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Nutritional and biochemical properties of locally produced wine from blended honey and coconut juice

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Abstract. *Tatah VS, Ogodo AC, Boyi RHN, Abah MA, Timothy M, Ayantse LM. 2023. Nutritional and biochemical properties of locally produced wine from blended honey and coconut juice. Asian J Trop Biotechnol 20: 31-36.* Humans have consumed honey since ancient times due to its high medicinal and nutritional value. Coconut (*Cocos nucifera* L.) is highly nutritious, fiber-rich, and contains essential vitamins and minerals. Coconut cream and coconut milk are two of the many edible products made from the coconut fruit. In addition, some wines are produced from a single fruit type or a combination of blended fruits and other raw materials. This research was conducted to determine the nutritional values and biochemical properties of locally produced wine from blended honey/coconut juice. The blended wine in this study was locally prepared and stored for about three years in the refrigerator at about 4ºC. The Association of Official Analytical method was used to determine phytochemical constituents, proximate composition, minerals composition, physicochemical properties, sugar/alcohol contents, and amino acid content. The phytochemical content includes saponins, tannins, flavonoids, glycosides, resins, alkaloids, terpenes, and cardiac glycosides. The wine contains 75.50% moisture, 0.15% carbohydrate, and 0.20% protein. Ash, fat and crude fibers content were 0.14%, 0.25%, and 0.13%, respectively. The essential amino acids in the blended wine were isoleucine, leucine, histidine, lysine, and threonine. And the non-amino acids were glutamine, glutamic acid, serine, alanine, proline, and aspartic acid with high concentrations. Several minerals were also contained in blended wine, i.e., lead, aluminum, calcium, zinc, phosphorus, sulphur, and iron. Several parameters from the blended wine are slightly higher regarding the recommended daily requirement. Therefore, good wine could be produced from blended honey and coconut juice.

Keywords: Coconut juice, fermentation, honey, phytochemicals, proximate composition, wine

INTRODUCTION

Wine is a product of the normal alcoholic fermentation of grape juice. However, the fermented juices of various fruits (apples, berries, peaches, plums, apricots, and herbs) are now also called wine (usually peach wine, etc.).Wine production involves fermentation using yeast, such as (*Saccharomyces cerevisiae)* that convert sugars into alcohol. The definition of wine is an alcoholic beverage derived from fermented grape juice; however, it has been attributed to other alcoholic beverages from fermented fruits and vegetables over the decades (Gupta and Sharma 2009). Fermented beverages and alcoholic drinks are acceptable for consumption, mostly during cultural and social practices, entertainment, customary practices, and religious purposes (Christoph and Bauer-Christoph 2007). Wine production starts with harvesting grapes' juice before fermentation and concludes with various storage and aging steps (Balogu et al. 2016).

Honey is a sweet jelly-like substance (mainly consisting of a monosaccharide of fructose and glucose) made from the nectar of flowers. Honey is a good substance for yeast fermentation due to its high sugar content, to produce alcohol and carbon dioxide gas (Balogu and Towobola 2017). Honey benefits eyes and eyesight (vision), breaks up hard masses, quenches thirst, and balances Kapha. Moreover, it reduces toxicity, stops hiccups, treating bleeding disorders, urinary tract disorders, diabetes, skin diseases, worms, bronchial asthma, cough, diarrhea, nausea, vomiting, and wound healing (Balogu and Towobola 2017; Luvanda and Lyimo 2018). Various alcoholic honey beverages with diverse content of alcohol have been produced from different fermentation processes (Kraus 2017). Most of these processes undertake a minimum of 21 days for fermentation to achieve 7.6%-22% alcohol. Alcoholic beverages of a mixture of honey and fruits have been documented mainly in personal blogs and unpublished studies (Gupta and Sharma 2009).

In the food processing industry, blending is the art of developing different colors, aromas, astringencies, and tastes to suit consumers. Blending could improve the wine's quality, correct deficiencies, enhance complexity, balance flavors, and produce the final product within legal specifications (Lauren et al. 2012). However, the success of blending relies solely on sensory evaluation, and the consumer likes and dislikes the blends if there are high differences in the blended wines (Kovacevic et al. 2003). For example, juice or extract of coconut fruit could be mixed with honey for mead production. Coconut (*Cocos nucifera* L.) belongs to Arcaceae or Palmae; the fruit is characterized by its hard outer shell and white inner flesh (Balogu and Towobola 2017). Coconut water is replaced

by coconut meat and air as the fruit ripens. Coconut milk is a liquid extract of grated and squeezed white coconut flesh rich in fat, minerals, and vitamins (Boateng et al. 2016).

Numerous secondary metabolites in food sources from plants and plant extracts exhibit various bioactivities. They can be used for disease prevention and treatment. For instance, tannins are potential antibacterial and antiviral (Balogu et al. 2016; Tatah et al. 2022). Flavonoids are antibacterial, anti-inflammatory, anti-allergic, anti-mutagenic, antiviral, antineoplastic, anti-thrombotic, and vasodilatory activities. A small number of alkaloids (morphine, codeine, and cocaine) are harmless (Formica and Regelson 1995) and used as painkillers, anesthetics, antimalarial, stimulants, and insecticides (Aiko et al. 2006). Flavonoids also play vital roles in anti-inflammatory, anti-allergic, and anti-cancer functions (Formica and Regelson 1995). Tannins cause protein inactivation; hence they are used as insecticides. They also possess astringent properties. Tannins can inactivate Polio Virus, Herpes simplex, and other enteric viruses (Jaykus 2000). Saponins are natural antibiotics reducing cardiovascular diseases and cholesterol levels. Carotenoids are known for their antioxidant properties, helping the body to destroy free radicals. Carotenoids have equally been shown to possess antihypertensive properties (Khanavi et al. 2013). The present study aims to analyze the biochemical and nutritional quality of wine produced from honey and coconut juice blends.

MATERIALS AND METHODS

Sample collection

A 200 mL of honey/coconut wine was obtained from Federal University Wukari, Taraba State Microbiology Laboratory, Nigeria. The wine sample was locally produced and stored in the refrigerator for about three (3) years at 4ºC.

Phytochemical analysis

Saponins

A 2 mL of the wine sample was weighed into a 125 cm conical flask, added with 100 mL of Isobutyl alcohol, and shaken for 5 hours using an electric shaker. The mixture was then filtered with No 1 Whatman filter paper into a 100 mL beaker containing 20 mL of 40% saturated solution of magnesium carbonate ($MgCO_3$). The mixture obtained was re-filtered again to get a clean, colorless solution. Next, 2 mL of the colorless solution was taken into a 50 mL volumetric flask pipetted and added with 2 mL of 5% iron (iii) chloride ($FeCl_3$) solution and made up to the mark with distilled water. It was allowed to stand for 30 minutes for the color to develop. The absorbance was read using a spectrophotometer against the blank at 380 nm (Brunner et al. 2013).

Cardiac glycosides

A 200 mL of the wine sample was pipetted into a 250 mL conical flask. Chloroform was added and mixed properly using the electric shaker for 1 hour. The mixture was filtered into a 125 cm conical flask. Next, 10 mL of pyridine and 2 mL of 29% sodium nitroprusside were added and shaken thoroughly for 10 min. Finally, 3 mL of 20% NaOH was added to the mixture, and a brownish-yellow color developed. Various concentrations of glycosides standard (Digitoxin) (0-50 mg/mL) were prepared from the stock solution, and the absorbance was read at 510 nm (Newman et al. 2008).

Flavonoids

The aluminum chloride method determined total flavonoid content using catechin as a standard. First, 2 mL of the wine sample and 4 mL of distilled water were appropriately mixed in a 10 mL volumetric flask. Next, 5 mL of the mixture was added with 0.3 mL of 5% sodium nitrite and 0.3 mL of 10% aluminum chloride, and the mixture was then incubated at room temperature for 6 min. Next, 2 mL of 1M sodium hydroxide was added to the reaction mixture; the final volume was immediately made up to 10 mL with distilled water. Finally, the mixture absorbance was measured at 510 nm against a blank using a spectrophotometer (Aiyegoro and Okoh 2010).

Alkaloids

A 2 mL of the wine sample, 5 mL of phosphate Buffer (pH 4.7), and 5 mL BCG solution were appropriately mixed in a 10 mL volumetric flask. Next, the solution was diluted to adjust volume with chloroform. The absorbance of the complex in chloroform was measured at 470 nm against a blank prepared without the sample. Atropine was used as a standard, and the mixture was calculated as the atropine equivalents (Kim et al. 2021).

Tannins

A 2 mL of the wine sample was mixed with 0.5 mL Folin-Ciocalteau's reagent. Next, 1 mL of saturated Na_2CO_2 solution and 8 mL of distilled water were added to the mixture. The reaction mixture was allowed to stand for 30 min at room temperature. The supernatant was obtained by centrifugation. The absorbance was recorded at 725 nm using a UV-visible spectrophotometer. An increasing concentration of the standard tannic acid was prepared, and the absorbance of the various tannic acid concentrations was plotted for a standard graph (Okuda et al. 1989).

Proximate analysis

Moisture content

An aluminum dish was heated in a Carbolite oven at 105ºC for 5 minutes to eliminate any possible moisture; then, the dish was allowed to cool in a desiccator. The weight of the dish was taken and recorded. Next, 5 mL of the wine sample was poured into the dish and weighed. Next, the dish containing the sample was placed in a Cobaltite oven at 105ºC for 24 hours. It was removed, cooled in a desiccator, and weighed (Odebunmi et al. 2010). The weight of the dish containing the dried sample was recorded, and the moisture was then calculated as follows:

Weight of moisture = weight of sample and dish – the weight of dried sample and dish

$$\% \text{ Weight of dried samle} = \frac{\text{Weight of moisture}}{\text{Weight of sample}} \text{ x } 100$$

Dry matter = 100 - % weight of moisture

Fat content

Fat content was analyzed using the method of AOAC (2005). First, 5 mL of the wine sample was collected in a Beaker. Next, the sample was transferred into a thimble and fixed into the machine accordingly. The beaker was filled with about 50 mL petroleum ether and placed under the fixed thimble containing the sample in the extractor chamber. The thimble was then lowered into the aluminum beaker using the adjustment knob and boiled for 10 min. Water tubing was collected. After this, the thimble was raised for another 10 minutes to rinse the extracted fat into the beaker. The condenser tap was closed for 10 minutes to remove residual petroleum ether. The aluminum beaker containing the extracted fat was removed and placed in an oven for 15 minutes to evaporate the remaining petroleum ether. Then, it was cooled in a desiccator and weighed. The fat content was calculated as follows:

Weight of fat = weight of sample and beaker – the weight of empty beaker % weight of fat = ×100

Crude fiber determination

5 mL of the defatted sample was weighed, dispensed into a quick-fit glass, and added with 50 mL of glacial acetic acid. The sample was placed in the heater in the fume cupboard (digestion flask) at about 200ºC-400ºC for 45 mins for proper digestion. After digestion, the sample was filtered thoroughly with a weighed filter paper; then, it was dried in an oven for 24 hours at 100ºC, weighed again, and recorded. The residue was in a weighed crucible and placed in a cooled furnace, then ashing at 580ºC-600ºC for 4-5 hrs. After cooling down, the crucible was placed in a desiccator, weighed, and recorded (Neubert et al. 1940). The fiber content was calculated as follows;

Weight of residue = weight of filter paper + residue – the weight of filter paper Weight of ash = weight of ash + crucible – the weight of the empty crucible

Weight of crude fiber = weight of ash – the weight of residue

Determination of ash content

According to AOAC (2005), the weight of an empty crucible was recorded, and then 5 mL of the sample was added to the crucible and weighed. Ashing sample at 600ºC for 2 hours and cooled in a desiccator. It was then weighed, then the new weight of the crucible plus ash was recorded. The ash content was calculated as follows;

Weight of ash = (weight of crucible + ash) – weight of crucible

$$\% \text{ Weight of ash} = \frac{\text{Weight of ash}}{\text{Weight of sample}} \text{ x } 100$$

Crude protein determination

The Kjeldahl method was used to determine the crude protein content. First, 5 mL of the wine sample was weighed into the 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 and cooled. The solution of 50 mL was diluted with distilled water. Next, 5 mL of the diluted solution was transferred into the distillation apparatus. Next, 5 mL of 2% boric acid was pipetted into a 100 mL conical flask (the receiver flask) and added with four drops of methyl red indicator. 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 color solution of the receiver flask turned blue, indicating the presence of ammonia. Distillation was continued until the flask's content was about 50 mL, after which the delivery of the condenser was rinsed with distilled water. The resulting solution was titrated with 0.1 M HCl in the conical flask (Aiyegoro and Okoh 2010).

Carbohydrate

The carbohydrate content in the sample was determined by calculation which is as follows;

Weight of carbohydrate = sum of values (protein+ash+fat+phosphorus+fiber+moisture+ calcium)– 100

Mineral composition

The minerals in the wine sample were analyzed using the spectrophotometer, and 2 mL of wine was placed in a 50 mL volumetric flask, added with 2 mL of perchloric acid, 1ml of H_2SO_4, and 5mL of HNO_3. The mixtures were placed in a water bath and evaporated to dryness. The solution was cooled and filtered into a 100 mL standard flask and diluted to volume with distilled water. Therefore, to analyze the minerals separately Atomic absorption spectrophotometer was used.

Physicochemical analysis

pH

The pH meter was calibrated using distilled water before use. Two mL of the wine sample was weighed accurately and dissolved in 25 mL of distilled water in a conical flask. The solution was transferred into a beaker. The pH meter electrode was inserted into the solution in the beaker, and the pH was recorded.

Temperature

The temperature of the wine sample was determined using a laboratory thermometer. Two mL of the wine sample was added with 20 mL of distilled water to a 100 mL beaker, and the thermometer was directly inserted into the solution.

Determination of alcohol content

Exactly 50 mL of the wine was added to a distillation flask and added with NaOH to become alkaline. Next, the samples were distilled until the temperature of the distillate reached 100ºC. Then, the distillates were diluted with distilled water to precisely 50 mL in a pre-weighed volumetric flask. Next, the flask and the liquid were weighed, and the solution density was calculated (Okuda et al. 1989). The alcohol contents were finally obtained using the Density – Alcohol Table.

Sugar

Two (2) mL of the wine sample was placed in a beaker, added with distilled water to mark 100 mL, and 2-3 drops of phenolphthalein were added. Then, NaOH solution was added until it turned pink, followed by adding HCL continuously until the solution turned to its original color. Distilled water was added to the 200 mL and marked (V1). Next, 5 g of Cupric acid was added to 50 mL of the above solution, boiled for 10 min in a water bath, and cooled; then distilled water was added to the 200 mL and marked (V2). Furthermore, to 2 mL of the wine sample, 5 mL of Fehling solution A and B was added and boiled for 2 min and then cooled, after which 2-3 drops of methylene blue were added and titrated with the wine solution of volume marked (V2) above until it turned brick red (Odebunmi et al. 2010).

Total sugar = Fehling solution constant 0.051 × 200 × 200 × 100⁄2 × 50 vol. of the wine solution used for titration.

Amino acid profile analysis

An ion-exchanger chromatography and a colorimeter were used to observe the amino acid composition of blended wine. First, the different amino acids in the wine sample were separated based on their and collected in a beaker by eluding the sample with sodium extract buffer. The amino acid in each beaker was then identified by calculating the buffer volume used in eluding the individual amino acids and the pH of the amino acid, thereby comparing it to the standard. Next, the same volume of each identified amino acid was collected in a test tube, and 1 mL of ninhydrin solution was added. All the tubes were covered with aluminum foil and kept for 15 min in a boiling water bath. After heating, the test tube was removed and cooled in cold water, and 1 mL of 50% ethanol was added and mixed till homogenous. In addition, each amino acid concentration in the tubes is determined using a colorimeter (AOAC 2005).

RESULTS AND DISCUSSION

Qualitative/quantitative phytochemical constituent of locally produced wine from blended honey/coconut juice

Table 1 shows the phytochemical constituent of locally produced wine from blended honey/coconut juice. The result revealed the presence of saponins, tannins, flavonoids, glycosides, resin, alkaloids, terpenes, and Cardiac glycosides. The sample's highest phytochemicals concentration was tannins (3.411 mg/100mL), whereas the lowest was glycosides (1.842 mg/100mL). Saponins, flavonoids, resins, alkaloids, terpenes, and Cardiac glycosides content were 2.892 mg/100mL, 3.262 mg/100mL, 1.921 mg/100mLL 1.961 mg/100mL, 2.471 mg/100mL and 2.492 mg/100mL, respectively.

Proximate composition of locally produced wine from blended honey/coconut juice

The nutritional composition of blended wine is shown in Table 2. The moisture, protein, fat, ash, fiber, and carbohydrates content were 75.50%, 0.23%, 0.25%, 0.14%, 0.13%, and 0.15%, respectively.

Mineral composition (heavy metals) of locally produced wine from blended honey/coconut juice

Table 3 shows the minerals content of the blended wine were lead, aluminum, calcium, sodium, magnesium, zinc, potassium, phosphorus, and iron with an estimated value of 0.01 mg/100mL, 3.20 mg/100mL, 3.20 mg/100mL, 3.80 mg/100mL, 1.80 mg/100mL, 3.40 mg/100mL, 3.2mg/100mL, 2.6 mg/100mL and 0.27 mg/100mL, respectively.

Physicochemical properties of locally produced wine from blended honey/coconut juice

The pH and temperature of locally produced wine were 3.6 and 22°C, respectively (Table 4). The alcohol and sugar content analysis of the blended wine revealed that the wine contained 15.13% alcohol and 2.4% sugar, respectively.

Table 1. Qualitative/quantitative phytochemical constituent of locally produced wine from blended honey/coconut juice

Parameters	Concentration (mg/100mL)	
	QL	QT
Saponins	+	2.892
Tannins	+	3.411
Flavonoids	+	3.262
Glycosides	+	1.842
Resins	+	1.921
Alkaloids	+	1.961
Terpenes	+	2.471
Cardiac glycosides	+	2.492

Note: QL: Qualitative analysis, QT: Quantitative analysis

Table 2. Proximate composition of locally produced wine from blended honey/coconut juice

Parameters	Concentration (%)
Moisture content	75.50
Protein	0.23
Fat	0.25
Ash	0.14
Fiber	0.13
Carbohydrates	0.15

Table 3. Mineral composition (heavy metals) of locally produced wine from blended honey/coconut juice

Parameters	Concentration (mg/100mL)
Lead	0.01
Aluminum	3.20
Calcium	3.20
Sodium	3.80
Magnesium	1.80
Zinc	3.40
Potassium	3.20
Phosphorus	2.60
Iron	0.27

Table 4. Physicochemical properties of locally produced wine from blended honey/coconut juice

Parameters	Values
Temperature (ºC)	21
Sugar content (%)	2.4
Alcohol content (%)	15.13
pH	3.6

Table 5. Amino acid profile of locally produced wine from blended honey/coconut juice.

Parameters	Concentration (mg/100mL)
Asp	131.7±7.5
Glu	121±5.0
Asn	214.1±5.4
Ser	119.8±4.0
Gln	252.0±12.1
His	14.5±0.4
Arg	22.6±0.8
Thr	76.2±9.0
Ala	189±5.2
Val	3.8±0.4
Lys	11.5±0.3
Ile	6.7±0.6
Leu	29.8±1.4
Phe	19.7±1.2
Pro	40.2±1.7

Amino acid profile analysis of locally produced wine from blended honey/coconut juice

The amino acids content of locally produced wine (Table 5) were asparagine, glutamic acid, serine, glutamine, histidine, arginine, threonine, alanine, tyrosine, valine, isoleucine, leucine, phenylalanine, and proline with the value of 131±7.5 mg/100mL, 121.6±5.0 mg/100mL, 117.9±1.4 mg/100mL, 260.4±11.0 mg/100mL, 14.2±0.9 mg/100mL, 22.6±0.4 mg/100mL, 7.47±5.2 mg/100mL, 1.924±5.9 mg/100mL, 34.0±07 mg/100mL, 38±12.1 mg/100mL, 6.1±0.2 mg/100mL, 29.8±1.4 mg/100mL, 19.1±16 mg/100mL and 40±16 mg/100mL, respectively.

Discussion

Honey produced by honey bees (*Apis mellifera* Linnaeus 1758) is a good energy source with antioxidant and antimicrobial properties. The concentrated sugar complex mixture in honey contains some carbohydrates, aromatic substances, waxes, minerals, pollen grains, pigments, and organic and amino acids. Coconut milk is a liquid extract of grated and squeezed white meat of the coconut, which is highly rich in fat, minerals, and vitamins. The phytochemical results of locally produced wine from blended honey/coconut juice contained higher saponins, tannins, flavonoids, and glycosides than that revealed in tetraptera fruits (Neubert et al. 1940). Saponins, tannins, flavonoids, and glycosides content in Tetraptera fruits was 2.892, 3.411, 1.70, and 1.58, respectively (Neubert et al. 1940). The alkaloids in the blended wine were estimated to be 1.961 mg/100mL, lower than that obtained by Ebana et al. (2019). Phytochemicals from the present study revealed that wine has great health benefits. For instance, several alkaloids have been used as painkillers, anesthetics, antimalarial, and stimulants. In addition, flavonoids also play vital roles as anti-inflammatory, anti-allergic, and anti-cancer roles.

Furthermore, flavonoids have been shown to possess antihypertensive properties (Haddad et al. 2008). In addition, Tannins cause protein inactivation, hence used as insecticides, and possess astringent properties. Tannins can inactivate Polio Virus, Herpes simplex, and other enteric viruses. Saponins also serve as natural antibiotics, reducing cardiovascular diseases and cholesterol levels (Haddad et al. 2008).

Proximate analysis results of wine produced from blended honey/coconut had 75.50 mg/100mL moisture content, 0.23 mg/100mL protein, 0.25 mg/100mL fat, 0.14 mg/100mL ash content, 0.13 mg/100mL, and 0.15 mg/100mL carbohydrates. The moisture content of blended wine (75.50%) is lower than that of *poporo* (beverage originating from sorghum stem sheath) (94.60%) (Somogyi 1926). The percentage of ash and carbohydrate obtained from this study are similar to that reported by (Michael and Hans-Werner 1998), which are 0.14%, 0.15% and, 0.12%, 0.20%, respectively.

Several minerals contained in blended wine were lead, sodium, magnesium, zinc, calcium, aluminum, iron, and phosphorus with an estimated values of: 0.01 mg/100mL, 3.80 mg/100mL, 3.40 mg/100mL, 3.20 mg/100mL, 3.20 mg/100mL, 3.20 mg/100mL, 2.60 mg/100mL, 1.5 mg/100mL and 0.27 mg/100mL, respectively. The lowest mineral content was iron, with a value of 0.27 mg/100 mL. Lead in the blended wine (0.01 mg/100mL) may be due to contaminants from the glass wares or equipment used in the analysis. However, this value does not exceed the recommended value. Most of the minerals analyzed from the blended wine are either lower or higher, while others fall within the range compared to those reported in the literature.

The alcohol and sugar content of the blended wine was 15.13% and 2.40%, respectively, while the alcohol concentration obtained by (Ebana et al. 2019) was 14%. The alcohol and sugar contents of the blended honey/coconut wine were 15,13% and 2,4%. These values were higher than blended wine in the study by Markov et al. (2021), with alcohol and sugar content of 9.5% and 0.25%, respectively.

Several amino acids were obtained, for example, aspartate, glutamine, glutamic acid, alanine, and asparagine. The estimated values of the amino acids present were observed to be significantly high, presented as follows: <131.7±7.5, <121±5.0, <252.0±12.1, <189±5.2 and <214.1±5.4 respectively (Table 5). On the other hand, valine and isoleucine, with values of <3.8±0.4 and <6.9±0.6, are lower than the values of other amino acids. The essential amino acids obtained were isoleucine, leucine, lysine, phenylalanine, threonine, tryptophan, and histidine with the following values: <6.7±0.6, <29.8±1.4, <11.5±0.3, <19.7±1.2, <76.2±9.0, <3.8±0.4 and <14.5±0.4 respectively (Table 5). At the same time, the non-essential

amino acids obtained are; asparagine, aspartate, serine, alanine, and proline, with the estimated values at <131.7±7.5, <121±5.0, <214.1±5.4, <119.8±4.0, <189±5.2, and <40.2±1.7, respectively. The values of valine and lysine are lower than that obtained by Rutherfurd and Gilani (2009), which were <3.8±0.4, <11.5±0.3, and 10.47, 16.15, respectively. All the amino acid values obtained by Rutherfurd and Gilani (2009) were lower than in this study. The high concentration of amino acids in the blended honey/coconut wine shows that the wine will have great nutritional benefits to consumers. It is because amino acids are used to synthesize proteins which helps to repair worn-out tissues and growth. In addition, proteins also serve as catalytic enzymes in a chemical reaction.

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