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Nutrient Analysis of Tomato Wine

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Abstract

Wine made from fruits are usually named after the fruit from which they are produced (eg: apple wine, banana wine) and are generically called fruit wine.. Wine made from many other fruits has received more research attention due to the nutritional, phytochemical and sensory qualitites**.** Tomato is one of the most important vegetable both nutritionally and economically. The edible part of this fruit is known as the power house of nutrition. It contains multitude of Vitamins and Minerals that act to support human health Wine is one of the products of Tomato processing with extended shelf life. . Tomato Wine is a unique product which plays a significant role with enhanced nutrient content. . As consumers demand for nutritious and healthy product, the preparation of Tomato Wine targets the overall wellness of the consumers.
Keywords: *Wine, Tomato wine, nutrition*

1. Introduction

Wine is defined as "the drink resulting from the fermentation by the Yeast cells". Wine is a complex alcoholic beverage which contains numerous chemical components. It includes Water, Alcohol, Acids, Sugar, Phenolic, Nitrogenous compounds, Vitamins and various volatile compounds which contributes the unique aroma, taste and oral sensation to the wine. The potential health benefits of wine are due to the presence of these components. Studies report that there is inverse relationship between wine consumption and risk of cardiovascular disease[1, 2, 3].

Tomato (Lycopersicon esculentum Mill.) is one of the most important crops of the world. It is one of the low calorie vegetable. The amount of calorie in Tomato is 18 calorie /100g. The fat content in Tomato is very low and it has zero Cholesterol level. It is an important source of Potassium, Phosphorus, Magnesium and Iron. Phytosterol, is a compound found in Tomato helps to keep the Cholesterol low. Tomato is the most prominent source of Lycopene [4].

Although, Tomato is rich in nutrient content, it is a highly perishable commodity. In order to extend its shelf life, Tomato is processed in different forms. The commonly available processed form of Tomato includes Juice, Paste, Ketchup, Sauce, Puree, Soup and Canned Tomato. In recent years Tomato is processed for Wine production. Wine is an alcoholic beverage with extended shelf life when compared to other Tomato products

The optimized wine was analysed for its nutrient content. The proximate and mineral content of fresh wine and aging wine was determinedt. The difference in free radical scavenging activity of fresh wine, and 6 months aging wine was analysed. Sensory attributes of optimized wine was analysed.
spacing rather than smaller point sizes. Some technical formatting software print mathematical formulas in italic type, with subscripts and superscripts in a slightly smaller font size. This is acceptable.

2. METHODOLOGY:

2.1 Proximate Analysis of Wine

The Carbohydrate, Protein and Fat content of wine was estimated according to the procedure of

Yemm et al, Lowry et al and Zak et al [5,6,7].

2. 2. Analysis of Mineral Content in Wine

Mass Spectroscopy was used to determine the mineral content of wine

2.3. Analysis of Phytochemical Content in Wine

The procedure of Chang et al, Schanderl et al and McDonald et al [8, 9, 10] was followed

to determine the phytochemical content in wine.

2.4. Analysis of DPPH Radical Scavenging Assay

The free radical scavenging activity of wine was determined by DPPH assay.

2.5. Estimation of Total Antioxidant Capacity and Total Reducing Potential of Wine

The Total Antioxidant capacity and Total Reducing Potential of wine was estimated.

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2.6. Estimation of ethanol

Gas liquid Chromatography was used to detect the alcohol (ethanol) content in wine

sample.

2.7. Sensory Analysis

Sensory attributes of Tomato wine was determined. The panel of twenty judges, familiar with taste of wine was selected. Sensory attributes of wine was analysed based on the characters such as Colour, Aroma, Bouquet, Acescent, Acidity, Sugar, Body, Flavour, Astringency and General quality.

3. RESULTS:

3.1. Proximate Analysis of wine

The Proximate composition of wine reflected the composition of fruit used to produce wine. The proximate composition of fruit vary with location where the fruits grown. So, in the present study proximate analysis of fresh juice was compared with fresh wine and aging wine.

Table 1 – Proximate Analysis of Wine

Nutrient	**Fresh wine**	**6 months aged wine**
	g/100ml	
Carbohydrate	0.028	0.025
Protein	0.021	0.024
Fat	0.0009	0.0004

The table illustrated that there was no change in the Carbohydrate and Protein content among the fresh wine and aging wine. Nitrogenous compounds play an important role in winemaking. They serve as nutrients for the growth and metabolic activity of the yeast during fermentation and as proteins, influence wine stability. The low protein content of wine is good for maintenance of cellular organization [11].

The fat content of fresh and aging wine was decreased slightly. The very minimum fat content in wine demonstrates the desirable nutritive quality as well as protection against excess body lipids.

3.2. Estimation of Mineral content of wine

Minerals present in wine are required for metabolic functioning of the body. The mineral content constitute the important quality parameters of wine. During aging, the greatest number of polymerization and condensation reaction occurs which modifies the composition of wine. So, the mineral composition of fresh wine and aging wine was determined.

Table 2 Mineral Analysis of Wine

Minerals	Fresh wine	6 months aging Wine	% increase or decrease from fresh wine
Sodium (mg/100ml)	245	545.6	+ 55.09
Potassium (mg/100ml)	294	309.4	+ 4.98
Phosphorus (mg/100ml)	359	134.5	- 166
Magnesium (mg/100ml)	49.7	45.84	- 8.52
Calcium (mg/100ml)	19.8	32.95	+ 39.81
Iron (mg/100ml)	18.04	10.44	- 72.27
Zinc (mg/100ml)	11.25	0.4911	- 129.12
Manganese (mg/100ml)	4.56	2.45	- 86.12
Copper (mg/100ml)	2.25	1.91	- 17.8
Selenium (µg/100ml)	1.54	0.334	- 361.08

. The result exhibited that fresh wine found to have maximum minerals when compared to aging wine expect sodium and potassium. Minerals such as Phosporus, Magnesium, Iron, Zinc, Manganese, Copper and Selenium in aging wine was found to be less when compared with fresh wine.

Sodium plays a role in number of process in the human body in conjunction with other electrolytes like chloride

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and potassium [12, 13]. The ***Sodium*** content of fresh wine and aging wine was increased by 55.09 percent . The study revealed that, sodium content was increased as wine ages. This may be the reason for moderate consumption of wine reduces the risk of Cardiovascular disease. As Sodium is a keyplayer in heartbeat regulation and maintaining balanced blood pressure level.

Potassium is essential for normal growth and sustaining life. It regulates cell growth [14, 15] and maintains normal blood pressure [16]. The sodium and potassium content should be well balanced in the body. Na:K ratio in food is more important than the concentration of individual cations The Potassium content of aging wine was increased by 4.98 percent when compared with fresh wine.

Phosphorus with Calcium is the main component of the inorganic part of the skeleton. Phosphorus helps to strengthen the teeth and bone structure. The phosphorus content of fresh wine was more (359mg/100ml) than in aging wine (134.5 mg/100ml).

Magnesium is a multifunctioning mineral that makes large contribution to health and nutrition.. The magnesium content of aging wine decreased by 8.52 than fresh wine.. Hence, the consumption of wine rich in Magnesium regulates potassium channel in the myocardial cells [17, 18].

Calcium is essential for bone formation, strong teeth development and digestion aids [19] enzyme stabilizers as well as transport cofactors in metabolic pathway. The calcium content was found to be more in fresh wine (68.79%). Aging wine has increased calcium content when compared to fresh wine.

Iron works primarily in the myoglobin of muscles and haemoglobin of red blood cells.. Recent studies indicate that iron can influence insulin metabolism in healthy individuals and in diabetics [20]. In the present study the iron content of freshly prepared wine was 18.04 mg/100ml and aging wine had iron content 10.44 mg/100ml. The wine prepared from Eugenia apples also has more iron content . The daily recommended allowance of iron was 15mg. Consuming 100 ml of tomato wine can meet the daily requirement of iron.

Zinc directs the function of immune system and the creation of male testosterone hormone [21]. ***Zinc (99.1%)*** content was dominant in fresh wine when compared to aging wine (79.63%). The dominant feature of Zinc in wine was agreed with the result of Galango et al [22]. The consumption of freshly prepared tomato wine can meet the daily requirement of 15mg of zinc.

Manganese in fresh wine was more than aging wine . Hence, the daily consumption of 100ml of tomato wine provides 4.5mg of ***Manganese*** which contributes to both enzyme activation as well as enzyme productivity. It supports the skeletal frame, eliminates free radicals and aids in healing wounds.

Copper is necessary for the development of connective tissue, cartilage and blood vessels. Copper contributes to the promotion of antioxidant quality and also boost the immune system. In the nervous system copper is relevance for the formation of Myelin. Melanin synthesis is also dependent on copper [23]. Copper content in fresh wine was 2.25mg/100ml, this was reduced in the aging wine . The daily need of copper was 2mg which can be balanced by consuming 100ml of freshly prepared wine.

The study illustrated that selenium was found to be more in fresh wine 1.54 mg/100ml when compared to aging wine 0.334mg/100ml. ***Selenium*** is the key fighter for the body against infections. It regulates thyroid functions .

The **mineral composition of optimized tomato wine** was unique as it contains Potassium, Calcium, Magnesium, Sodium, Iron, Phosphorus, Zinc, Copper all of which necessary to cover daily needs of human beings.

3.3 Phytochemical analysis of wine

Phytochemicals are plant compounds capable of carrying out biological or biochemical activity within the body when consumed. Phytochemical includes ***Flavonoids, Phenols Tannin and Lycopene***.

Table 3 – Phytochemical Analysis of Wine

Phytochemicals (% w/w)	**Fresh Wine**	**6 months aging wine**
Total phenols	0.260	0.388
Flavanoids	0.110	0.105
Tannins	0.361	0.346
Lycopene (mcg/100ml)	4560	256.7

The ***Total Phenol*** content of 6 months aging wine was enhanced when compared to fresh wine. The study of Matejicek et al [24] reported that aging can increase the phenolic compounds in wine. The activity of microorganisms during alcoholic fermentation enhances the phenolic compounds in wine. These phenolic

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compounds are responsible for the taste and other sensory characters. Katalinic et al [25] proved that there is positive relationship between phenolic compounds and antioxidant activity of wine.

There was no significant difference in the ***Flavonoid*** and ***Tannin*** content among fresh and aging wine. The findings of Mercurio et al [26] revealed that aged wine has similar concentration of tannin as young wine. During processing and aging, the tannin content in the wine polymerized. Polymerization leads to increased molecular size. As the molecular size increases the astringency is perceived more than bitterness.

The process of aging reduces the ***Lycopene*** content of wine. Fresh wine has more Lycopene when compared to aging wine. This may be due to the reduction of pigment during aging proce

3.4. DPPH Free Radical Scavenging Activity of Wine Samples

The free radical scavenging activity of Tomato Wine was determined by DPPH. DPPH radicals are the most used and stable chromogen compounds to measure the antioxidant activity of compounds. The table represented the free radical scavenging activity of fresh, 2months and 6months aging wine.

Table.4 Free Radical Scavenging Activity of Wine

Name of the sample	**IC 50 value (µg/ml)**
Fresh wine	47.44
6 months aging wine **Percentage increase or decrease**	35.27 **+ 25.65%**

The antioxidant activity was increased during aging. The above data also illustrated that 6 months aging wine has higher antioxidant activity than 2 months aging and fresh wine. Pellegrini et al [27] suggested that aging is the main factor influencing the antioxidant activity of wine. Similarly Larrauri et al [28] reported that aged wine has higher antioxidant activity than younger wine. **3.5. Total Antioxidant capacity and Total Reducing Potential of the wine**

Vitamin is an important factor in the overall nutritional value of food. Because of its antioxidant and therapeutic property, it is a valuable food component. Hence, the Vitamin C and Vitamin E content of fresh and aging wine was represented in the table.

Table 5 - Total Antioxidant capacity and Total Reducing Potential of the wine

Name of the sample	**Vitamin C equivalent**	**Vitamin E equivalent**
Fresh wine	0.057	0.412
2 months aging wine	0.0278	0.226
6 months aging wine	0.025	0.20

The table reveals that aging of wine decreased the Vitamin C and Vitamin E content of wine when compared to fresh wine. The destruction of Vitamin C may be due to the oxidation, because large quantities of carbondioxide are produced by the biological and respiratory process [29].

3.6. Gas – Liquid Chromatography of ethanol

Gas Chromatography (GC) is a powerful and widely used tool for the separation, identification and quantification of components in a mixture. The goal of GC is to separate and detect components of a mixture as efficiently as possible. The figure illustrated the ethanol content of prepared wine sample

Fig 1 Gas Chromatography analysis of Wine

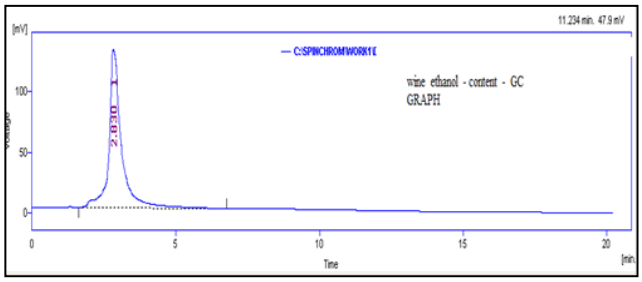

Table 6 Ethanol content in wine

Reten. Time [min]	Area [mV.s]	Height [mV]	Area [%]	Height [%]	W05 [min]
2.830	3935.610	129.790	100.0	100.0	0.34
Total	3935.610	129.790	100.0	100.0	

The peak in the graph represented the ethanol content of wine sample, which is the most predominant alcohol. The ethanol content of prepared wine sample was 5.24 percent. The peak of ethanol occurred around the retention time of 2.83 minutes. The area percent of ethanol was 100 percent which implies that *Saccharomyces* is most efficient in ethanol production. This indicates that the source of yeast

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may influence the alcohol profile of wine and also the quality of wine.

3.7 Sensory Analysis of Wine

Sensory analysis is a scientific discipline that applies principles of experimental design and statistical analysis to the use of human senses for the purpose of evaluating consumer products.

Sensory analysis of wine is important parameters in determining the quality of Wine. The following Sensory attributes of fresh and aging Wine was analysed.

Table 7 – Sensory Analysis of Wine

Characters	Average score by tasters	
	Fresh Wine Mean±S.D	**Aging Wine Mean±S.D**
Colour	1.47 ± 0.2	1.70 ± 0.3
Aroma	1.28 ± 0.24	2.00 ± 0.00
Bouquet	1.43 ± 0.21	1.81 ± 0.24
Acescent	1.01 ± 0.25	1.60 ± 0.22
Acidity	1.34 ± 0.3	1.04 ± 0.21
Sugar	1.51 ± 0.22	1.64 ± 0.24
Body	1.06 ± 0.31	1.91 ± 0.23
Flavour	1.07 ± 0.33	1.76 ± 0.30
Astringency	1.50 ± 0.26	1.12 ± 0.26
General quality	1.02 ± 0.24	1.89 ± 0.28

A close look at the table reveals that fresh and aging wine rated good. But, when compared to fresh wine, aging wine scored good in all sensory attributes.

During aging the following changes occurred,

Colour is one of the most appealing properties of a wine. Colour of wine become paler, taste softer and less astringent. This may be loss of tannin and pigment in wine. The bouquet of wine was more developed and multilayered. Wine was less acidic and produces good aromas due to the esterification of acids. The astringency of wine was reduced and provides smooth and soft taste which plays a key role in improving wine sensory appeal. Aging wine has beautiful and plumy aroma of tomato and harmonious wine taste.

4. CONCLUSION: The study proves that the proximate content of fresh was decreased when compared to aging wine except for sodium and potassium. Mineral content of fresh wine was higher than the aging wine. Phenol in aging wine was high whereas the flavonoid and tannin was low when compared to young wine. DPPH assay revealed that aging of wine enhances the antioxidant capacity. Gas chromatography analysis reported that the aging wine has 5.24 percent ethanol. The Sensory attributes was enhanced with aging wine.

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