Preparation of Brandy from Pomelo Wine and Its Physico-chemical Characteristics

Sandar Aye[1], Thwe Linn Ko[2], Cho Cho Oo[3]

Abstract

The aim of the research work is to prepare pomelo brandy and to determine its physic-chemical characteristics. Pomelo, Citrus maxima or Citrus grandis, is one of the largest citrus fruits. The fruit flesh is normally consumed rather than processing it into a juice and is renowned for its good flavor and juicy texture. Firstly, the physico-chemical characteristics of pomelo wine like pH, acidity, total soluble solids, reducing sugar, specific gravity, alcohol content, colour (absorbance) and tannin content were determined. Fruit brandy was prepared from pomelo wine by double distillation processes. The effect of aging time on the characteristics of brandy was studied. The physic-chemical characteristics and organoleptic properties of processed pomelo brandy were studied. Gas chromatography mass spectrometry analysis of prepared pomelo brandy was carried out to analyse the main constituent and volatile compounds. In the preparation of pomelo brandy, the alcohol percent of first distillate, 38.07 %v/v and second distillate, 69.75 %v/v were obtained at 78-80 ºC for 1 hr and 30 min respectively. But, alcohol content was significantly decreased to 56.60 %v/v, when kept prepared brandy at room temperature for one and half year.

Keywords: Pomelo, brandy, physico-chemical characteristics, sensory properties

Introduction

Pomelo fruit scientifically known as Citrus maxima or Citrus grandis, is a type of citrus fruits which belongs to the family Rutaceae. The pomelo is native to southeastern Asia (Shamsudin, Buang & Aziz, 2015). The pomelo fruit has a thick rind which protects the flesh inside from applied forces and water evaporation. This also helps in the handling of the pomelo fruit during transportation. However, the properties of this fruit can differ significantly depending on the time the fruit is harvested or the length of storage (Sirisomboon & Lapchareonsuk, 2012). Fresh fruits give the most directly available vitamins and nutrition in the human diet but they could be easily deteriorated and perishable. However, to overcome the problems, fruits can be processed into juice or alcoholic beverages. Fresh fruit juices normally contain the nutrients which are naturally found in whole fruits. Furthermore, juices or alcoholic beverages can be consumed more conveniently compared with the consumption of whole fruits (Shamsudin, *et al*, 2015).Fruit brandies are a large group of alcoholic beverages and the consummation of which is increasing from year to year. During the last ten years, many small distilleries started to work and produce many different types of fruits brandies. When producing wine and brandy, it is important to obtain good fermenting condition for yeast growth (temperature, oxygen and pH) and sufficient nutrients to improve the characteristics of the compounds newly formed during fermentation. Depending on the biological predisposition and the conditions and the nutrients available during yeast growth, many minor compounds are formed that impart specific organoleptic characteristics to the final product. Aroma is one of the main characteristics that determine an organoleptic quality and style of a brandy. This is the result of the contribution of hundreds of volatile compounds, including higher alcohols, esters, acids, aldehydes, ketones, terpenes and volatile phenols that are derived from

[1] Assistant Lecturer, Department of Industrial Chemistry, Dagon University
[2] Pro-Rector, Dr., Pyay University
[3] Professor and Head (Retired), Dr., Department of Industrial Chemistry, University of Yangon

volatile chemical compounds arising from the fruit, and the fermentation and distillation processes. During alcoholic fermentation and distillation, many volatile components are formed and modified by the yeast, and the yeast strain has a great influence on the profile and production levels of these compounds. In addition, the flavor and aroma are further enhanced by proper aging of the freshly distilled brandy (Ivan, Ninoslav, Ljubiša, Boban, Tijana, Gordana & Vele, 2014). The objective of this research was to study the preparation of pomelo brandy by distillation process. The ultimate aim of this study was to identify the relationship between the physico-chemical properties, volatile compounds and sensory characteristics of aged pomelo brandy.

Material and Methodology

Material

Collecting of Material

For the preparation of pomelo brandy, pomelo wine 10.70 ± 0.15 %v/v was used.

Preparation of Pomelo Brandy

The pomelo wine 300 mL was distilled in simple distillation unit by double distillation. The distillation unit had a capacity of 500 mL. The first distillation of the fermented wine was performed 5 mL separation of a head. First distillate was respectively collected at the temperature ranges of 78-80 ˚C for 1 hr. Second distillation was conducted by the same procedure for 30 min and the second distillate was collected and the amount of volume obtained was determined. During the redistillation, fractions were collected: the first fraction (head), the second fraction (heart) and a third fraction (tail). After distillation, the freshly distilled brandy was placed into roasted oak barrels to mature at room temperature until analysis.

Physico-chemical Analysis

The physico-chemical characteristics of pomelo wine and pomelo brandy were determined as follows: reducing sugar by Lane and Eynon's method (AOAC 920.183,2000), specific gravity was measured by using density bottle (AOAC 920.212,2000), alcohol percent by reading standard density table, pH value by using pH meter (Pen Type pH Meter 009 (I)), acidity by titratable acidity method (AOAC 939.05,2000), tannin by titrimetric method (AOAC 952.03,2000), total soluble solids by using refractometer (Portable Refractometer, RHB-080) and colour (Absorbance) by using UV Spectrophotometer (UV-1800 SHIMAZU).

Sensory Evaluation

The sensory properties of aged pomelo brandy (such as colour, clarity, odour, taste and overall acceptability) were evaluated by using the modified Buxbaum method and maximum number of points was 20. A six-member panel, (gender: 4 males and 2 females) who are familiar with alcoholic beverages consumption, evaluated following brandies properties: colour (max. 2 points), clarity (max. 2 points), odour (max. 4 points) and taste (max. 12 points). Before tasting, prepared brandy was blended and diluted to around 40 %v/v alcohol by adding pure water. After tasting, the results of all testers for sample were summarized and mean value was calculated. Sample was served in clean transparent glasses which had been labelled with two digit random number. The prepared aged pomelo brandy was presented to the trained panel of sensory analysis.

Results and Discussion

The physico-chemical characteristics of the base pomelo wine were determined in order to evaluate a potential of pomelo wine for brandy processing. The physico-chemical characteristics of pomelo wine are shown in Table (1). pH value of pomelo wine was 3.17 with acidity, 0.560 %w/v. The specific gravity of pomelo wine was 0.9857 and tannin content was 0.5265 %w/w. Tannin would contribute to the texture, colour and taste of wine. The alcohol content of wine was found to be 10.70 %v/v. Total soluble solids was 4.17 (˚Brix), while the reducing sugar content was 1.70 mg/g. Sugar is an essential constituent of all wine and it contributes to sweet taste. The data obtained generally indicated that the pomelo wine was suitable for use as raw materials in brandy preparation.

Table (1) Physico-chemical Characteristics of Pomelo Wine

Sr.No.	Characteristics	Pomelo Wine
1	pH	3.17 ± 0.04
2	Acidity (%w/v)	0.560 ± 0.034
3	Specific gravity	0.9857 ± 0.0002
4	Alcohol (%v/v)	10.70 ± 0.15
5	Total soluble solids (ºBrix)	4.17 ± 0.204
6	Reducing sugar (mg/g)	1.70 ± 0.0
7	Tannin (%w/v)	0.5265 ± 0.0339
8	Colour (Absorbance) (at 430 nm)	0.289
9	Age of wine (year)	1

Table (2) Physico-chemical Characteristics of First and Second Distillates from Pomelo Wine

Sr.No.	Characteristics	First Distillate of Pomelo Wine	Second Distillate of Pomelo Wine
1	pH	4.07 ± 0.06	4.6 ± 0.0
2	Acidity (%w/v)	0.68 ± 0.04	0.28 ± 0.14
3	Specific gravity	0.9527 ± 0.0002	0.8877 ± 0.0011
4	Alcohol (%v/v)	38.07 ± 0.17	69.75 ± 0.46
5	Total soluble solids (ºBrix)	11.83 ± 0.29	15.7 ± 0.29
6	Reducing sugar (mg/g)	N.D	N.D
7	Tannin (%w/v)	0.0 ± 0.0	0.3603 ± 0.0479
8	Colour (Absorbance) (430 nm)	0.006	0.019

ND = Not detected

The physico-chemical characteristics of distillates after first and second distillation are shown in Table (2). Brandy was distilled from pomelo wine into two phases. First distillate 47mL was obtained from 300 mL pomelo wine and second distillate 35 mL was further obtained from first distillate. Distillation period of 1 hr was required to convert 300 mL of pomelo wine to first distillate 47mL. But, distillation period for second distillation was taken as 30 min. It is observed that alcohol content of first distillate was 38.07 %v/v, whereas 69.75 %v/v for second distillate from pomelo wine. The alcohol content increased after second distillation. There was no reducing sugar in the first and second distillates. Even though the alcohol contents of first and second distillates increased, specific gravities of these distillates decreased. But soluble solids (˚Brix) of first and second distillates increased with increasing alcohol content. The increase in soluble solids might be due to the dissolution of residual sugar from wine during distillation.

Table (3) Physico-chemical Characteristics of Prepared Aged Pomelo Brandy

Sr.No.	Properties	Prepared Aged Pomelo Brandy
1	pH	4.33 ± 0.06
2	Acidity (%w/v)	0.22 ± 0.017
3	Total soluble solids (˚Brix)	12.5 ± 0.0
4	Reducing sugar(mg/g)	N.D
5	Specific gravity	0.9395 ± 0.0361
6	Alcohol content(%v/v)	56.60 ± 0.23
7	Tannin content (%w/v)	1.7182 ± 0.0959
8	Colour (Absorbance) (430 nm)	0.696

Physico-chemical characteristics of prepared pomelo brandy after one and half year aging were studied and the results are shown in Table (3). There were variation in the ethanol and other characteristics of aged brandy as were differences in freshly prepared brandy. It was observed that the alcohol content of aged brandy decreased from the freshly prepared brandy in correspondence to specific gravity increased. It was due to the volatilization of alcohol during aging. The aging of fresh brandy in oak cask significantly affected the pH, acidity, tannin and colour. The decrease in pH is probably due to the dissolution of fixed acid from the wood (Shah & Joshi, 1999). Fresh brandy was compared with that aged brandy in oak barrel and found that the content of tannin and colour (absorbance) were more abundant in aged brandy than fresh brandy. Tannin, which is polymeric phenolic substances, was extracted from the wood and contributes to the flavor of brandy. Sensory attributes of the brandies such as colour and flavour are greatly influenced by wood, the different heat treatment applied to wooden barrel and the aging time (Tsakiris, Kallithraka & Kourkoutas, 2014). In aged brandy, soluble solids decreased during maturation but there were no changes in reducing sugar of fresh and aged brandy. Wood has a significant impact on the quality and composition of aged brandy.

Gas chromatography–mass spectrometry analysis of aged pomelo brandy led to the identification of main constituent and volatile compounds, including,

esters, acids, alcohols, aldehyde and ketone and other trace level flavour compounds. These were ethanol, 1-propanol, 1-butanol, isobutyl alcohol, phenethyl alcohol,, 1-propanol, 2-methyl, 3-methyl 1-butanol, acetaldehyde, 1,2-diethoxyethane (acetal), ethyl acetate, ethyl ester, acetic acid and so on. Ethanol and carbon dioxide are the primary compounds emitted during the fermentation step in the production of wines and brandy as a consequence of the fermentation of carbohydrates with yeast (MRI, 1995).

Table (4) Organoleptic Properties of Prepared Aged Pomelo Brandy

Scale used to assess scores: colour- 2 points, clarity-2 points, odour -4 points, taste – 12 points

Sr.No.	Organoleptic Properties	Prepared Pomelo Brandy	
1	Colour	1.2	Amber
2	Clarity	1.5	Bright
3	Odour	2.3	Woody
4	Taste	6.7	Bitter
5	Overall Acceptability	11.7	Moderate

The organoleptic properties of prepared aged brandy for one and half year was evaluated and the results are shown in Table (4). It was observed that the aged pomelo brandy had amber colour, woody odour and bitter taste. Sensory evaluation of the pomelo brandy produced with optimized aging time showed good quality, according to the assigned average values for colour (1.2), clarity (1.5), odour (2.3) and taste (6.7).

Conclusion

In this research work, pomelo brandy was prepared from pomelo wine by double distillation processes. It can be seen that changes in ethanol concentration and other properties during distillation and aging are well described. It had been shown that distillation at 78-80 ºC could be completed in 1 hr for first distillate and 30 min for second distillate. After one and a half year aging, the alcohol content of aged brandies was decreased from freshly prepared brandy and also other characteristics were slightly changed between freshly prepared brandy and aged brandy. Analysis of aged brandy by gas chromatography-mass spectrometry proved that the fusel oil component of distillates decreased from first distillates to second distillate and the ethanol, fusel oils and volatile components of aged brandy differed significantly from fresh distillate in aged pomelo brandy during maturation. These various compounds play an important role in development of the sensory characteristics of brandy during aging and that may affect the brandy quality. Pomelo brandy had woody aroma, a little bitter and amber colour. Pomelo brandy processed with the optimal conditions had good sensory properties and acceptability.

Acknowledgements

I would like to express my gratitude to Dr Cho Cho Oo, Professor and Head (Retired) of the Department of Industrial Chemistry, University of Yangon for giving invaluable suggestions and advice throughout this research work. I would like to express my sincere gratitude to Dr Thwe Linn Ko, Pro-rector, Pyay University for her patience, guidance, kind encouragement. I also give special

thanks to Dr Khin Hla Mon, Professor and Head of Industrial Chemistry Department, Dagon University for her kind permission to submit this article.

References

A.O.A.C., (2000), "*Official Method of Analysis*", International Food Research Journal,17,426 -432.

Ivan, U., Ninoslav, N., Ljubiša, S., Boban, A., Tijana, U., Gordana, K & Vele., (2014). Influence of yeast and nutrients on the quality of apricot brandy. *J. Serb.Chem. Soc*. 79 (10) 1223–1234 (2014)

Midwest Research Institute., (1995). Wine and Brandy. Emission Factor Documentation for AP-42 Section 9.1.2.2

Shah., P. K & Joshi., V. K., (1999). Effect of Different Sugar Sources and Wood Chips on the Quality of Peach Brandy. Journal of Sciecntific & Industrial Research, Vol 58, pp 995

Shamsudin, R., Buang, S., Aziz., N. A., (2015). Effect of Different Extraction Methods on the Physico-chemical Properties of Pomelo Juice. Chemical Engineering Transactions. ISBN 978-88-95608-35-8; ISSN 2283-9216

Sirisomboon., P & Lapchareonsuk., R.,(2012**).** Evaluation of the physicochemical and textural properties of pomelo fruit following storage. Fruits, 2012, vol. 67, p. 399–413,DOI: 10.1051/Fruits/20122034)

Tsakiris, A., Kallithraka, S & Kourkoutas, Y., (2014). Grape brandy production, composition and sensory evaluation. *J Sci Food Agric*; 94: 404–414