PHYSICOCHEMICAL PROPERTIES AND SENSORY EVALUATION OF PROCESSED COGNAC (GRAPE BRANDY)

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Abstract

Cognac (Grape Brandy) is a portable spirit by distilling of grape wine and aging in oak cask. This research work is concerned with the preparation of cognac (grape brandy) from locally available table grapes. Firstly, the characteristics of table grape were studied and wine was made by fermenting clarified juice of table grapes. The highest alcohol content 10 % v/v in prepared wine was formed with 1:0.2 juice to sugar ratio after twenty weeks fermentation period. The main constituent and fusel oils in prepared wine were firmly resolved by gas chromatography. For higher alcohol content in processed cognac (grape brandy), most fine brandies (35 % v/v- 65 % v/v alcohol) were taken into double distillation. Prepared wines were distilled to obtain cognac (grape brandy) and properties of cognac (grape brandy) were also studied. It was observed that alcohol content of the first distillate from wine was 36 % v/v and the second distillate contained 76 % v/v of alcohol content. The main constituent (ethanol) and fusel oils were observed in these distillates by gas chromatography. Processed cognac (grape brandy) was aged in oak cask to improve colour, taste and odour. Moreover, caramel colour was prepared by heating brown sugar and white sugar and effect of prepared caramel colour on the characteristics of cognac (grape brandy) without aging in the oak cask was evaluated.

Keywords: table grapes, white wine, grape brandy, distillation

Introduction

Table grapes are grown for production of juice, production of wine or for drying into raisins. Table grapes may be either seeded or non-seeded varieties in terms of colour, size, sweetness and are the deciduous woody vines of the botanical genus *Vitis vinifera*. White wine is specially made from "white" (table) grapes, which are green, yellow, straw-yellow, yellow green, or yellow-gold in colour. White wine is a wine that is fermented except for the skin and is not produced by the alcoholic fermentation of the non-coloured pulp of grapes (Reisch, Peterson and Martens, 2008).

Grape brandy is a spirit processed by means of distilling wine and the alcohol content of brandy is generally 35–60 % by volume. Grape brandy are mostly aged in wooden casks and some are coloured with caramel colouring to affect aging and some are produced using a combination of both aging and colouring. While grape brandies are usually produced from wine or various fermented fruit juices, it can be distilled from any liquid that consists of sugar (Blue, 2004).

Wine is made by crushing and pressing the grapes to extract the juice. This juice is then fermented, which means that the sugar contained within the juice turns to alcohol. In the method of making grape brandy, the grapes are picked, crushed and pressed, after which fermented. The fermented wine is then distilled twice in pot stills. Within these stills the liquid is heated, and the various volatile components within the liquid are separated and eliminated and the alcohol is concentrated. The process is carried out twice, which is one of the unique aspects of grape brandy making. This is referred to as "double distilled" (Eisenman, 1998).

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Distillation is usually used for purifying beverages and separating mixtures of liquids into their individual components. In practice, distillation may be carried out by way of either of two principal methods. After distillation, the aging of brandy is made in oak casks for 3 to 15 years or more. At the time of aging, some of the ethanol and water ooze through the oak and evaporate, so brandy is filled to substitute for this loss. Caramel coloring is introduced to offer the brandy a dark brown color. Brandy may be mixed and/or flavored, and then chilled, filtered, and bottled after aging (McCabe, 2005).

The main objective of this research was to make a study on processing of grape brandy from locally available table grapes. The specific objectives of this study were to study the characteristics of table grape, physicochemical properties of prepared wines and to analyze the properties of distillates for processing of grape brandy, to determine the main constituent and fusel oils in prepared wine, distillate and grape brandy by gas chromatography, and to study the effect of aging in the oak cask and the effect of caramel colour on the processed grape brandy.

Materials and Methods

Materials

Raw materials for processing of grape brandy, table grapes were collected from Saebauk Grape Farm, Kyaukpadung Township, Mandalay Region. Sugar was purchased from City Mart supermarket, 8 miles, Mayangone Township, Yangon Region. Yeast (*Saccharomyces cerevisiae*), ascorbic acid, potassium metabisulphite and potassium sorbate (Analar grade, England) were purchased from KEMIKO chemical shop, 28th Street, Pabedan Township, Yangon Region.

Methods

Processing of Grape Brandy

Selected table grapes were washed with water and seeds were removed. And then the grapes were crushed and pressed immediately to separate the juice from the table grapes. After pressing, the skins, stems and seeds were discarded and juice was collected and allowed to stand for 2 hr, and the clear juice was again collected and residue was discarded. Various ratios of grape juice and sugar were used (1:0, 1:0.01, 1:0.1, 1:0.2 and 1:0.3 v/w) to obtain high yield of wine. Sugar was added in the form of syrup and water was added to it. After that yeast (*Saccharomyces cerevisiae*) was added to enhance fermentation and the content stirred two times day by day for three weeks of fermentation time. On the sugar fermentation that kept for three weeks, the liquid was separated from the stable substances through racking. After racking, prepared white wines were obtained and stored in the wine pot.

Prepared wine was placed into a one-necked round bottomed flask. The distillation column, condenser and distillate collector were attached. Heating was applied to the round bottomed flask. The column top temperature was at 78 ºC as the first distillate was being produced and the quantity of first distillate which was collected, and the final volume of first distillate was recorded.

After the first distillation which took about two hours, wine had been converted to the concentrated liquid (not yet grape brandy) with an alcohol content of 36 % v/v. Second distillation was conducted similarly and the second distillate was collected and amount of

volume obtained was recorded. The product of the second distillation had an alcohol content of around 76 % v/v. The grape brandy so produced was not yet ready for drinking after the second distillation was placed in oak casks and allowed to age for three years. As the grape brandy ages, it absorbed flavors from the oak while its owned structure softens, becoming less astringent, and curing to be an acceptable brandy.

Preparation of Caramel Colour

Caramel colour was prepared by heating either brown sugar or white sugar. Sugar and water were mixed in a pan and strongly heated until the sugar was dissolved. Then, ammonium chloride was added to it and heating was continued. When it reached the point of almost being burnt, it became foaming and smoking. Then it was removed from heat immediately. The lumps left were strained out. The caramel was cooled and stored in airtight bottle.

Characterization

Physicochemical characteristics of table grapes, wine and grape brandy were determined. Main constituent (ethanol) and fusel oils of wine, first distillate, second distillate, grape brandy aged three years in oak cask were examined separately by gas chromatography at the Scientific and Technological Instrument Centers (STIC), Mae Fah Luang University, Chiang Rai, Thailand. In determining alcohol content, firstly specific gravity of sample was determined and then specific gravity of sample was converted to respective alcohol percent (%v/v) by reading Standard Alcohol Density Table. Colours (absorbance) were measured by UV spectrophotometer (UV-1800 SHIMADZU). Sensory evaluation (organoleptic properties) of grape brandy with caramel colour and aged three years in oak cask were also carried out based on colour, taste, odour and overall acceptability were analyzed on the basic of 15 semi-trained panelists. For sensory evaluation, the scoring was based on a 9-point Hedonic Scale: 9 - like extremely, 8 - like very much, 7 - like moderately, 6 - like slightly, 5 - neither like nor dislike, 4 - dislike slightly, 3 - dislike moderately, 2 - dislike very much, 1- dislike extremely. The overall acceptability was taken as the average score of all these organoleptic properties.

Results and Discussion

Grapes are planted in very dry areas of Central Myanmar. As table grape possesses thin skin and soft texture, it has lower fiber content than wine grape, 0.33 %. pH value of table grape was 2.69 with acidity 1.21 and reducing sugar content was 1.73 mg/g for table grape. The right proportion of acid in grape (acid balance) could provide to produce good wine because good acid balance was important in wine making. These properties would be varied depending on the grape variety and climatic conditions of grape growing areas and ideal grape varieties should be chosen to get good wine and related beverages.

As wine was prepared with different amounts of sugar, it was observed that alcohol content of wines depended upon the quantity of sugar to a certain limit. Sucrose inverts into glucose and fructose and then turns into alcohol and carbon dioxide. Colour of prepared wines had a straw yellow due to oxidation during storage.

The highest alcohol content 10 % v/v (wine) was found in grape juices to sugar ratio of 1:02 v/w. Alcohol content of wines gradually increased till a certain fermentation period of twenty weeks (five months).

Effect of fermentation period on the yield of alcohol in wines was studied. The results are shown in Table 1. It was found that five months fermentation period to complete fermentation to produce wine. Several different fermentation parameters such as period, temperature, skin contact time, pressing technique could manage fermentation were studied. After complete fermentation period, yield of alcohol in wine was 10 % v/v.

pH value of prepared wine was 3.3, which can distinctly affect on the wines' flavor, such as aroma, colour, and stability. The acidity value was 0.65 for prepared wine. It was the practical value for expression of the organic acid concentration within wine. Sugar content in wine was measured as soluble solids. A soluble solid (˚Brix) of prepared wine was 2.7 and alcohol content was 10 % v/v. The reducing sugar content was displayed by the conversion of sugars in the grape juice to alcohol by yeast.

The colour of wine had 0.05 colour (absorbance) in the visible region (wavelength-520 nm) and were clear and transparent, without sediments or cloudiness. There is an extra absorption band in the ultraviolet region (500-524 nm) for wine. The colour also indicates the age and evolution of the wine.

Table 1: Effect of Fermentation Period on the Yield of Alcohol in Wines

Wine (Grape Juice: Sugar Ratio) (v/w)	**Yield of Alcohol (% v/v)**					
	FP 1	**FP 2**	**FP 3**	**FP 4**	**FP 5**	**FP 6**
1 : 0	2.0	3.0	3.0	4.0	5.0	5.0
1 : 0.01	2.0	4.0	5.0	6.0	7.0	7.0
1 : 0.1	3.0	5.0	7.0	8.0	9.0	9.0
1 : 0.2*	4.0	6.0	8.0	9.0	10.0	10.0
1 : 0.3	3.0	5.0	6.0	7.0	8.0	8.0

FP = Fermentation Period (month)

Main constituent and fusel oils content of wine, first and second distillates from wine were analyzed by gas chromatography. The spectra are shown in Figures 1, 2, and 3 and their respective data are also presented in Tables 2, 3 and 4. From analysis by gas chromatography, it could be confirmed that the main organic compound in first and second distillates were ethanol. Minute trace amount of other organic compounds were contained in the distillates. The other compounds were acetaldehyde 1,1-dioxyethane, isoamyl alcohol, propyl alcohol, ethyl acetate, 1,3-dioxolane,2,4,5-trimethyl alcohol, 2-methyl-n-butyl etc.

Volatile fatty acids, ethyl acetate and acetaldehyde were contributed to the flavor and aroma of wine. The aroma of wines was represented by a complex of volatile compounds coming from several sources. These may be by products of alcoholic fermentation and the composition can vary widely depending on the raw materials used. It was observed that alcohol content of

first distillate and second distillate of white wine were 36 % v/v and 76 % v/v respectively. The alcohol content was drastically increased after second distillation.

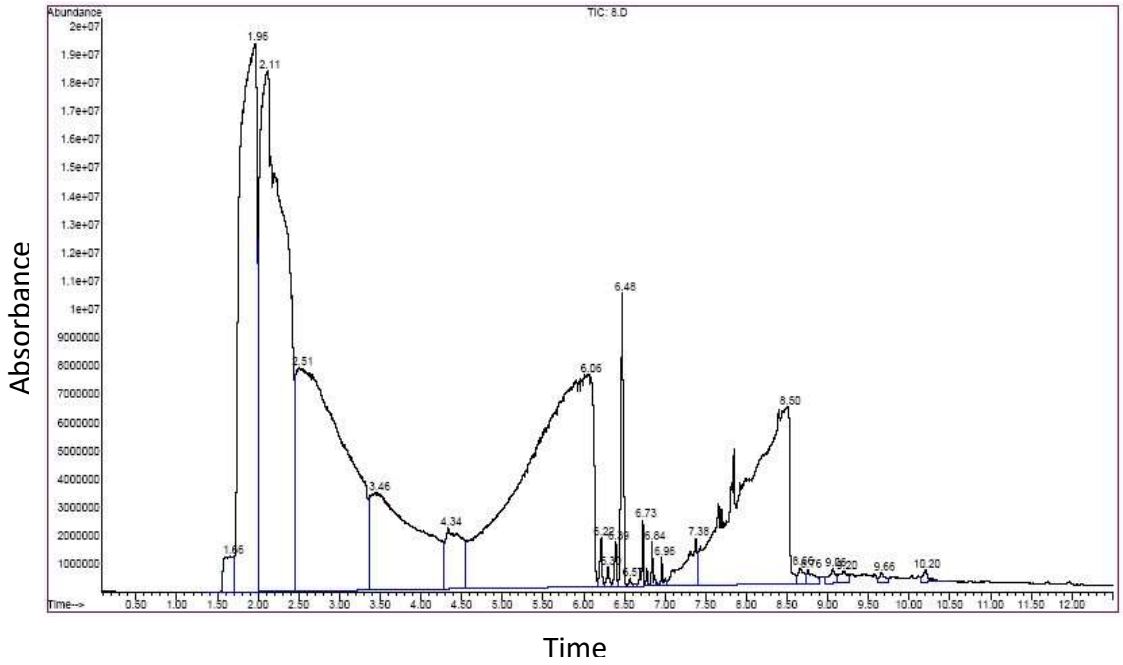

Figure 1: Gas Chromatography Spectrum of Main Constituent and Fusel Oils in Prepared Wine

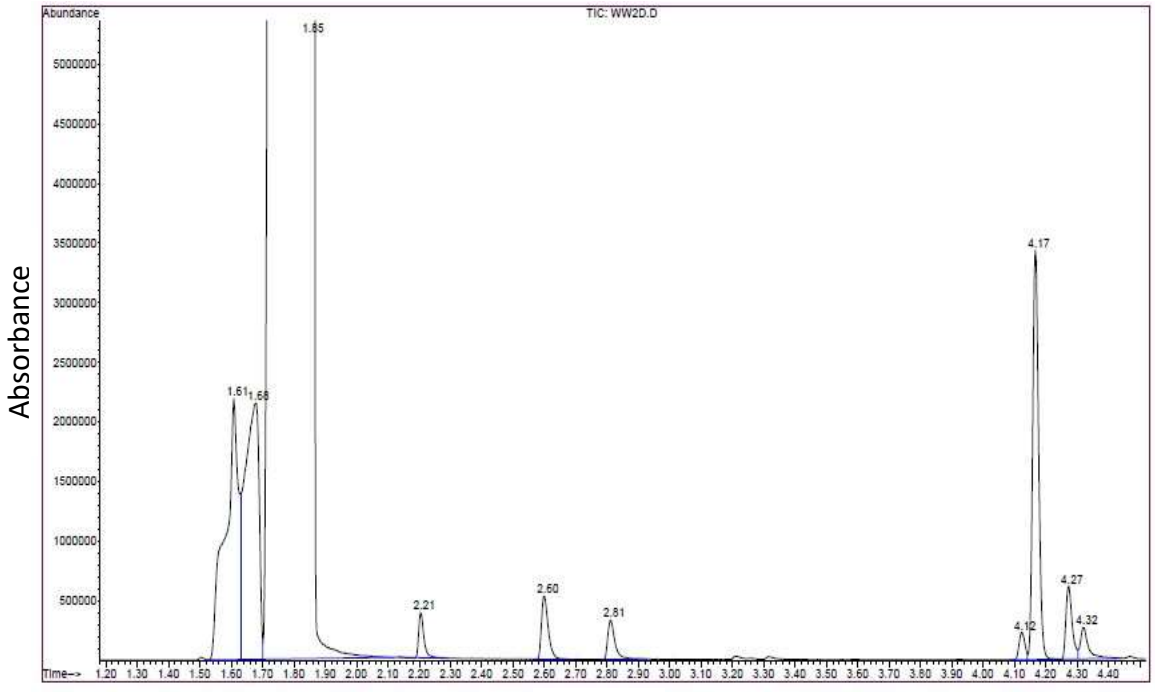

Figure 2: Gas Chromatography Spectrum of Main Constituent and Fusel Oils in First Distillate from Wine

Table 2: Main Constituent and Fusel Oils in Prepared Wine Analyzed by Gas Chromatography

Peak No.	Retention Time (min)	Area (%)	Compound Name	Quality	Total (%)
1	1.66	0.52	Not detected: Value of quality less than 60%	2	0.522
2	1.96	14.05	Ethanol $$ Ethyl alcohol	91	14.046
3	2.11	20.17	Ethanol $$ Ethyl alcohol	91	20.168
4	2.51	17.21	Ethanol $$ Ethyl alcohol	90	17.212
5	3.46	7.24	Ethanol $$ Ethyl alcohol	90	7.242
6	4.34	1.55	Not detected: Value of quality less than 60%	4	1.551
7	6.06	22.75	Not detected: Value of quality less than 60%	2	22.746
8	6.21	0.18	Acetic acid $$ Ethylic acid	91	0.175
9	6.30	0.08	Not Report: Value of quality less than 80%	47	0.082
10	6.39	0.14	1,2-Propanediol $$ Propylene glycol	91	0.145
11	6.48	1.17	2,3-Butanediol	90	1.169
12	6.57	0.04	Not detected: Value of quality less than 60%	47	0.039
13	6.73	0.21	Not detected: Value of quality less than 60%	56	0.211
14	6.84	0.12	Butyrolactone $$ Butyryl lactone	64	0.118
15	6.96	0.08	cis-5-hydroxy-2-methyl-1,3-dioxane	87	0.076
16	7.38	0.92	Not Report: Value of quality less than 60%	43	0.921
17	8.50	12.77	Glycerin $$ Glycyl alcohol	83	12.771
18	8.66	0.14	Not detected: Value of quality less than 60%	47	0.142
19	8.76	0.16	Not detected: Value of quality less than 60%	38	0.158
20	9.06	0.15	Not detected: Value of quality less than 60%	46	0.148
21	9.20	0.15	Not detected: Value of quality less than 60%	35	-
22	9.66	0.09	Not detected: Value of quality less than 60%	50	-
23	10.20	0.11	Benzene ethanol, 4-hydroxy-	74	-

Table 3: Main Constituent and Fusel Oils in First Distillate from Wine Analyzed by Gas Chromatography

Peak No.	Retention Time (min)	Area (%)	Compound Name	Quality	Total (%)
1.	1.61	2.27	*Acetaldehyde	86	2.27
2.	1.85	92.43	Ethyl alcohol	86	92.43
3.	2.21	0.16	*Propyl alcohol	90	0.16
4.	2.60	0.28	*Ethyl acetate	91	0.28
5.	2.81	0.19	*Isobutyl alcohol	90	0.19
6.	4.12	0.10	*1,3-dioxolane,2,4,5-trimethyl alcohol	83	0.10
7.	4.17	1.63	*1,1-diethoxyethane	83	1.63
8.	4.27	0.30	*Isoamyl alcohol	86	0.30
9.	4.32	0.17	*2-methyl butyl alcohol	87	0.17

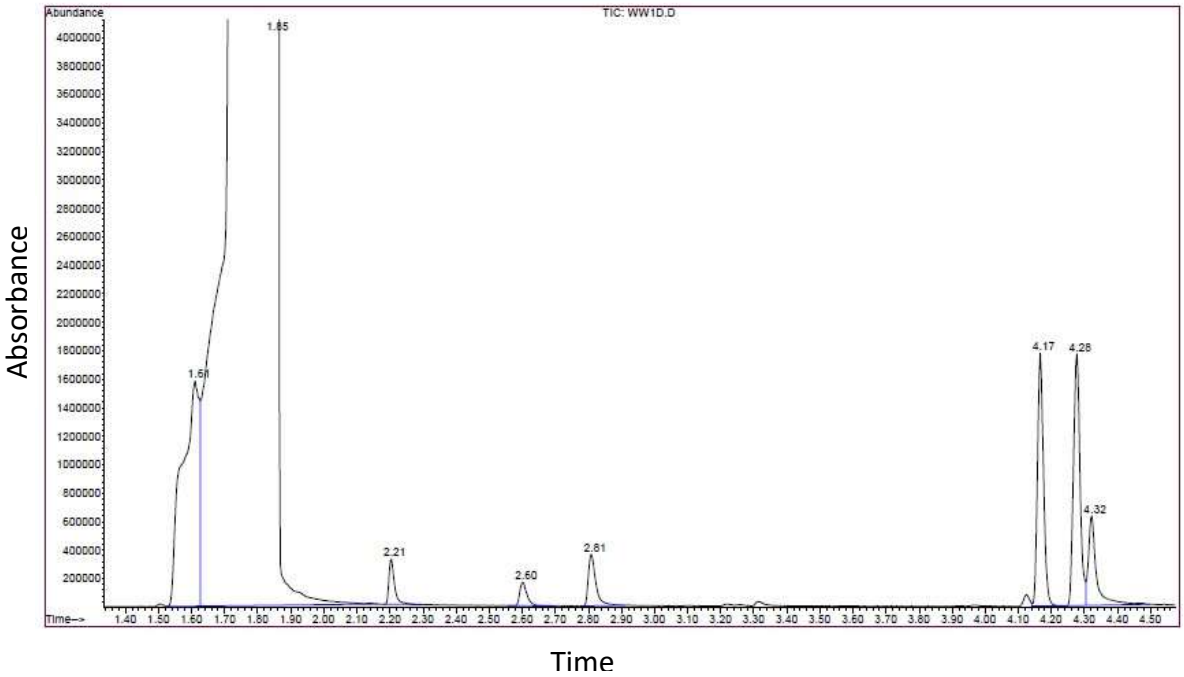

Figure 3: Gas Chromatography Spectrum of Main Constituent and Fusel Oils in Second Distillate from Wine

Table 4: Main Constituent and Fusel Oils in Second Distillate from Wine Analyzed by Gas Chromatography

Peak No.	Retention Time (min)	Area (%)	Compound Name	Quality	Total (%)
1.	1.84	95.47	Ethyl alcohol	86	95.47
2.	2.20	0.14	*Propyl alcohol	91	0.14
3.	2.60	0.09	*Ethyl acetate	91	0.09
4.	2.81	0.21	*Isobutyl alcohol	91	0.21
5.	4.17	0.81	*1,1-diethoxyethane	83	0.81
6.	4.28	0.88	*Isoamyl alcohol	90	0.88
7.	4.32	0.39	*2-methyl butyl alcohol	91	0.39

Processed grape brandy from wine was aged in the toasted oak cask at 18˚C. Aged grape brandy (aged for three years in the oak cask) contains ethanol as main constituent with no fusel oils according to the result of Gas Chromatography, as described in Figure 4 and Table 5. Thus, aging in the oak cask supported the brandy to improve the taste, colour, and odour and also excluded the fusel oils.

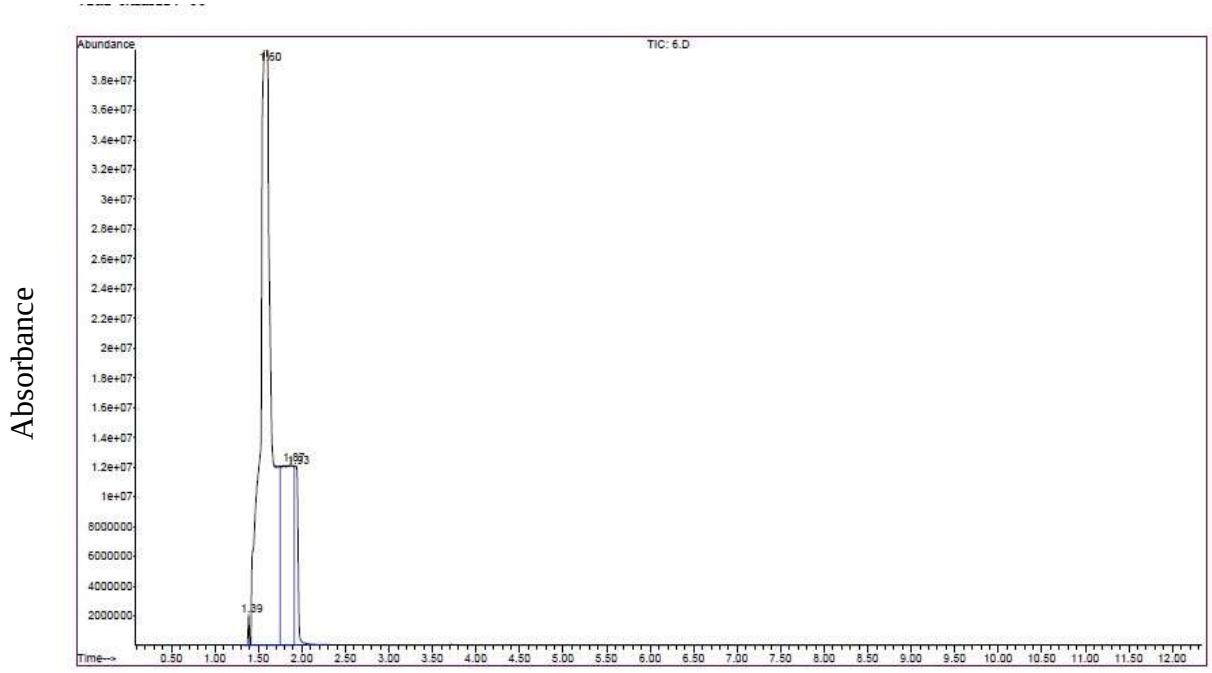

Figure 4: Gas Chromatography Spectrum of Main Constituent and Fusel Oils in Three Years Aged Grape Brandy in Oak Cask

Table 5: Main Constituent in Three Years Aged Grape Brandy in Oak Cask Analyzed by Gas Chromatography

Peak No.	Retention Time (min)	Area (%)	Compound Name	Quality (Grade)	Total (%)
1.	1.58	70	Ethyl alcohol	83	76.45

Colour (absorbance) of prepared caramel colour from brown sugar and white sugar was 4.992 and 4.978. Colour (absorbance) of commercial caramel colour was 5.457. It was observed that prepared caramel colour had rather higher absorbance than that of commercial product colour. The effect of caramel colour on the colour of grape brandy to match the effect of aging in the oak cask is shown in Table 6. The suitable amounts of added caramel colour were 0.03 g from brown sugar and 0.04 g from white sugar for processed grape brandy. Since these amount could provide the absorbance nearly the same as commercial brandy.

Sensory evaluation (organoleptic properties) of grape brandy was similar to wine tasting that includes appearance, colour, taste and aroma**.** Grape brandy contained lower quantities of acids and a much higher quantity of ethyl alcohol. The organoleptic properties of grape brandy with added caramel colour (sample 1), grape brandy aged three years in oak cask (sample 2), and also commercial brandy (sample 3) were studied and these results are shown in Table 7. Panelists gave the highest preference for all sensory attributes of sample (2) followed by sample (3) and sample (1). Sample (2) was recorded the highest overall acceptance of sensory evaluation (7.08) and mean scores for appearance (7.15), colour (6.98), taste (6.86) and aroma (7.32). The least preference for all sensory attributes sample recorded the least overall acceptance of sensory evaluation (5.77). The overall acceptability of grape brandy depended on the organoleptic properties of processed grape brandy.

Table 6: Effect of Caramel Colour on the Colour of Grape Brandy

Sr. No.	Colour (absorbance) of Grape Brandy without Caramel	Amount of Caramel Colour Added (g)	Colour (absorbance) of Prepared Grape Brandy from Wine using Caramel			Colour (absorbance) of Commercial Brandy
			Caramel Colour (Brown Sugar)	Caramel Colour (White Sugar)	Commercial Caramel Colour	
1	1.112	0.01	2.912	3.654	1.345	5.389
2		0.02	4.229	3.792	2.476	
3		0.03	*4.922	4.092	3.891	
4		0.04	5.788	*4.978	5.342	
5		0.05	6.865	4.108	*5.457	

Table 7: Sensory Evaluation (Organoleptic Properties) of Grape Brandy

Organoleptic Properties	Panelist Hedonic Rating		
	Sample (1)	***Sample (2)**	**Sample (3)**
Appearance	5.53	7.15	6.91
Colour	5.74	6.98	6.75
Taste	5.92	6.86	6.67
Aroma	5.87	7.32	7.11
Overall Acceptance	5.77	7.08	6.86

Sample (1) = Prepared Grape Brandy processed with caramel color
Sample (2) = Prepared Grape Brandy aged two years in oak cask
Sample (3) = Commercial Brandy

Conclusion

Grape brandy is a wine spirit processed by distillation of wine and is aged in oak casks. This research was emphasized mainly on alcoholic fermentation, distillation, aging and to study the characteristics that may affect grape brandy quality, according to their composition to promote quality and to provide a dissimilar aroma and a smooth taste to the finished product. It was found that the alcohol content of wine depended upon the certain limit of the quantity of sugar and fermentation period. Double distillation sharply increased ethanol concentration. Grape brandy from wine was colourless and odourless, thus needs to study the effect of aging. The addition of caramel was rather common in the processing of aged grape brandy since it has given an attractive amber coloration to the consumer. To obtain fine brandy, concentrated alcohol must be placed in oak casks and allowed to age for at least three years, an important step in the production process. Compounds released from wood into brandy depend on the factors such as type of wood and time of contact. Aging in the oak cask could support not only to improve the taste, colour and odour of finished grape brandy but also to eliminate the fusel oils. Moreover, by aging in the oak cask, grape brandy could also have interacting with air and oak barrel in which evaporation can take place and concentration would be dropped from 76 % v/v to about 65 % v/v. Processing of grape brandy could be conducted from locally available table grapes which provides value-added product for Myanmar grapes cultivators and communities.

Acknowledgements

I am grateful to Dr Tin Tun, Rector, University of Mandalay and Pro-Rectors, University of Mandalay, for their permission to submit this article. I would like to express my greatest appreciation to Dr Soe Win, Professor and Head, Department of Industrial Chemistry, University of Mandalay for his permission to submit this research paper, reviewing the manuscript and suggestions.

References

Anderson, F., and Hull, R., (1970). “The Art of Wine Making”, New York.

Blue, Anthony, (2004). “The Complete Book of Spirits”. New York: HarperCollins. p. 239. ISBN 978-0-06-054218-4.

Eisenman, L., (1998), “The Home Winemakers Manual”.

Green Don W. & Perry Robert H., (1997). “Perry's Chemical Engineers’ Handbook, 8th Edition, McGraw-Hill, Inc., New York.

McCabe Warren L., Smith Julian C. & Harriott Peter, (2002). “Unit Operations of Chemical Engineering”, 5th Edition, McGraw-Hill Chemical Engineering Series, New York.

McCabe Warren L., Smith Julian C. & Harriott Peter, (2005). “Unit Operations of Chemical Engineering”, 7th Edition, McGraw-Hill Chemical Engineering Series, New York.

Reisch B. I., Peterson D. V. & Martens M-H., (2008). "Seedless Grapes Breeding for Disease Resistance by Using Embryo Rescue" Archived 2008-06-19.

Reisch Bruce I., Peterson David V. & Martens Mary-Howell, (1993). "Table Grape Varieties for Cool Climates", Information Bulletin 234, Cornell University, New York State Agricultural Experiment Station