Open Access Journal of Animal & Plant Husbandry

Academic Strive
Researcher's perception is our reality

Research Article

Volume 4 Issue 1

Evaluation of Physicochemical Property of Wine Developed from Papaya Fruit

Tilinti BZ*, Tsegaye K, Asre D, Wondu B and Tigabu N

Department of Industrial Chemistry, Arba Minch University, Ethiopia

***Corresponding author:** Birhanu Zeleke Tilinti, Department of Industrial Chemistry, College of Natural & Computational Sciences, Arba Minch University, P.O.Box 21, Arba Minch, Ethiopia, Email: birhanzele@gmail.com

Received Date: August 22, 2024; **Published Date:** September 16, 2024

Abstract

Papaya is one of the most important tropical fruits in Ethiopia. Increased production has been observed over years paralleled by large postharvest losses which are partly attributed to poor value addition practices. Commonly wine is produced from grapes and, it can also produce from other fruit. The purpose of this study will be to provide an alternative for reducing the level of postharvest losses in papaya by producing papaya wine. Wines are unprocessed alcoholic alimentary beverages typically made from fruits such as grapes, banana, peaches, etc. The pawpaw fruits was collected in a clean sterile basin, washed with water containing sodium metabisulphate (0.3 g/L), Peele, remove seeds and pulverize using sterile Philip electric blender with the addition of water. Physicochemical parameters such as pH, total soluble solid, titratable acidity, specific gravity and alcohol content were determined. The result found was 2.697 ± 0.641 pH, 23.33±0.61 TSS, 1.148 ± 0.0034 TTA, and 13.291 ± 0.0 ABV. The pH of different fruit wines will be different. Acidity has a crucial role in dictating the quality of the wine by regulating fermentation, improving the balance and overall characteristic traits of wine. The absence of acidity will certainly diminish the fermentation and will lead to a poor product. Choose ripe and highquality papaya is crucial for quality wine production process. The different parameters analyzed in the present study will help to produce good quality wine and, to ensure its consistency therefore, it is expected that by using these parameters, the quality of wine can be improved during large-scale production. By monitoring and optimizing these parameters throughout the production process, producers can ensure the papaya wine meets quality standards and is safe for consumption. The research suggests that other tropical fruits could also be used to produce high-quality wine with potential for commercial success.

Keywords: Grape; Papaya; Physicochemical; Sensory; Wine

Abbreviations

°Bx: Degree Brix; ABV: Alcohol by Volume; ANOVA: Analysis of Variance; AOAC: Association of Official Analytical Chemists; CSA: Central Statistical Authority; CRD : Completely Randomized Design; RCBD: Randomized Complete Block Design; TSS: Total Soluble Solids; TTA : Total Titratable Acidity.

Introduction

Wine is a product of alcoholic fermentation by yeast of the juice of ripe grapes or any fruit with a good proportion of sugar Okafor N [1]. Wine is one of the most recognizable high value added products from fruit. Wine manufacture is challenging in which marketable product can be obtained, but the processes involved in its production are relatively straight forward. Highly acceptable wines can be made practically from all fruits Anon [2]. Although grapes are the most common fruit used to make wine for the past few decades. Moreover, the non-availability of grapes, which is usually the fruit of choice for wine production in the tropics, has necessitated the search for alternative fruit source in tropical countries Alobo AP, et al. [3]). Fruits such as banana, cucumber, pineapple, papaya and other fruits are used in wine production Obaedo ME, et al. [4], Chilaka CA, et al. [5], Noll RG [6]. Wine represents a safe and healthful beverage; it also provides calories and vitamins. Pawpaw (Carica papaya), a flowering plant, belongs to the family Caricaceae, which include about 20-25 species of short- lived evergreen shrubs or small trees growing to 5-10 m tall Svans p [7]. Pawpaw originated from Southern Mexico, Central America and South America. It is also cultivated in most countries with topical climate, such as Brazil, India, South Africa, Nigeria, Haiti and South East Asia Anon [8]. The ripe fruit is usually eaten raw, without the skin or seed, because of its high sugar content (59%) and thus could be used in wine production as any fruit with a good proportion of sugar may be used Anon [9].

Papaya is a tropical fruit with a unique, strong, and penetrating flavor. Moreover, it is a good source of vitamin A and C Anon [9]. The fruit's high nutritional quality also makes it an excellent contribution to a balanced diet. It is also a potential source of natural fruit flavor. Pawpaw also has high levels of potassium, calcium and iron, making it an excellent food source Anon [8]. The skin color of the ripe fruit usually ranges from green to bright yellow, although in some varieties, a pinkish blush may also be observed. The fruit is also characterized by a delicate skin and a large amount of small, hard seeds in its flesh. 2 Ethiopia is among five top papaya producing country in Africa CSA [10]. Based on CSA2015, papaya ranks the third in amount of fruit production (40,435.06 tons) during 2014/15 cropping season with area coverage of 3,109.52 hectares. Papaya is being produced in all regional states of Ethiopia and consumed as fresh fruit in most parts of the country. About 15, 572,313 Ethiopian small holder farmers were involved in papaya production. Area of papaya production increased from 22,262.52 to 40,435.06 hectares from year 2011 to 2015 which is 81.6% total increment within five years interval. Papaya has great potential for extensive commercial use because of its ease of culture, high nutritive value and popularity of processed papaya products. While ripe fruit is usually eaten as a dessert, processed products like juices, nectar, jam, jellies, baby foods, puree, beverage base, syrup and wine are also prepared from papaya (Figures 1-3).

Soluble solids are the basic requirement for the function of papaya or any other fruit for wine production. It has been reported that the chief sugar components are fructose and sucrose. For the production of wine from over ripe papaya fruits using Saccharomyces crevices, the juices of papaya were extracted and analyzed for TSS, pH, and total Sugar. Various factors influence the fermentation process and determine the end products obtained [11]. These include substrate related factors such as cultivar types, cultivation condition, conditions at harvest and postharvest handling. Yeast species are used in many industrial fermentations processes including alcohol beverages production. The quality of wine produced greatly depends on the yeast strain; development of improved starter organisms for fermentation of papaya juice may offer a relative simple avenue for reducing postharvest wastage of papaya fruits in low utilization environment and in places where the production of papaya concentrates is low or nonexistent. Juice concentrates are readily 3 Storable and can be used for production processes even when the fruit is out of season. In an effort aimed at increasing the low industrial utilization and reducing the high wastage of papaya fruits in the developing world, and investigated the possibility of exploiting the fermentative ability of yeasts to produce papaya wines [12].

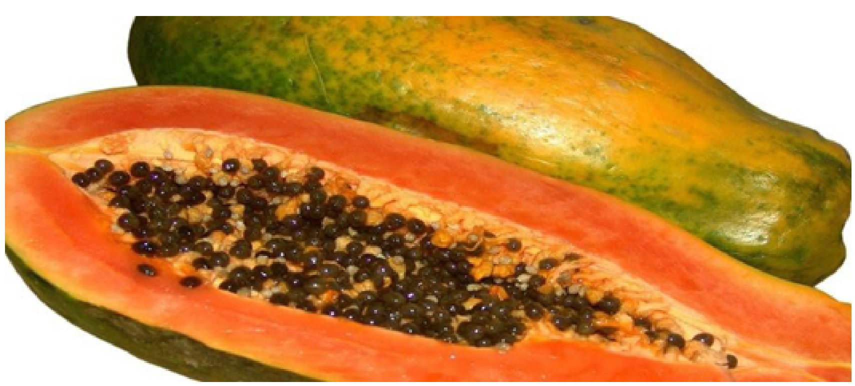

Figure 1: Image of Papaya Fruit.

Methodology

Processing of the "Must" The pawpaw fruits was collected in a clean sterile basin, washed with water containing sodium metabisulphate (0.3 g/L), Peele, remove seeds and pulverize using sterile Philip electric blender with the addition of water. The slurry further diluted in a ratio of 1:1 (water and pulp) and sieve with a muslin cloth of pore size 0.8 mm to obtain the filtrate "must" (Tables 1 & 2).

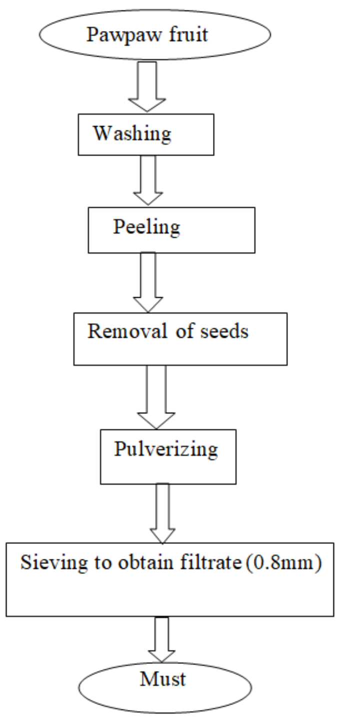

Figure 2: Flow process diagram for the production of must from pawpaw fruit.

Capitalization and Supplementation of the "Must"

Some litters of the must were poured into a white plastic vessel (bucket). The must was capitalized with some gram of sugar and dissolved in some quantity of "must". The must was enriched with some gram of ammonium sulphate and some gram of potassium dihydrogen phosphate to enhance the rapid growth of the fermenting yeast [13].

Primary Fermentation

A broth culture (200 mL) containing 2.0 × 108 cfu/mL was pitch into the must in a fermentation vessel by sprinkling it over the surface of the juice. The inoculated must was covered with cotton wool and incubated at room temperature. The fermenting "must" was aerated daily by shaking to encourage yeast multiplication. Aerobic fermentation was terminated after 7 days [14]. During this period, microbial analysis, sugar content, specific gravity, titratable acidity and pH was monitored at two-day intervals (Appendix).

Secondary Fermentation

After the primary fermentation, an air taps was fixed to the fermenting vessel to indicate the end of primary fermentation [15]. Secondary fermentation was terminated after 7 days and then the wine was filtered. Microbial analysis, alcohol, sugar content, specific gravity, titratable acidity and pH of the wine also monitored at the end of the secondary fermentation.

Clarification and Racking

After secondary fermentation, the wine was racked weekly for 3 weeks to clear the wine.

Aging

After the racking, the wine was kept in the refrigerator for maturation (2weeks) and then packaged for further analysis. Extraction was most commonly achieved through maceration (soaking the skins of the crushed grapes in the wine after fermentation) during which alcohol helps dissolved flavor, aroma and especially tannin molecules as with a steeping tea bag, the longer and warmer the maceration, the greater the degree of extraction [16,17].

Chemicals and Apparatus

Water, yeast, ethanol, sodium Metabisulphate, calcium carbonate, ammonium sulphate, potassium dihydrogen phosphate, cinnamon, sugar, sodium hydroxide, phenophetaline indicator, grapes and papaya will be chemicals used [18]. The apparatus used for this study is fermentation vessel, cleaning and sanitizing equipment, temperature control, pH-meter, hydrometer, titration kits, cambden tablet, siphoning equipment, bottles or corks, primary and secondary fermenter, refractometer, pycnometer, closures, and thermometer [19].

Preparation of Juice

The papaya fruits was thoroughly sorted and graded to remove bad ones from the lot. The sorted fruits were washed to remove adhering soils, dirt's and extraneous materials. The fruits here thereafter were peeled, sliced and seeds removed. It will be then diced, blended and sieved [20-23]. T.S.S of fruit juice sample was adjusted to 22°Bx in order to have sizable amount of alcohol in wine by addition of sugar Juice sample (3000ml) were pasteurized at 82°-85°C for 20 minutes and kept at room temperature for 24 hrs to stabilize. Sugar and yeast (S.cerevisiae) were then added and lifted to ferment for 10-15days. Fermentation was done by using fermenter [24,25]. Then it was clarified, and then labeled, bottled and sealed.

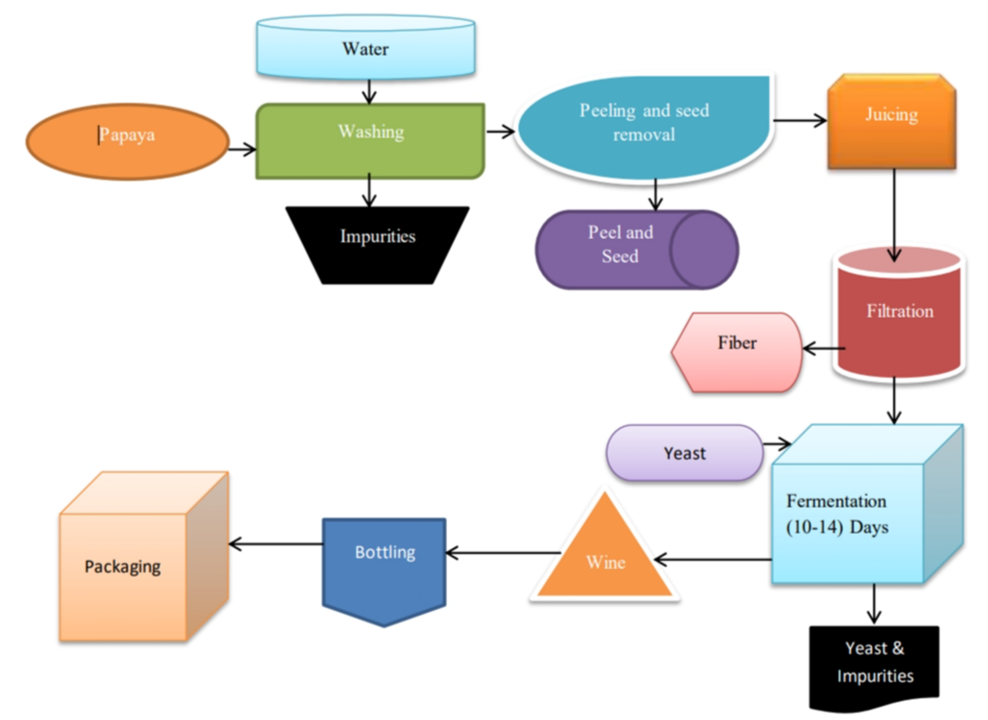

Figure 3: Flow diagram of papaya wine Source: Nwanekezi EC, et al. [26].

Physicochemical Parameters

Physicochemical parameters such as pH, total soluble solid, titratable acidity, specific gravity and alcohol content were determined Latimer GW [27].

Determination of pH

The pH was measured using a pH meter, the pH meter was standardized (calibrated) at 25°C with buffer solution of 4.0 and 7.0 Latimer GW [27]. The glass electrode of pH meter was dipped (immersed) in glass beaker containing the beverage sample measured at ambient temperature and was allowed to stabilize for sometimes after which the reading was taken [28,29].

Determination of Total Soluble Solids (TSS)

The TSS was determined as total sugars in the juice using fractometer at 20°C Latimer GW [27].This will be done by placing about 3drops of the wine sample on top of the prism assembly and then closed with the daylight plate [30]. The sample was then allowed to stand for approximately 30 seconds for it to adjust to the temperature of the refractometer. Then the result was taken by reading the calibrations of the refractometer through the eyepiece expressed in ºBx [31-33].

Determination of Total Titratable Acidity (TTA)

Total titratable Acidity was determined by following method Latimer GW [27]. 10 ml of wine sample solution was betaken and titrated with 0.1N NaOH using three drops of phenolphthalein solutions as indicator with constant shaking. Stop titration when pink color end point was appeared. The burette reading was noted down. Calculate the acidity in terms of citric acid by using following Formula.

$$\text{Acidity}(\%) = \frac{\text{VNaOH} \times 0.064 \times \text{NNaOH}}{\text{sample volume}} \times 100$$

Where:
V=ml of 0.1 NaOH required for the titration
N = Normality of NaOH used and 0.064 is a Constant

Determination of Alcohol Content (ABV)

The total alcohol of the wine samples was determined by the specific gravity method by using following formula.

$$ABV(\%) = \frac{[1.05X \ (OG - FG)]}{0.79} \times 100$$

Where:
OG is the initial specific gravity measurement to juice
FG is the final specific gravity measurement of wine ABV is alcohol by volume.

Result and Discussion

Reagent	Papaya	Potassium dihydrogenphosphate	Ammonium sulphate	Calcium carbonate	Sugar	Yeast	Water
Amount	3kg	6.938g	6.83g	4.89g	400g	2spetula	2liter

Table 1: Chemicals and Reagents Dosage used per Kg of Sample.

Physicochemical parameter	Days		
	0	7	14
pH	4.56	3.67	2.7
Specific gravity	1.103	1.004	1.003
Temperature(°C	25	28	30

Table 2: physicochemical parameters of papaya wine during regular intervals.

Wines are unprocessed alcoholic alimentary beverages typically made from fruits such as grapes, banana, peaches, etc. The fruit juices endure through a process of aging after the action of yeasts which leads to a major change in the composition and flavor. Awe S [34]. Besides ethanol, most wines contain different types of aldehydes, sugars, tannins, esters vitamins, minerals, and other flavoring compounds. The pH of different fruit wines will be different Ayoola PB, et al. [35], Berry CJJ [36].The pH of the unfermented must in the present study was 4.56 and it gradually decreased to 2.70 during the course of fermentation. The decrease in pH indicates an increase in acidity. The initial specific gravity obtained was 1.103 g cm^{-3}. It then decreased and reached a value of 1.003 g cm^{-3} on the 14th day.

The values of pH, and specific gravity were shown in the above table 2.The results were in agreement with the reports of Satav, et al. [37].The acidic pH, however, favors the increased production of alcohols. A probable cause for this might be growth inhibition of other microorganisms at acidic pH, leading toward increased alcohol production by yeasts [38]. Acidity has a crucial role in dictating the quality of the wine by regulating fermentation, improving the balance and overall characteristic traits of wine. The absence of acidity will certainly diminish the fermentation and will lead to a poor product Bezabih E, et al. [39], Bisson LF, et al. [40]. The temperature also showed variations during fermentation. It may be because of the changes that occur during utilization of the substrate by the yeast [41].

Acknowledgments

The authors acknowledge the Industrial Chemistry Departments of Arba Minch University for supporting the laboratory. The author thanks the organizing staff Research and Publication Directorate and especially the Department of Industrial Chemistry for their encouragement.

Conflict of Interest

There are no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

References

1. Okafor N (2007) The Technology of Passion Fruit and Pawpaw Wines. Amerian J Enol Vitic, pp: 17-27.
2. Anon (2007) Wine Encyclopedia.
3. Alobo AP, Offonry SU (2009) Characteristics of Coloured Wine Produced from Roselle (Hibiscus Sabdariffa) Calyx Extract. Journal of the Institute of Brewing 115(2): 91-94.
4. Obaedo ME, Ikenebomeh MJ (2009) Microbiology and Production of Banana (Musa Sapientum) Wine. Niger J Microbiol 23(1): 1886-1891.
5. Chilaka CA, Uchechukwu N, Obidiegwu JE, Akpor OB (2010) Evaluation of the Efficiency of Yeast Isolates from Palm Wine in Diverse Fruit Wine Production. African Journal of Food Science 4(12): 764-774.
6. Noll RG (2008) The Wines of West Africa: History, Technology and Tasting Notes. Journal of Wine Economics 3(1): 85-94.
7. Svans P (2008) Preservatives in Wine and Why We Need Them.
8. Anon (2010) Yeast Encyclopedia Britannica, Ultimate Reference Suite. Chacago: Encyclopedia Britannica.
9. Anon (2008) Making Wines at Home Use Wild Yeasts.
10. CSA (2015) Agricultural Sample Survey: Report on Area and Production for Major Crops (Private Peasant

Holdings, Meher Season). Statistical Bulletin 578, Addis Ababa, Ethiopia, pp: 54.

11. Alexander H, Charpenter C (1998) Biochemical Aspects of Stunk and Sluggish Fermentation in Grape Must. Journal of Industrial Microbiology and Biotechnology 20: 20-27.

12. Amerine MA, Joslyn MA (1990) Table Wines: The Technology of Their Production. 2nd (Edn), University of California Press, Berkeley.

13. Amerine MA, EB Roessler, F Filipello (1959) Modern Sensory Methods of Evaluating Wine. Hilgadia 28(18): 477-567.

14. Amerine MA, Singleton VL (1986) Operations in Wine Making. Wine an Introduction, pp: 89-116.

15. Buglione M, Lozano J (2002) Nonenzymatic Browning and Chemical Changes during Grape Juice Storage. Journal of Food Science 67(4): 1538-1543.

16. FAO (2005) Production Status Food and Agriculture Organizations of the United Nations.

17. Feher J, Lengyel G, Lugasi A (2005) Cultural History of Wine, the Theoretical Background of Wine Therapy. Orv Hetil 146(52): 2635-2639.

18. German JB, Walzem RL (2000) The Health Benefits of Wine. Annual Review of Nutrition 20: 561-593.

19. Hewett EW (2006) An Overview of Pre-Harvest Factors Influencing Postharvest Quality of Horticultural Products. International Journal of Postharvest Technology and Innovation 1(1).

20. Emmanuel IO, Odoyo O (2011) Studies on Wine Production from Pawpaw (Carica Papaya). Journal of Brewing and Distilling 2(4): 56-62.

21. Jackson RS (2008) Wine Science Principles and Applications. In: 5th (Edn.), California: Academic Press, pp: 948.

22. Jacobs F (2001) Making Wine from Pineapple, Them Davis Press, Owerri.

23. Joonsten F (2007) Development Strategy for Export Oriented Horticulture in Ethiopia. Agricultural and Food Sciences, Economics.

24. Kilingo JK, Muendo KM, Mairura Z, Kariuki JG (2001) Marketing of Smallholder Produce: A Synthesis of Case Studies in the High Lands of Central Kenya.

25. Josef SB (2008) Production of Papaya: A Production Manual, Provide in Support of Papaya Extension Program of the Ministry of Agriculture Land and Marine Resources, Extension, Training and Information Division, Trinidad and Tobago.

26. Nwanekezi EC, Osuji CM, Osuke JC (2004) Brewing and Beverage Technology. Supreme Publishers, Oweri, Nigeria, pp: 74-85.

27. Latimer GW (2023) Official Methods of Analysis. In: 22nd (Edn.), Association of Official Analytical Chemists, Washington, USA.

28. Laundry CR, Townsend JP, Hartl DL, Cavalieri D (2006) Ecological and Evolutionary Genomics of Saccharomyces Cerevisiae. Mol Eco 15(3): 59-575.

29. Lindberg ML, Amsterdam EA (2008) Alcohol, Wine, and Cardiovascular Health. Clin Cardiol 31(8): 347-351.

30. Nwofia GE, Okwu QU (2012) Studies on Nutritive Characteristics and Variability in Pawpaw (Carica Papaya L.). Pakistan Journal of Nutrition 11(10): 859-864.

31. Robinson J (2006) Jancis Robinson's Wine: A Guide to the World of Wine, BBC World wide Ltd., Oxford University Press, New York, USA, pp: 39.

32. Ruf JC (2003) Overview of Epidemiological Studies on Wine, Health and Mortality. Drugs Exp Clin Res 29(5-6): 173-179.

33. Sevda SB, Rodrigues L (2011) Fermentative Behavior of Saccharomyces Strains during Guava (Psidium Guajava L) Must Fermentation and Optimizationof Guava Wine Production. Journal of Food Processing & Technology 2(4).

34. Awe S (2011) Production and Microbiology of Pawpaw (*Carica Papaya* L) Wine. Curr ResJ Biol Sci 3(5): 443-447.

35. Ayoola PB, Adeyeye A (2010) Phytochemical and Nutrient Evaluation of Cariea Papaya (Pawpaw) Leaves. International Journal of Research 5(3): 325-328.

36. Berry CJJ (2000) First Steps in Wine Making. Wine Making Books.

37. Swiegers JH, Bartowksy EJ, Henschke PA, Pretorius IS (2005) Yeast and Bacterial Modulation of Wine Aroma and Flavor. Australian Journal of Grape Wine Research 11(2): 139-173.

38. Ugbogu OC, Ogodo AC (2015) Microbial Flora, Proximate Composition and Vitamin Content of Three Fruits Bought from a Local Market in Nigeria. International Journal of Chemistry Eng Appl 6(6): 440-443.

39. Bezabih E, Hadera G (2007) Constraints and Opportunities of Horticulture Production and Marketing in Eastern Ethiopia. Dry Lands Coordination Group Report.

40. Bisson LF, Doir KG, Butzkc CE (2009) History of Wine making, Wine, microsoftencarta.

41. Weinberger K, Lumpkin TA (2005) Horticulture for Poverty Alleviation. The World Vegetable Center pp: 19.