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Nutritional Properties of 'COBAWA' Wine

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ABSTRACT

The study was conducted to investigate the nutritional quality of wine produced from the blend of Coconut (*Cocos nucifera*), Banana (*Musa* spp.*)* and Watermelon (*Citrullus lanatus)*. Proximate analysis of the individual fruits showed that coconut recorded the highest moisture content 60.32±0.12 and banana the least composition of 16.57±0.15. watermelon recorded the highest crude protein content 8.05± 0.13, crude lipid, 31.02±0.02; and crude fibre, 12.23±0.3 while Banana recorded highest carbohydrate content of 56.52±0.10. The result of the proximate analysis of the produced wine showed moisture content, 43.63±0.02; crude protein, 9.44±0.04; crude lipid, 5.07±0.04; total ash, 7.97±0.10; crude fibre, 6.32± 0.07 and carbohydrate, 27.55±0.01. Physico-chemical analysis revealed pH, 5.5±0.05; citric acid, 0.04± 0.002; Total organic content 0.32±0.02; total phenolic acid, 603.8± 0.60 and alcohol, 8.59± 0.9. Antioxidant results revealed vitamin C, 3.74± 0.04; Beta Carotene, 30.30± 0.04 and Glutathione, 4.21±0.01. The produced 'Cobawa' wine can be consumed moderately for its nutritional and medicinal benefits.

KEY WORDS: Wine, Coconut, Banana, Watermelon, Proximate, Physicochemical

INTRODUCTION

Wine is an alcoholic beverage made by fermentation of fruit juice of ripe grapes using *Saccharomyces cerevisiae;* other sugar rich fruits can also be used. It has been produced for thousands of years since ancient civilization to modern times and is enjoyed by people: from peasants to kings. Fruits are an integral part of African diet and are consumed as relishes and snacks. They are rich in vitamins, especially vitamin C, minerals, fats and sugars Fruits are neglected by many people due to ignorance of the nutritive value of most of the fruits. Rising cost of fruits, problems of storage of distribution also contribute to this neglect (Tindall & Florence, 1983).

One of the earliest known medicines is wine, which has been used for medical purposes since 2200 BC (Guilford & Pezzuto, 2011). Prior to that, in 8000 BC, wine was consumed as a recreational drink during celebrations, rites, and festivals due to its intoxicating properties (Vlachvei, 2011). Today, wine is utilized for a variety of purposes beyond just being an alcoholic beverage, including cooking, cleaning, dyeing, creating vinegar, composting, and even powering a car (Hornsey, 2007). Additionally, regular, moderate wine consumption may lower the risk of cardiovascular disease in people and lengthen life (Guilford & Pezzuto, 2011). Wine has varieties due to different fruits it can be produced from. Fruit wines production has been growing steadily in recent years, and its market potential is strong, which correlates with the demand for and development of new functional products. Likewise, the production of fruit wines has become an integrated component of the fruit processing industry, often compensating for post-harvest losses. Fruit wines represent a value-added fruit product.

They contain nutritionally important components like minerals and antioxidants, as well as aromatic nuances typically from the fruits used.

Today, a wide variety of fruits which differ in shape, color, taste and nutritive value, are available at the market and many are widely utilized for production of fermented beverages (Jagtap & Bapat, 2015). Fruits used for the production of fruit wines in different parts of the world include apples, berries, cherries, wild apricots, pears, kiwifruit, plums, peaches, strawberries, currants, bananas, pineapples, cashew nuts, pomegranates, lemons, tangerines, oranges, dates, and figs (Joshi et al., 2017).

Wine plays almost an indispensable role in the life of man ranging from social function, religious rites, rituals as well as economic benefits to produce and merchants. In religious sector, wine had been held sacred throughout history (Jagtap & Bapat, 2015).

'COBAWA' Is an acronym that represents Coconut, Banana and Watermelon. A lot of studies have been carried out on bioproduction of wine from various fruits but there are limited studies on bioproduction of wine from combination of banana, watermelon, and coconut.

This study will be looking to attempt the production of cobawa fruit wine using three exotic fruits namely coconut, banana and watermelon; previous research and literatures in this area and other related aspects of oenology will be perused to gain insights into the fermentation process, microbial quality, physicochemical properties, proximate composition, antioxidant quality, sensory evaluation, and toxicity levels of fruit wines.

MATERIALS AND METHODS

Determination of proximate Composition of Coconut, banana, and Watermelon respectively. All parameters were determined in triplicates and the mean values were utilized.

3.2.1 Determination of crude protein

The Crude protein of the fruit juice was determined following standard procedure according to A.O.A.C (2016) method. About 1g of the samples was weighed into micro Kjeldahl digestion flask and one tablet of Selenium catalyst was added. The mixture was digested on an electrothermal heater until a clear solution was obtained. The flask was allowed to cool after which the solution was diluted with distilled water to 50ml and 5ml of this was transferred into the distillation apparatus, 5ml of 2% boric acid was pipetted into a 100ml conical flask (the receiver flask) and four drops of screened methyl red indicator were added. About 50% NaOH was continually added to the digested sample until the solution turned cloudy which indicated that the solution had become alkaline. Then distillation was carried out into the boric acid solution in the receiver flask with the delivery tube below the acid level. As the distillation was going on, the pink colour solution of the receiver flask turned blue indicating the presence of ammonia. Distillation continued until the content of the flask was about 50ml after which the delivery of the condenser was rinsed with distilled water. The resulting solution in the conical flask was then titrated with 0.1M HCl.

Calculation : % Nitrogen = $\frac{100 \text{ x titre value x } 0.0014 \text{ x } 6.25}{\text{Weight of sample used.}}$ ……equation 3.1

3.2.2 Determination of moisture content

About 2ml of each sample was measured into a previously weighed crucible, dried over water for sometimes. The crucible plus sample taken was transferred into the oven set at 1000 c to dry to a content weight for 24hour overnight. At the end of 24hours, the crucible plus sample was removed from the oven and transferred to the desiccator, cooled for ten minutes and weighed (A.O.A.C, 2016). The weight of empty crucible plus sample was W1while the weight of crucible plus oven dried sample was W3 (AOAC, 2016)

% Moisture= $\frac{W1 - W3 \text{ x } 100}{W1 - W0}$

% Moisture content= 100-%DM……...equation 3.2

3.2.3 Determination of Crude Lipid:

Fat determination This was carried out using the method of AOAC (2016). Clean and dried thimble was weighed(W1) and 5g oven dried sample was added and re-weighed (W2). Round bottom flask was filled with petroleum (ether40- 60)0 C up to ¾ of the flask. Soxhlet extractor was fixed with a reflux condenser to adjust the heat sources so that the solvent boils gently, the samples were put inside the thimble and inserted into the soxhlet apparatus and extraction under reflux was carried out with petroleum ether for 6 hours. After the barrel of the extractor is empty, the condenser was removed and the thimble was removed, taken into the oven at 1000C for 1 hour and later cooled in the desiccator and weighed again (W3).

Crude lipid (%) = $W2 - W1\ X\ 100$ / s……equation 3.3

Where W1 = Weight of empty flask

W2 = Weight of flask and content

S = weight of sample

3.2.4 Determination of Crude fibre:

The fruit juice sample was weighed and transferred to a beaker followed by the addition of 200ml of 5HCl. The solution was heated in a water bath at 900ºC for 2hours, filtered and washed back into a beaker with 200ml of NaOH solution and reheated for 2 hours at the same temperature. The resulting

mixture was filtered, washed thoroughly with hot water, alcohol and ether followed by drying at 120^0C. On cooling, the mixture was weighed, ignited in a muffle, cooled in a desiccator, and weighed again. The loss in weight was recorded as crude fibre for both samples.

3.2.5 Determination of total ash

Total ash content was determined by igniting previously dried sample in a muffle furnace at 500°C for 4 hours. The ash content was calculated by the equation below:

Ash (%) = weight of ash / *weight* of $dried\ sample\ X$ 100……. equation 3.4

3.2.6 Total carbohydrate estimation

Available carbohydrate content in the sample was determined following the method described by AOAC (2016). This was calculated as the difference obtained after subtracting the lipid, ash and fibre values from the total dry matter using the formula below:

% Carbohydrate = 100 – (a + b + c + d)…….equation 3.5

Where a = amount of crude protein

b = amount of crude lipid

c = amount of ash content

d = amount of crude fibre

3.3 Proximate composition of 'Cobawa' wine

The procedure above was adopted for the determination of the proximate composition of the produced wine**.**

3.4 Physico chemical Determination of Wine sample

3.4.1 pH determination

The pH of wine sample was determined with pH meter Jenway, 301-5. The meter was put on for 15 mins to stabilize. The electrode was rinsed with distilled water and calibrated with buffer 4 and 7 and was rinsed with distilled water after which it was dipped into wine sample. Figures displayed on the screen were allowed to stabilize before the final record was taken for sample.

3.4.2 Determination of Alcohol, Total Organic Acid, Total phenolic acid and Citric acid

Sample Preparation: 120µl of homogenized sample was extracted with 500µl of hexane. The mixture was vigorously shaken on an electronic shaker for 4 min, centrifuged for 2 min at 10,000rpm and the supernatant pooled. The extraction process was repeated. The pooled supernatant was evaporated to dryness under Nitrogen (N_2) gas and redissolved in 120µl mobile phase (in HPLC grade methanol).

Analysis: Samples were analysed with SPD-2010 High performance liquid chromatography at their corresponding wave lengths 450. Their corresponding standards were prepared and chromatographed. Areas corresponding to the standard retention time were identified**.**

3.5 Determination of Antioxidant properties of wine

3.5.1 Vitamin C Determination

120µl of homogenized sample was extracted with 500µl of hexane. The mixture was vigorously shaken on an electronic shaker for 4 min, centrifuged for 2 min at 10,000rpm and the supernatant pooled. The extraction process was repeated. The pooled supernatant was evaporated to dryness under Nitrogen (N_2) gas and redissolved in 120µl mobile phase (in HPLC grade methanol).

Samples were analyzed with SPD-2010 High performance liquid chromatography at their corresponding wavelengths 450. Their corresponding standards were prepared and chromatographed. Areas corresponding to the standard retention time were identified**.**

3.5.2 Beta Carotene Determination

50g of KOH pellets were dissolved into 100ml of deionized water. The solution was well diluted to mix the content properly. The solution was prepared ready before use and stored in a dark and cool place. 5ml of sample was transferred into a clean saponification flask. 1g of L-ascorbic acid was transferred into the flask containing the sample and 50ml of ethanol was poured into the flask. Also 50% KOH was transferred into the sample flask and mixed properly. For saponification, a reflux condenser and heat sample flask were attached to a water bath at 74^0c and was shaken periodically. The flask was

carried out after 90 minutes, condenser was detached, and the sample closed immediately. The saponification sample was poured into a separating funnel and the flask was washed with 50ml ethanol and was poured into the separation funnel. The funnel was washed again with 100ml of deionized water and transferred into the funnel. The funnel was closed with the cap and shaken vigorously for 2 minutes to mix the contents properly. 50ml of n-hexane was added and shaken to mix again. The funnel was allowed to stand until a clear layer was formed. This time, all the lower layers were discarded leaving only the hexane layer. 100ml of deionized water was added and the funnel shaken vigorously. The funnel was allowed to stand for about 5 minutes, the lower water layer was discarded and washed again with 100ml of water and shaken, then allowed to stand and the lower layer was discarded again. The 100ml deionized water was repeated for the third time, shaken, and allowed to stand and the water layer was collected. Phenolphaline indicator was added to confirm that all the KOH pellets were removed, indicating that no more washing is needed. A filtration system was prepared adding about 10grams of $NaSO_4$ to the filter paper. The hexane in the funnel was allowed to pass through the $NaSO_4$ drop by drop until all is filtered. The beaker was taken into the oven and allowed to allow the hexane dry at 70^0 until its dried completely. For dilution and injection, 100ml of methanol was added into the dry beaker containing the antioxidant and was allowed to completely dissolve. 1ml was taken into the amber vial and was placed for the injection of vitamins into the HPLC machine.

3.5.3 Glutathione Determination

Gluthathione content of the wine sample was determined according to the procedure described by Martínez et al. (2014). 50ml of sample was collected and frozen at -20 °C for GSH analysis. Five ml of the frozen sample was weighed and placed in a 20 mL tube, with 15 mL 0.1 N HCl and 0.01 % EDTA, and then kept for two hours with horizontal agitation at room temperature. The extract was centrifuged at 5000 x g for 10 min at 5 °C. Then, 5 mL of the supernatant was taken for the determination of GSH by HPLC. The analysis was carried out by SPD-2010 High performance liquid chromatography, by automatic derivatization in precolumn with o-phthaladehyde (OPA). The separation was conducted in a Hypersil ODS column (250 x 4.0 mm 5µm). The eluents used were A: 75 mM sodium acetate buffer, 0.018 % triethylamine (pH 6.9) + 0.3 % tetrahydrofuran and B: methanol/acetonitrile/water (45/45/10). Detection was done by fluorescence (excitation = 340 nm and emission = 450 nm)

Methods of Data Analysis

Data obtained were subjected to statistical analysis using standard computerized Statistical Package for Social Science (SPSS) version 11. ANOVA, post hoc (least significant difference - multiple comparison) test were carried out and values expressed as mean±SEM. Statistical significance was accepted at $p<0.05$.

RESULTS

Table 4.1 Proximate composition of coconut, Banana, watermelon and Cobawa wine

Parameters	Coconut	Banana	Watermelon	cobawa wine
Crude Protein	3.38±0.44	5.40±0.07	8.05±0.13	9.44±0.04
Crude Lipid	2.02±0.02	3.20±0.02	31.02±0.02	5.07±0.04
Total Ash	5.13±0.03	9.54±0.05	3.13±0.03	7.97±0.10
Crude Fibre	10.23±0.03	8.76±0.17	12.23±0.03	6.32±0.07
Carbohydrate	18.90±0.54	56.52±0.10	15.23±0.05	27.55±0.01
Moisture	60.32±0.12	16.57±0.25	30.32±0.12	43.63±0.02

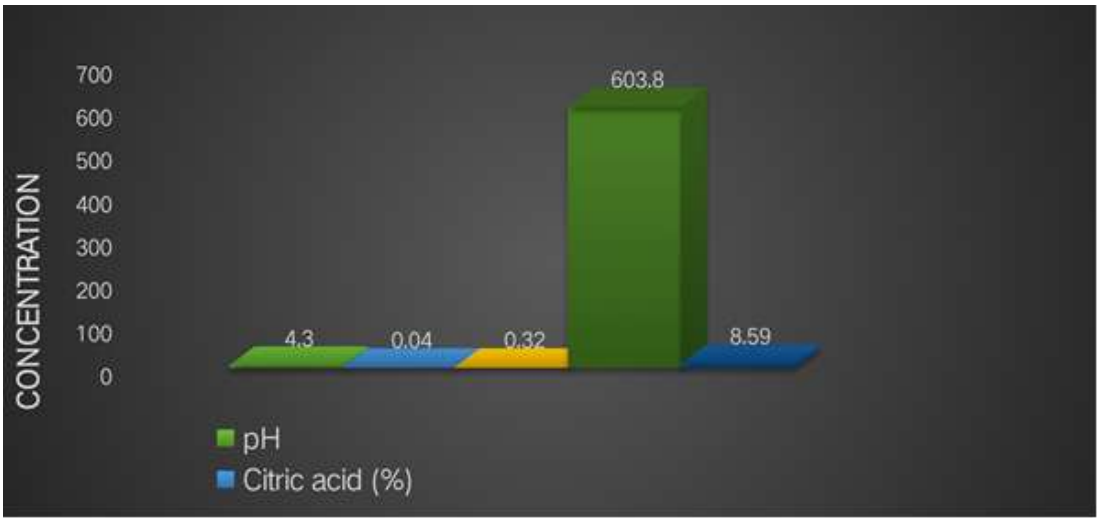

Figure 4.1 Physiochemical Properties of the Produced Wine

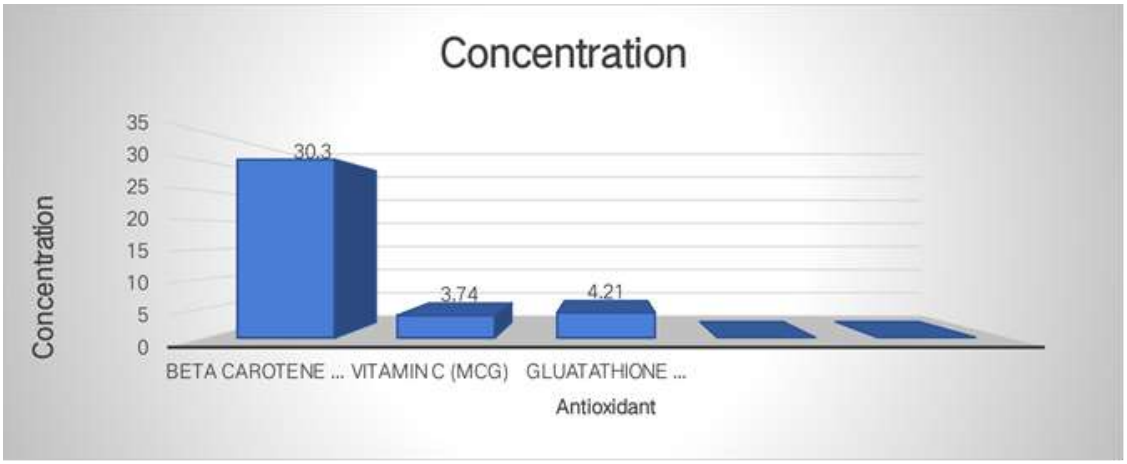

Figure 4.2 Antioxidant Quality of the Produced Wine

This study was aimed at producing quality ready to serve wine from the combination of coconut, banana, and watermelon juices. Proximate composition of coconut, Banana and watermelon were analyzed before fermenting for the wine production; with coconut recording the highest in moisture content 60.32 ± 0.12 and banana the least composition, 16 .57 ± 0.25. Watermelon recorded the highest crude protein content, 8.05 ± 0.13; crude lipid, 31.02 ± 0.02 and crude fibre, 12.23 ± 0.3; while banana had recorded the highest carbohydrate content of 56.52 ± 0.10. The Proximate result is not in line with the result obtained by Ekpete and Edori (2013), where the results of the proximate analysis carried out on Banana, Pawpaw and apple were considerable low, recording an ash value of 0.3% to 2.50% when compared to the ash value of Banana (9.54±0.05) obtained in this study. The results obtained for the carbohydrate and protein contents are high when compared to that of Ekpete and Edori (2013) that ranged between 7.50% to 18.60% and 0.29% to 1.28% respectively. However, the variations in the proximate compositions of fruits may be attributed to the location where the fruits were grown.

The proximate composition of the produced 'cobawa' wine showed high moisture content of 43.63 ± 0.02. This is similar to the results obtained from the study of Ezenwa et al. (2020) on the Proximate, chemical Compositions and sensory Properties of Wine Produced from Beetroot **(***Beta vulgaris***),** moisture content ranged from 86.53 to 88.25%. High moisture content makes beverage suitable. The crude protein, ash, crude fat, and carbohydrate contents of the produced wine is considerable high when compared to the results obtained by Ezenwa et al. (2020) where (protein = 0.54 %, ash content = 0.50 to 0.81%, crude ash = 0.3%, crude fat = 0.10%, carbohydrate = 3.25 – 4.20%). This indicates that the produced 'cobawa' wine is a rich source of nutrient and would be greatly beneficial to the human body when consumed in a considerable amount.

The physicochemical properties of the produced wine were recorded in table 3.3. The pH of the wine (5.5± 0.05) indicates acidity, and it is comparable to the result obtained by okeke et al. (2015) in a produced mixed fruit wine from watermelon and pineapple. The pH value obtained is comparable to NAFDAC (2019) recommendation that table wine should not contain less than 6% alcohol and not more than 17% absolute alcohol by volume. The result is also similar to the result obtained by Yusufu et al. in 2018 that carried out a study on the evaluation of wine from watermelon juice & ginger extract. Additionally, the result of the pH is also comparable to that obtained by Alabare and Adebayo-olaijide (2023**)** from the analysis of physiochemical properties of wine produced from banana and pineapple where wine had low pH Values which reduced from 4.0 to 3.4 for the wine fermented by *Meyerozyma guilliermondii* and 4.0 to 3.5 for the wine fermented by *Pichia guilliermondii*. The alcohol content of the produced 'cobawa' wine was 8.59 ± 0.09 by percentage. This is lower than the control wine of 12.0% but higher than the value obtained by Ezemba and Archibong (2017), where the alcohol content was between to 6.8% and 4.8% for coconut and mango wine respectively. However, the alcoholic content obtained by Ogodo et al. (2018) were considerably higher when compared to the produced 'cobawa' wine. The study showed alcoholic contents of the final wines as 17.50 ± 0.02 % (pawpaw and Watermelon) 16.00±0.02 (pawpaw and Banana), 18.50 ± 0.02% (banana and watermelon wine) and 18.00 ± 0.02% (pawpaw, banana and watermelon).

There exists a correlation between pH and the total titrable acidity of the wines. The higher the pH, the lower the total titrable acidity and the lower the pH, the higher the total titrable acidity. This can be attributed to the acidification of the medium during fermentation. Studies have shown that during fementation, low pH and high acidity are inhibitory to the growth of spoilage organisms but create a favourable environment for the growth of desirable organisms. This gives the fermenting yeasts a competitive advantage in natural environments (Reddy & Reddy, 2005).

Citric acid (0.04± 0.002), total organic acid (0.32 ± 0.02), total phenolic acid (603.8 ± 0.60) simply indicate that the produced wine is generally acidic. This could also be the reason for the low microbial growth in the wine as only acid tolerant organisms can survive in the wine. Phenolic compounds are well known for their health benefits related to antioxidant activity. Other important characteristics associated to phenolic compounds are the antimicrobial activity, because phenolics have the capacity of retarding the microbial invasion in some products and avoiding the putrefaction of others, mainly fruits and vegetables. These properties allow phenolic compounds to be suitable for numerous food preservation applications.

The antioxidant level of the produced wine was 3.74 ± 0.04mcg for vitamin c. This is slightly lower than the results obtained in the evaluation of wine from watermelon juice and ginger extract in the study of Yusufu et al. (2018) where vitamin C contents ranged from 1.95 - 2.85 mg / 100g. Also, the Vitamin C content obtained by Ezenwa et al. (2020) in wine Produced from Beetroot (Beta vulgaris) ranged from 1.697 to 1.873 mg/100ml. Ezenwa et al. (2020) attributed the reduction in Vitamin C content to the effect of heat during pasteurization. The antioxidant, vitamin C (ascorbic acid) is not

naturally made by the body. Additionally, Vitamin C. stimulates collagen synthesis and when combined with iron leads to better absorption & plays a role in enhanced brain function. Its antioxidant properties help guard against chronic diseases and strengthens the immune system.

In the wine produced (COBAWA), beta carotene had a concentration level of 30.30 ± 0.04mcg. This is comparable to the values obtained by Ezenwa et al. (2020) where the Pro-Vitamin A Content ranged from 24.16 to 25.83mg/100ml. In the human body, beta – carotene converts into vitamin A (Retinol). This antioxidant is needed for good vision and eye health, for a strong immune system, healthy skin, and mucous membranes.

The concentration of glutathione in the produced wine was 4.21 ± 0.01 which is considerably low when compared with the recommended amount of 500mg per-day. Glutathione is largely comprised of three acids glutamine, glycine, and cysteine. The antioxidant reduces oxidative stress, may reduce the impact of uncontrolled diabetes and respiratory disease symptoms. Glutathione (a natural tri – peptide) found in wine is a powerful antioxidant that protects wines from oxidation and loss of aroma or flavor.

CONCLUSION

The investigation of the nutritional quality of Cobawa wine showed that the produced fruit wine is highly nutritional with several medicinal and economic importance.

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