TOROS UNIVERSITY
JOURNAL OF FOOD, NUTRITION AND GASTRONOMY

Research Article

Sensory profile and physicochemical composition of premixed and post mixed fruit wine from blends of pineapple and watermelon juice

Azuka Irene Ugo [1*]
Mbaeyi-Nwaoha Ifeoma [1]
Uvere Peter [1]
Ofoegbu Deborah Chinwendu [1]

1 Department of Food Science and Technology, Faculty of Agriculture, University of Nigeria, Nsukka, Nigeria

Article info

Keywords:

tropical fruits, fermentation, total acidity, total soluble solid, alcohol content

Received: 26.08.2022

Accepted: 29.09.2022

E-ISSN: 2979-9511

DOI: 10.58625/jfng-1917

Azuka ve diğ.; Sensory profile and physicochemical composition of premixed and post mixed fruit wine from blends of pineapple and watermelon juice

Available online at https://jfng.toros.edu.tr

Corresponding author:

*Deborah Ofoegbu, deborahofoegbu4@gmail.com

*Ifeoma Nwaoha, ifeoma.mbaeyi-nwaoha@unn.edu.ng

ABSTRACT

Wines are mostly produced from grapes that are not grown in Nigeria, hence the need for alternative use of fruits for wine production. Tropical fruits have high perishability, thus, the production of wine from common fruits could help reduce the level of post-harvest losses and increase the variety of wine. In the research. The wine samples were produced from juices that were blended before and after fermentation known as premixed; coded as PWp and post mixed; coded as PWs at the ratio of pineapple to watermelon as follows 90:10, 80:20, 70:30, 60:40, and 50:50, and fermented for 7 days at 28±2oC and aged for two weeks, bottled and corked. Physicochemical analysis and sensory evaluation were carried. Experimental design used was a split plot in Completely Randomized Design and data obtained were statistically analyzed. pH of both premixed and post mixed wine decreased as total acidity increased which may be due to yeast metabolism. Total soluble solid decreased in premixed wine due to the level of water melon added to pineapple wine increased; while increase in post mixed wine increased as level of watermelon added to the pineapple wine increased. Moisture content of the premixed and post mixed wines decreased. Post mixed wines were preferred and had higher scores in terms of taste, mouth feel and overall acceptability. Blending of pineapple and watermelon after fermentation in the ratio of 80:20 was the best in physicochemical examination.

INTRODUCTION

Fruits have living biological systems, begin to deteriorate immediately after harvest and have a short shelf life due to their high moisture and nutrient contents. Improper post-harvest handling and inadequate processing facilities have resulted in 20% to 50% loss of horticultural product (Kasso and Bekele, 2018). The shelf-life of these highly perishable fruits can be increased by fermentation of the fruit juices from fruits to make fruit wines which are high sources of energy, vitamins, minerals, etc.

Although, grape wine is the most widely consumed fruit wine in the world, due to the increasing diversification of consumers' needs, the variety of fruit wines in the market is becoming more and more abundant (Yang et al., 2020). Wine is a mild natural tranquilizer that serves to reduce anxiety and tension. As part of a normal diet, wine provides the body with energy, substances that aid digestion and small amounts of minerals and vitamins. Pineapple (*Ananas comosus*) is a tropical plant with edible multiple fruit consisting of coalesced berries. Pineapples are a good source of sugar as they have high sugar proportion which is suitable for making wine (Adaikan and Ganesan, 2004). Watermelon is a vine-like (scrambler and trailer) flowering plant which is thought to have originated in southern Africa, because it is found growing wild throughout the area. It produces a fruit that is about 93% water, hence the name "water" melon. Watermelon is a rich natural source of lycopene, a carotenoid of great interest because of its antioxidant capacity and potential health benefits (Rhodes and Zhang, 1999). The objective of this work was to evaluate the effects of blending on the sensory profile and physicochemical compositions of table wine from premixed and post-mixed pineapple and watermelon blends.

MATERIAL AND METHOD

Material

Mature and ripe pineapple and watermelon were procured from Ogige market in Nsukka, Enugu State, Nigeria. Other materials were granulated sugar, instant dry bakers' yeast, sodium metabisulphite, distilled water, funnel, aluminum foil, stainless knives, electric juice extractor (Model MJ-SJ01WTZ Sheldon Manufacturing Incorporation, Oregon, USA), muslin cloth.

METHOD

Preparation of juice from water melon and pineapple

The procedures were carried out according to Ibegbulemet al. (2014) with modificatins. All equipments were washed and sterilized sing hot water. The pineapples and watermelon were washed, peeled, juice extracted and pressed.

Inoculation of must

In a conical flask, 700 mL of the must (extracted juice) (500 mL pineapple and 200 mL watermelon) was added to 10 g of sugar and 10 g of brewers' yeast. The starter culture was inactivated for 2 days at room temperature before inoculation into the must. The must was inoculated with the wine yeast (brewer's yeast).

Fermentation of the musts

After inoculation, the must was allowed to ferment in gallon at a temperature of 28 + 2oC for 7 days. The post mixed wine which was blended into various ratios (90:10, 80:20, 70:30, 60:40 and 50:50), was filled into sterilized bottle and sealed/corked and then allowed to age for 2 weeks to allow the development of characteristic flavor of the wines. This process was termed post fermentation and it involves the blending of the juices into various proportions (90:10, 80:20, 70:30, 60:40 and 50:50), fermentation, filtration, bottling and aging was also done.

Physical and chemical analyses

The following analyses were carried out on the fresh juices and wines produced from them and their blends.

Determination of percentage yield

The yield of the juice (%) was calculated using the method of Tressler and Joslyn (1961).

Determination of moisture content

Moisture content of any wine influences the other components of the wine and also the storage stability of the final product**.** Moisture content was determined by the hot air oven method described by the AOAC. Stainless steel oven dishes were cleaned and dried in the oven (Fulton, Model NYC -101 Sheldon Manufacturing Incorporation, Oregon, USA) at 100oC for one hour. The oven dishes were cooled in a desiccator and then weighed. 10 mL of each of the sample was placed in the oven dish and dried at 100oC. The sample was removed from the oven and placed in a desiccator to cool to room temperature (27 ± 2oC) before weighing.

The oven dishes were put back into the oven and weighed intermittently until a constant weight was recorded. The loss in weight from the original sample weight was calculated as the moisture content.

$$\text{Moisture Content (\%)} = \frac{W2 - W3}{W2 - W1} x100$$

Where;

W_1 = weight of empty oven dish,

W_2 = weight of oven dish + sample before drying,

W_3 = weight of oven dish + sample after drying.

Determination of total soluble solids

This was carried out with the method described by Pearson (1976). 10 mL of the sample was pipetted into a washed, dried and weighed crucible. The dish and the contents (crucible containing 10 mL of the sample) were put into an oven and dried at 70oC for 3 hours at pressure not exceeding 100 mm Hg. It was cooled in a desiccator and the weight of the solid determined.

Percentage (%) total solid was calculated as:

$$\text{by mass of total solid(\%)} = \frac{\text{weight of dried solid}}{\text{Volume of sample}} x100$$

Determination of pH

The pH was determined using a pH meter as described by the AOAC. 5 mL of sample was measured into the beaker and glass electrode was inserted inside the beaker and the reading was taken.

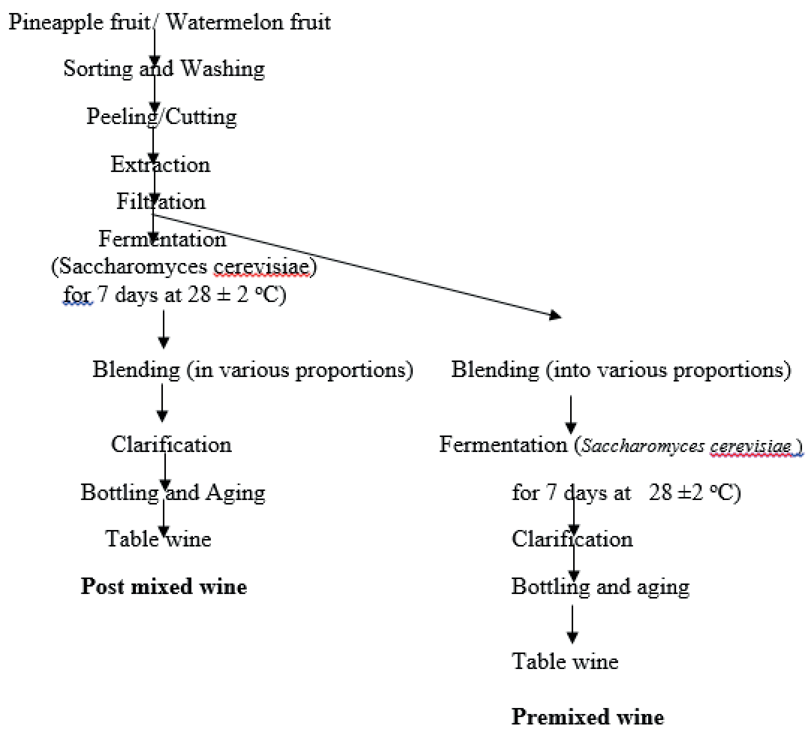

Figure 1. Flow chart for the production of table wine from postmixed and premixed blends of pineapple and watermelon

Determination of titratable acidity

Determination of titratable acidity of the wine was carried out in accordance with the method described by AOAC (2010). 10 mL of the wine was diluted to 250 mL using distilled water and titrated with standardized 0.1N NaOH (Sodium Hydroxide) solution using 0.3 mL phenolphthalein for each 100 mL solution as an indicator to get a pink end point, which persisted for 30 seconds. This was expressed in terms of NaOH/100 mL of the sample.

Determination of alcohol content

The alcohol content was determined using the method of difference in potential alcohol method (Jacobson, 2006). In this method, the alcohol contents were calculated based on the sugar contents of the must before fermentation and the final sugar level of the fermented must.

Sensory evaluation

Sensory evaluation was carried out on the samples using a 9-point Hedonic scale (where '9' was graded extremely liked, while 1 was assigned extremely disliked). 20 members semi-trained panel of judges evaluated and scored the products based on flavor, taste, aftertaste, mouthfeel, color and overall acceptability. The sample were filled in disposable cups which were labeled as PWp1 to PWp5 and PWs1 to PWs5 for premixed and post mixed and the control was labeled as G and water was provided for rinsing of their mouth after each testing.

Data analysis and experimental design

The experimental design that was used for this analysis was Split plot in Completely Randomized Design. The wine produced from two fruits (pineapple and watermelon) was the main plot while premixed and post mixed into various proportions were the sub plots. The data generated from all analyses and sensory evaluation were subjected to Statistical Analysis of variance (ANOVA) using the Statistical Package for Social Science (SPSS) version 16. Means were separated using the Duncan's Multiple Range Test and the significance was accepted at $p< 0.05$ (Steel and Torrie, 1980).

RESULTS AND DISCUSSION

Physicochemical composition of fresh pineapple (*Ananas comosus*) and watermelon (*Citrullus lunatus*) juice is given in Table 1

Table 1. Physichemical composition of fresh pineapple (A.comosus) and (*C.lunatus*) juices

Parameters	PJ	WJ
Juice Yield (%)	65.0	74.0
M.C (%)	$87.70^b \pm 0.34$	$91.87^a \pm 0.71$
TSS (°Brix)	$13.12^a \pm 0.02$	$4.11^b \pm 0.03$
pH	4.1	5.2
T.A (%)	$0.57^a \pm 0.03$	$0.45^b \pm 0.02$
Alcohol (%)	Not detected	Not detected

Values are means ± standard deviation of triplicate determinations.

WJ = Watermelon Juice; PJ = Pineapple Juice; TSS = Total Soluble Solids, M.C= Moisture content, T.A= Titrable Acidity

The percentage yield of pineapple juice and watermelon juice were 65.0 and 74.0%, respectively and this could be attributed to the fact that watermelon had higher moisture content (91.87%) when compared to pineapple juice (87.70%). The high moisture content of watermelon is in agreement with the work by Oyeleke et al. (2012) who stated that watermelon juice had 94.63% moisture content. High moisture content makes the juice suitable as a refreshing and thirst-quenching product which is characteristic of good juice. The pineapple juice had lower moisture content (87.70%) but higher total soluble solids (13.12oBrix). This was because the total soluble solids added body and improved the taste of the juice.

The pH of pineapple juice was 4.1 and watermelon was 5.2. The results on pH showed that standard pineapple juice is acidic (pH < 7.0) and that of watermelon is slightly acidic, (between 5.0 and 5.8) according to Akinosun (2010).

The titratable acidity of pineapple juice was 0.57% and that of watermelon was 0.45%. There exists a correlation between pH and acidity of the juice, the higher the acidity, the lower the pH of the juice. Both juices had no alcohol content.

There was a decrease in the pH of both the premixed and post mixed pineapple-watermelon wine (4.0 to 3.8). This decrease is as a result of the increase in the quantity of watermelon juice which caused, the pH to reduce. This was as a result of the fact that watermelon fruit generally is of medium acidity. Thus, the pH gradually dropped from 5.2 before the fermentation to 3.4 after the fermentation. There was a significant decrease ($p < 0.05$) in pH of the fresh juice after fermentation that is from 4.1 to 3.5 for pineapple wine and from 5.2 to 3.4 for watermelon wine. This might be due to increase in titratable acidity and pH are sometimes inversely proportional to each other though not in all cases. The drop in pH and corresponding increase in titratable acidity of must during the fermentation is attributed to yeast metabolism.

There was a decrease in the titratable acidity of PWP (0.54 to 0.48%) as the level of watermelon added to the pineapple juice increased while there was an increase in the PWS (0.48 to 0.55%) as the level of watermelon added to the pineapple wine increased. This could be a result of the fact that pineapple is more acidic than watermelon. There was no significant difference ($p > 0.05$) among samples PWP4, PWP5 and PWS5 and among samples PWP2, PWP3, and PWS4 in their titratable acidity. The control sample had the highest titratable acidity followed by wine produced from PJ and WJ and then post mixed pineapple and watermelon blends.

There was a decrease in moisture content of the sample PWP (93.10 to 88.65%) and PWS (91.02 to 88.08 %). Sample PWp5 had the highest moisture content (93.10%) followed by sample PWP2 (92.03%), that is, to say that moisture content of the mixed fruit wine was higher than the fruit wine and these values were higher than the control sample (87.10%).

The total soluble solids (TSS) increased with increase in the volume of watermelon added to the pineapple wine in the PWP (9.57 to 12.54 oBrix) as well as the PWS (8.93 to 10.90 oBrix) when compared to the fruit wine. Increase in total soluble solid is an indication that addition of pineapple juice had resulted in high sugar-to-acid ratio in the blends and this confirmed a high correlation between total soluble solids and sugar content as observed by Ravi et al. (2010). The increase in total soluble solids on addition of pineapple to watermelon could also be attributed to the conversion of polysaccharides and other constituents of the juice to sugar. These results were in agreement with that of

Table 2. Physicochemical composition of wine from pineapple and watermelon

Samples	pH	MC(%)	TSS (Brix)	T.A (%)	Alcohol(%)
P	3.5	87.25^{a}±1.11	8.50^{a} ± 0.15	0.67^{ab}±0.01	13.03^{de}±0.32
W	3.4	88.25^{b} ±0.87	9.60^{b} ± 0.15	0.51^{a}±0.03	12.90^{de}±0.20
G	3.8	87.10^{a} ±1.08	12.20^{d} ±0.10	0.71^{c}±0.06	13.93^{e}±0.31
PW_{P1}	3.9	88.65^{b} ±0.10	10.82^{c} ±0.35	0.54^{ab}±0.04	12.27^{cd}±0.13
PW_{P2}	3.9	92.03^{c}±0.21	12.54^{d} ±0.19	0.53^{a} ±0.04	8.50^{a} ±2.33
PW_{P3}	3.9	91.66^{c} ±0.51	9.57^{b}±0.36	0.50^{a}±0.17	11.04^{ab}±0.14
PWP_4	3.8	89.24^{b} ±0.21	10.70^{c}±0.41	0.51^{a}±0.05	12.73^{de}±0.02
PW_{P5}	3.8	93.10^{c} ±0.52	10.90^{c}±0.18	0.48^{a}±0.06	9.77^{b}±0.45
PW_{S1}	3.8	89.70^{b}±0.28	10.56^{bc} ±0.29	0.48^{a}±0.04	12.44^{c} ±0.21
PW_{S2}	3.8	89.03^{b}±0.52	10.90^{bc}±0.39	0.50^{a}±0.02	13.98^{cd}±0.08
PW_{S3}	4.0	89.01^{b}±0.44	8.93^{a}±0.35	0.53^{a}±0.06	12.73^{cd}±0.46
PW_{S4}	3.8	91.02^{c} ±0.68	10.63^{bc}±0.41	0.51^{a}±0.02	9.16^{a} ±0.91
PW_{S5}	3.9	88.08^{b} ±0.64	10.64^{c} ±0.24	0.55^{a} ±0.08	11.82^{b} ±0.04

Values are means ± standard deviation of triplicate determinations. Means with different superscripts in the same column are significantly different at $p<0.05$

P = Pineapple wine; W =Watermelon wine; G = Commercial Grape wine; PW_{P1} (90:10), PW_{P2} (80:20), PW_{P3} (70:30), PW_{P4} (60:40), PW_{P5} (50:50)= Pre-mixed Pineapple-Watermelon wine; PW_{S1} (90:10)= Post mixed Pineapple-Watermelon wine, PW_{S2} (80:20), ; PW_{S3} (70:30), PW_{S4} (60:40), ; PW_{S5} (50:50)= Post mixed Pineapple-Watermelon wine; TSS = Total Soluble Solids.PJ=Pineapplejuice;WJ=Watermelon

Ifie et al. (2012) who reported the increase in total soluble solids and pH, and increase in the yield of alcohol during the fermentation of roselle wine. However, roselle wine had lower ethanol content (9.6%), final TSS (4.8 °Brix) and pH-value (3.09). The PWS3 had lower total soluble solid (8.93 oBrix). The decrease in the total soluble solids of the different proportions after fermentation could also be attributed to the enzymatic, chemical, biological and physical alterations of the must after fermentation. There was no significant difference ($p < 0.05$) between the TSS of the control sample (G) and PWP2.

There was an increase in alcohol content of the premixed wine (PWP) and post mixed wine (PWS) (8.50 to 12.75% and 9.16% to 13.98%) respectively. The alcohol content (8.50% to 13.98%) of the wine was at the acceptable range for table wine. The final alcohol content of the wine (13.98%) ranks it among good table wines. Based on Bisson and Butzke (2009), a good table wine must have alcohol content between 8 and 14%. Grape wine prepared in the study of Bindon et al. (2013) had alcohol content of 11.77 - 15.5% and pH of 3.46 - 3.62.

The sensory scores for the preximed and post mixed pineapple and watermelon wines are shown in Table 3.

Table 3 showed the mean sensory scores of the blended wine for color, flavor, taste, aftertaste, mouthfeel and overall acceptability. There was a reduction in the level of acceptance of color in the premixed wine (6.75 to 5.35) and post mixed wine (6.75 to 5.60) on the addition of watermelon to pineapple wine.

There was a reduction in flavor, taste, aftertaste of the premixed wine and post mixed wine. Based on the mouthfeel, there was a decrease in the premixed wine (6.05 to 4.75) and (6.50 to 5.50) for post mixed wine. There was also a decrease in the overall acceptability of the premixed wine (6.50 to 5.15) on the addition of watermelon to pineapple wine and these was also seen on the post mixed wine (6.50 to 5.20).

The control sample (G) was most preferred with higher scores in color (7.55) and flavor (6.75). This might be as a result of familiarity and conversance of the panelist with grape wine. Sample PWS2 were more preferred and had higher score in terms of taste (6.50), mouthfeel (6.60) and overall acceptability (6.85). Generally, the mean sensory scores for the whole samples compared favorably well with the control (G) in taste, aftertaste, mouthfeel and overall acceptability as compared with Ningli et al. (2017) who reported that the pineapple wine has higher acceptanceand there were significant ($p< 0.05$) differences in the evaluated attributes.

Table 3. Sensory scores of the premixed and post mixed pineapple and watermelon wine

Sample	Color	Flavor	Taste	Aftertaste	Mouthfeel	O.A
G	$7.55^{c}\pm0.88$	$6.75^{c}\pm1.57$	$6.05^{bc}\pm1.76$	$5.90^{ab}\pm1.68$	$5.75^{abc}\pm1.80$	$6.45^{b}\pm1.23$
PW_{P1}	$6.75^{b}\pm1.25$	$6.15^{bc}\pm1.38$	$5.85^{a}\pm1.31$	$6.15^{b}\pm 0.14$	$6.05^{b}\pm 1.15$	$6.50^{b}\pm1.32$
PW_{P2}	$6.50^{b}\pm0.88$	$6.45^{bc}\pm0.99$	$6.00^{a}\pm1.03$	$6.20^{b}\pm1.05$	$6.40^{c}\pm0.94$	$6.50^{b}\pm0.76$
PW_{P3}	$6.35^{b}\pm1.03$	$5.90^{ab}\pm1.25$	$5.40^{a}\pm1.19$	$5.55^{ab}\pm0.94$	$5.55^{ab}\pm1.09$	$5.90^{ab}\pm0.97$
PWP_{4}	$6.50^{b}\pm1.10$	$5.75^{ab}\pm1.41$	$5.60^{a}\pm0.31$	$5.35^{ab}\pm1.18$	$6.00^{b}\pm0.79$	$5.95^{b}\pm1.31$
PW_{P5}	$5.35^{a}\pm1.32$	$5.04^{a}\pm1.46$	$5.10^{a}\pm1.51$	$5.05^{a}\pm1.57$	$4.75^{a}\pm1.80$	$5.15^{a}\pm2.03$
PW_{S1}	$6.75^{b}\pm1.29$	$5.70^{ab}\pm1.59$	$6.20^{c}\pm1.15$	$6.10^{ab}\pm 0.78$	$6.50^{bc}\pm 0.94$	$6.50^{b}\pm0.94$
PW_{S2}	$6.55^{b}\pm1.23$	$6.30^{bc}\pm1.26$	$6.50^{c}\pm1.00$	$6.35^{b}\pm1.09$	$6.60^{c}\pm0.99$	$6.85^{b}\pm0.86$
PW_{S3}	$6.15^{ab}\pm1.18$	$5.30^{a}\pm1.30$	$5.25^{ab}\pm1.37$	$5.75^{ab}\pm1.52$	$5.70^{abc}\pm1.30$	$6.40^{b}\pm1.39$
PW_{S4}	$6.25^{ab}\pm1.12$	$5.60^{ab}\pm1.39$	$5.95^{bc}\pm0.76$	$5.55^{ab}\pm1.39$	$5.55^{ab}\pm1.39$	$5.95^{ab}\pm1.36$
PW_{S5}	$5.60^{a}\pm1.23$	$5.45^{ab}\pm1.23$	$5.05^{a}\pm1.36$	$5.30^{a}\pm1.69$	$5.00^{a}\pm2.08$	$5.20^{a}\pm2.04$

Values are means ± standard deviation of triplicate determinations. Means with different superscripts in the same column are significantly different at ($p< 0.05$)

G =Grape wine, PWP = Post-mixed Pineapple-Watermelon wine, PWS = Post-mixed Pineapple-Watermelon wine, O. A= Overall acceptability

CONCLUSION

Wine was produced from the 'must' prepared from blends of pineapple and watermelon fruit and was found to compare favorably with the wine produced from grape (control) in most of the physicochemical parameters (titratable acidity, total soluble solid among others) evaluated.

In terms of the time for fermentation, post-mixed wine was the best in the physicochemical properties examined. From the data obtained, the post-mixed wine sample in the ratio of 80:20 was the best physicochemically. With respect to the sensory attributes examined, there was slight significant difference ($p < 0.05$) in the taste, flavor, appearance and overall acceptability of the different blends which made some samples more acceptable than the other. The formulated wine compared favorably with grape wine (control) since it had similar properties with it and it was organoleptically acceptable to the potential consumers and these were observed in the result of the sensory evaluation.

Conflict of interest

The authors declare no conflict of interest

REFERENCES

Adaikan, P., & Ganesan, A. (2004). A mechanism of the oxytoxic activity of cosmosus proteinaes. *Journal of Phanrmacy and Biology*. *42(8)*, 646-655.

AOAC. (2010). *Official methods of analysis. association of official analytical chemists*. 18th edition, Gaithersburg, USA.

Akinosun F. F. (2010). Production and quality evaluation of juice from blend of water melon and pineapple fruits. *J. Food Sci*, *2(4*), 54-58.

Bindon, K., Varela, C., Kennedy, J., Holt, H., & Herderich, M. (2013). Relationships betweenharvest time and wine composition in vitisvinifera l.cv. cabernet sauvignon 1. grape and wine chemistry. *Food Chemistry*, 138, 1696 – 1705.

Bisson, L., & Butzke, C. (2009). Wines. microsoft encarta, online encyclopedia. http://encarta.msn.com. [Accesed: March 20, 2015]

Yang, H., Cai, G., Lu, J., & Gómez Plaza, E. (2021). The production and application of enzymes related to the quality of fruit wine. *Critical reviews in food science and nutrition*, *61(10)*, 1605-1615.

Ibegbulem, C.O., Chikezie, P.C., Nweke, C.O., Nwanyanwu, C.E., & Belonwu, D.C. (2014). Effects of processing pineapple-based must into wines by anaerobic fermentation*. American Journal of Food Technology*, *9(3)*, 162-171.

Ifie, I., Olurin, T. O., & Aina, J. O. (2012). Production and quality attributes of vegetable wine from *Hibiscus sabdariffa* Linn. *African Journal of Food Science*, *6 (7)*, 212 – 215.

Jacobson, J. L. (2006). İntroduction to wine laboratory practices and procedures. Springer Science & Business Media

Kasso, M., & Bekele, A. (2016). Post-harvest loss and quality deterioration of horticultural crops in Dire Dawa Region, Ethiopia. *Journal of the Saudi Society of Agricultural Science*s, *17(1)*, 88–96.

Ningli, Q., Lina, M., Xiao, G., & Jianzhi, Y. (2017). Production and quality evaluation of pineapple fruit wine. 1st international global on renewable energy and development. *IOP conference series: Earth and Environmental Science 100*, 012028.

Oyeleke, G. O., Olagunju E. O., & Ojo, A. (2012). Functional and physico-chemical properties of water melon (*Citrullus lanatus*) seed and seed oil. *Journal of Applied Chemistry*, *2(2)*, 29 - 31.

Pearson, D. (1976). *The chemical analysis of food*. Churchill Livingstone, London.

Ravi, U., Menon, L., Aruna, M., & Jananni, B. K. (2010). Development of orange-white pumpkin crush and analysis of its physicochemical, nutritional and sensory properties. *American-Eurasian Journal of Agriculture and Environmental Science*, *8(1)*, 44 – 49.

Rhodes, B., & Zhang, X. P. (1999). *Hybrid seed production in watermelon*. Food Products Press: New York.

Steel, R. G. D., & Torrie, J. H. (1980). *principles and procedures of statistics*. McGraw Hill, Singapore.

Tressler, D. K., & Joslyn, M. A. (1961). *Fruits and vegetable juice processing technology*. 1 st edition, Westport: AVI Publication Company.