ND | Dry |
| Mean | 3.78 | 12.4 | 0.520 | 0.250* | 9.34 | - | - |
| Std. Dev. | 0.28 | 3.34 | 0.31 | 0.15 | 3.33 | - | - |

***Note:*** The numbers with asterisk are those that did not comply with the standard set by the PNS for the wine parameter. ND is no detection.

**Table 2. Characterization of the Distilled Wines**

| Wine Sample | pH | Ethanol Content (%v/v) | Titratable acidity as Tartaric acid (%v/v) | Volatile acidity as acetic acid (%v/v) | TSS ($^{o}$Brix) | Methanol Content (%v/v) | Type of Wine |
|---|---|---|---|---|---|---|---|
| Standard | 3 - 4 | Minimum of 30% | Maximum of 0.3% | Not more than 0.14 | Not less than 8 | Not added | |
| A | 3.79 | 18.3* | 0.515* | 0.335* | 8.50 | ND | Dry |
| B | 3.80 | 31.1 | 0.148 | 0.141* | 9.90 | ND | Dry |
| C | 3.22 | 25.5* | 0.216 | 0.209* | 8.76 | ND | Dry |
| D | 3.39 | 18.8* | 1.130* | 0.464* | 5.83* | ND | Dry |
| Mean | 3.55 | 23.43* | 0.500* | 0.290* | 9.34 | - | - |
| Std. Dev. | 0.29 | 6.08 | 0.45 | 0.14 | 3.33 | - | - |

***Note:*** The numbers with asterisk are those that did not comply with the standard set by the PNS for the wine parameter. ND is no detection.

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**Table 3. Characterization of Tuba**

| Wine Sample | pH | Ethanol Content (%v/v) | Titratable acidity as Tartaric acid (%v/v) | Volatile acidity as acetic acid (%v/v) | TSS ($^0$Brix) | Methanol Content (%v/v) | Type of Wine |
|---|---|---|---|---|---|---|---|
| Standard | 3 - 4 | 2 - 4 | Maximum of 0.09% | No required value | Minimum of 3.0% | No value required | |
| A | 3.80 | 3.8 | 0.0310 | 0.209 | 3.80 | ND | Sweet |
| B | 3.80 | 3.7 | 0.0311 | 0.106 | 3.80 | ND | Sweet |
| C | 4.05 | 3.8 | 0.0313 | 0.100 | 3.80 | ND | Sweet |
| D | 3.82 | 3.8 | 0.0312 | 0.101 | 3.81 | ND | Sweet |
| E | 3.90 | 3.9 | 0.0305 | 0.100 | 3.79 | ND | Sweet |
| Mean | 3.87 | 3.8 | 0.0310 | 0.120 | 3.80 | - | - |
| Std. Dev. | 0.11 | 0.1 | 0.0003 | 0.005 | 0.01 | - | - |

***Note:*** The numbers with asterisk are those that did not comply with the standard set by the PNS for the wine parameter. ND is no detection.

The result showed that the tropical fruit wines complied with the required pH. The ethanol content was lower for 2 samples due to incomplete fermentation. The titratable acidity was lower for 7 wines due to acid degradation, tartaric acid formation and the temperature when the fruit was picked. Volatile acidity was higher for 12 samples due to the presence of acetic and propionic acids as well as an anomalous amount of acetic acid which is an indication of diseased wine [16]. These noncompliant wines were processed, packaged and handled erroneously. There was no methanol detected.

The distilled wines complied with pH and ethanol content, the titratable acidity of 1 sample was higher due to the added raisins, the volatile aidity of 3 samples were higher due to spoilage and the total soluble solids of 1 sample was lower due to low sugar content of the sap. The deviation in the distilled wine is because of the nonconformity with the specifications given by PNS/FDA 31:2010. The tuba or fermented coconut sap complied with the all the standards set. There was no methanol detected in the distilled wines and tuba.

***The Wine Catalog:*** The data gathered from the questionnaire and the documentations made on the wine bottle were collated in making the wine catalog.

## IV. CONCLUSION

The wine producers identified, profile and sampled were grouped into tropical fruit wine makers, distillers of coconut sap and nipa and tuba producers. The wine parameters analyzed were pH, ethanol content, methanol content, titratable acidity, volatile acidity and total soluble solids. The result showed that the pH and ethanol content of the tropical fruit wines and tuba conformed to the standards. There were deviations in the titratable acidity, volatile acidity and total soluble solids in the tropical fruit wines and distilled wines because of the nonconformity in the production and packaging of the wines to the standards. The wine catalog showed the profile and quality of the locally produced wines to inform the drinking population of the safety, price, availability and contact details of the manufacturers. Further studies must be conducted to monitor the wine parameters that were not compliant with the standards.

## ACKNOWLEDGEMENT

The author wishes to extend her profound gratitude to the wine manufacturers for cooperating and allowing their wine sample(s) to be analyzed for the wine parameters. To the Department of Science and Technology, Standards Testing Division at Taguig City, Philippines and Intertek Services Laboratories, Makati City, Philippines for conducting the

physico-chemical analyses. To Bicol University Research and Development Center for approving and allowing this project to happen.

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