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MEDICINAL ENHANCEMENT AND SENSORY ANALYSIS OF DATES FRUIT WINE

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ABSTRACT
This is the first report to prepare a wine using date palm fruits blended with spices such as cloves, ginger, cardamom and cinnamon which would be inexpensive, medicinal, nutritive and can be produced at home. Baker's yeast (commercially available) is used for fermentation. Wine must with different initial ^{o}Brix 26 and 21 for sample 1 and 2, respectively, were prepared. The initial and final specific gravity for sample 1 was 1.120 and 1.050, for sample 2 was 1.095 and 1.045. The wine produced has AFD 6.25 and 4.5, fermentative capacity 14 and 9.0, fermentation velocity 0.679 and 0.740 for sample 1 and 2, respectively. The final total soluble solids for both samples were 12 ^{o}Brix. The ethanol content was 9.5% for sample 1 and sample 2 was 7.2%. The titratable acidity for sample 1 was 0.345 mg/ml and sample 2 was 0.562 mg/ml. Both samples recorded 0.99 mg/ml for reducing sugar, the protein content in sample 1 was 1.17 mg/ml and 1.01 mg/ml in sample 2. The vitamin C in the samples was found out be 60µg/g and 55 µg/g for sample 1 and sample 2, respectively. Sensory evaluation of wine in terms of color, flavor, taste and overall acceptability showed both samples would be acceptable. So, the developed processing technology for preparation of date fruit wine is techno-economically viable and its industrial potential should be exploited.

KEYWORDS: Dates fruits, fermentation, spices, medicinal, sensory evaluation.

INTRODUCTION

Ancient biotechnology that has persisted throughout ages is winemaking (Cocolin & Ercolini, 2008). Winemaking involves the fermentation of fruits or vegetables by yeast to produce wine, for thousands of years' fermentation is strongly linked to culture and tradition in the production of fermented foods such as bread, cheese, wine, idly, dosa *etc*., in both urban households and village communities (Bhusari *et al*., 2013). The ethanol component of wine also confers health benefits and, accordingly, the moderate consumption of beer and spirits is also associated with a decreased risk of death from cardiovascular disease (Boban *et al*., 2016). The nutritional value of date palm can never be undermined. Research shows that date palm fruits possess nutrients that are capable of preventing cardiac diseases (Essa *et al*., 2016; Saleh *et al*., 2011) and contains minerals that improve eye sights and other medicinal properties for the well-being of the individual when ingested (Eid *et al*., 2015; Jahromi *et al*., 2015; Karasawa *et al*., 2011). The most important components of dates are the carbohydrates in particular sugars, which can constitute up to 78% and provide a readily available source of energy to the human body. Dates are a good source of dietary fiber and depending upon the variety and stage of ripening, it ranged from 6.4% to 11.5% in 14 different varieties (Al-Shahib & Marshall, 2003). Protein and lipid occur in small amounts in dates. Proteins occur in the date fruit in the range of 1% to 3%. Dates contain many important vitamins and minerals and their mineral content in dried dates can vary from 0.1 to 916 mg/100 g of date flesh (Al-Farsi *et al*., 2005; Khan *et al*., 2008). Therefore, using date palm fruit in wine preparation will not only serve the original purpose of being a satisfactory taste to the consumers but a lifesaving product to promote the campaign on healthy eating. In view of these the current study which is the first report on producing wine using dates palm fruit that would be affordable and above all can be manufactured at home. This would make consumers be able to customize their own wine in a hygienic manner. Again also winemakers would be rectifying the harm caused by other alcoholic beverages when they tend to produce dates wine.

This study is to come out with a wine of that which an ordinary individual can produce at the same time maintaining the nutritive value of the wine. The best process methodology is adopted for the production of the wine, in terms of packaging or bottling in industrial bottles and paper packages. Additives like preservatives and artificial coloring which might alter the results for hue and color intensity were not used. The yeast is baker's yeast that is commercially obtainable. For the enrichment of the wine's flavor chosen spices like ginger, cloves, cardamom, cinnamon would be another that intend can integrate their healthful properties into the wine.

In general, the spices can go a long way to have an effect on the color, aroma, preservation of the wine and increase its acceptability by consumers. These spices are derivative of several components of the plant like the bark, seeds, flowers, fruits, leaves, stigmas, rhizomes, roots, styles and or the entire plant (Rajathi *et al*., 2017). Contemporary

ginger contains 80.9% moisture, 12.3% carbohydrates, 2.4% fibre, 2.3% protein, 1.2% minerals, and 0.9% fat and as such iron, calcium, phosphorous are also present. In addition, thiamine, riboflavin, niacin and vitamin C are the vitamins found in ginger. The medicinal use of cardamom in the past decades has been enormous as it is employed in the treatment of infections of the teeth and gums, also to prevent and treat throat trouble, congestion of the lungs and pulmonary tuberculosis, asthma, heart disease, inflammation of the eyelids and digestive disorders (Korikanthimathm *et al*., 2001). Similarly, cloves and cinnamon possess antioxidant and fungicidal properties. Wine from dates fruit and a few spices were ready and analyzed. This work was to standardize a technology of winemaking from dates fruit with the subsequent objectives.

1. To prepare wine from dates palm fruits
2. Biochemical analysis of the prepared dates fruit wine
3. Sensory evaluation of dates fruit wine

MATERIALS AND METHODS

Sample Collection

The fresh and soft dates palm fruits were purchased from the local market of Bahadurgarh of Delhi-NCR and used for the preparation of wine. The fruits were procured from the local market; seeds were separated at the time of preparation.

Chemicals

Most of the chemicals used in the investigation were of analytical grade obtained from E. Merck, India and Himedia Ltd.

Yeast preparation

Baker's yeast was acquired from the local market of Bahadurgarh of Delhi-NCR. The starter culture was prepared according to the method of Ogodo *et al*. (2018) with slight modifications. Five gram of commercial baker's yeast (*Saccharomyces cerevisiae*) was mixed in 100 ml of warm water and stirred gently. 2 g of sugar was added in yeast mixture. The mixture was allowed to stand for 10 to 15 minutes for the activation of the yeast which was transferred into the mash for fermentation at room temperature.

Extraction of dates fruit mash

The seeds of fresh dates which weigh 500 grams were manually separated from the pulp. The pulp was boiled with 500 ml of water in an autoclaved beaker for a period of 30 minutes which was cooled down before transferred into a 2 liters bottle.

Preparation of the must

The boiled and cooled dates pulp was transferred into a 2-liter glass bottle along with sugar, and the following spices ginger, citric acid, cardamom, cinnamon and cloves which was inoculated with the agitated yeast. The initial brix for sample 1 was adjusted to 26 and sample 2 was adjusted 22 (table 1) and fermentation was carried out in a glass bottle at 25^{o} C. The entire process for the production of dates fruit wine is shown in figure 1.

TABLE 1: Initial brix of must

Sample	Initial brix value before fermentation
Sample 1	26
Sample 2	21

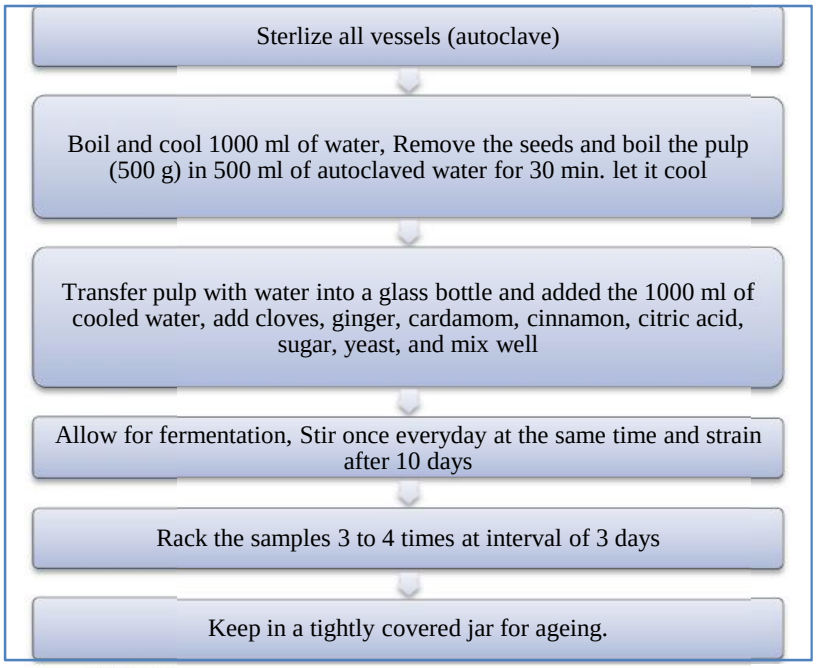

FIGURE 1: Process of Dates Fruit Wine Production

Biochemical analysis

Estimation of all the biochemical parameters was done in duplicates. Specific gravity (SG) of the wines were determined by the method of Kamassah *et al*. (2013). The following parameters were calculated based on the value of the initial and final specific gravity; Apparent fermentation degree (*AFD*), fermentative capacity (*V*C), and fermentation velocity (*F*V). The ethanol concentration in the samples was determined according to the method as described by Caputi *et al*. (1968). The pH of the samples was determined by using Digital pH meter (Eutech Instruments, Germany). Total soluble solids (TSS) in dates fruit wine were determined by measuring 50mL of the sample into a measuring cylinder at 20◦C; and a brix thermo-hydrometer was dipped into it with an appropriate temperature correction factor. It was expressed as percent acidity and analyzed using the method of Pithava and Pandey (2013). The vitamin C content in the samples was determined by the method described by Tareen *et al*. (2015). A measure of color density or intensity can be achieved by summation of absorbance reading at 420 and 520 nm as described by Bain (2009). The protein concentration in the samples was determined according to the method as described by Lowry et al. (1951). The quantitative estimation of reducing sugar of the wine was determined using the method described by Miller (1959).

Sensory Evaluation

The samples obtained after racking and aging were subjected to sensory analysis. The sensory evaluation of dates fruit wine was done by selected suitable panelists from a group of 14 (age group: 22-40). On the basis of appearance, color, flavor, mouth feel and overall acceptability the semi-trained panelist made up of students, lecturers, and staff of PDM University, Bahadurgarh analyzed the samples. Consumer acceptance for the products was evaluated on a nine-point "Hedonic scale" Lawless & Heymann (2010) with the following scale; 9=like extremely, 8=like very much, 7=like moderately, 6=like slightly, 5=neither like nor disliked, 4=like slightly, 3=disliked moderately, 2=disliked very much, 1=disliked extremely. The panelists were familiar with all the quality attributes of good wine. Each panelist was served 30 ml of cooled wine in transparent glasses for the sensory evaluation Ifie *et al*. (2012).

Statistical Analysis

One-way analysis of variance (ANOVA) was used as described by (Winner, 2004) to analyze the data obtained from the sensory evaluation. Mean separation and comparison was done using IBM SPSS version 20. Significance was accepted at $P < 0.05$ and results were expressed as the mean ± standard deviation from the mean.

RESULTS AND DISCUSSION

Biochemical characterization of Dates Fruit Wine

The prepared samples were characterized for the following biochemical parameters: specific gravity, apparent fermentation degree (AFD), fermentative capacity (Vc), fermentation velocity (Fv), ethanol %, titratable acidity, vitamin C, hue and intensity, protein, reducing sugars, TSS, and pH.

Specific Gravity (SG)

It was determined by using the hydrometer. The AFD, Vc and Fv were then calculated based on the specific gravity.

TABLE 2: Enological properties of Dates fruit wine

SN	Parameters	Sample 1	Sample 2
1	Initial SG	1.120 ±0.001	1.095 ±0.002
2	Final SG	1.050 ±0.002	1.045 ±0.002
3	Apparent fermentation degree	6.25 ±0.03	4.5 ±0.01
4	Fermentative capacity	14 ±0.1	9 ±0.2
5	Fermentation velocity	0.679 ±0.01	0.74 ±0.03
6	Final ^{o}Brix	12 ±0.1	12 ±0.2

Values are mean ± SD (n=10)

A correlation was found between Vc and AFD of the wine, as both parameters measure the quality and rate of sugar utilization, respectively. The Vc of the samples were found out to be 14 in the case of sample 1 and 9 for sample 2 (table 2). High values were recorded in the study of ginger honey wine ranging from 120 to 185 (Jangra *et al*. (2018). As reported by Balogu and Towobola in 2017 the Vc of honey and coconut milk wine for the various treatments ranges from 14 to 195. The AFD of the samples were 6.25 and 4.5 with respect to sample 1 and sample 2 in that order. The AFD of the six treatments of the honey and coconut milk wine was 3.04, 0.67, 9.65, 11.29, 0.61 and 10.14 Balogu & Towobola (2017). Fermentation velocity tends to measure the percentage or rate of sugar conversion to alcohol. It was found to be slightly different in both samples with the rate of 0.679 and 0.74 in sample 1 and sample 2 respectively (Table 2). The results are comparable to the report of Balogu and Tawobola in 2017 recorded Fv for their wine versions 0.99, 0.54 and 0.64 of honey and coconut milk blend wine. Apparently, these values are higher to that of (Jangra *et al.* (2018) for the various treatments of ginger honey wine recorded Fv ranging from 0.066 to 0.091. However, these values were significantly low compared to that of Malvar wine with rates of Fv ranging from 4.9 to 6.7 (Arroyo *et al*. (2016).This suggests slow fermentation that encourages volatile acidity accumulation during primary fermentation. It is also possible that the chemical configuration, heat treatment of mash, and length of fermentation diminished the overall fermentation velocity Balogu & Towobola, (2017).

TABLE 3: Biochemical characterization Dates fruit wine

S.N.	Parameter	Sample 1	Sample 2
1	Ethanol (%)	9.5±0.01	7.2±0.02
2	Titratable Acidity	0.345±0.01	0.562±0.02
3	Vitamin C (µg/g)	60±0.3	55±0.5
4	Hue and Intensity	3.55±0.02	1.45±0.01
5	Protein (mg/ml)	1.17±0.1	1.01±0.02
6	Reducing sugars (mg/ml)	0.99±0.02	0.99±0.03

Values are mean ± SD (n=10)

Ethanol concentration

The ethanol content produced from the respective dates fruit wine samples at the end of fermentation was recorded as 9.5% and 7.2% for sample 1 and sample 2, respectively (Table 3). The percent ethanol obtained is comparable to that reported for wine from dates fruit wine (Awe & Nnadoze, 2015; Bhusari *et al*., 2013). Do that of moderate grape wine (Okunowo *et al*., 2005), passion fruit, and pineapple fruits must (Chilaka *et al*., 2010). However, the analyzed ethanol percent is lower than that reported for wine from the honey slurry and dates fruit (Mohammed *et al*. (2018). Higher values of ethanol concentration for two apple varieties were found to be 11.0 ±0.04% and 10.50 ±0.03% in *Syzygium malaccensis* and *Eugenia owariensis*, respectively (Enidiok & Attah, 2011). A report has shown that the fermentation of fruits juices using yeast from different sources creates variety in flavor and varying levels of alcoholic contents in wines (Chilaka *et al*., 2010). More so, alcoholic fermentation leads to a series of by-products in addition to ethanol; and that some of the by-products include carbonyl compounds, alcohols, esters, and acids, (Clemente-Jimenez *et al.* (2005) all of them influencing the quality of the finished product.

Titratable Acidity

The present study also revealed a consistent increase in the titratable acidity of the mixed fruit wines throughout the period of fermentation. The result of the titratable acidity in the dates fruit wine for the samples was 0.375 g/100 ml and 0.562 g/100 ml for sample 1 and sample 2, respectively (table 3). These results are in agreement with those of (Swami *et al*., 2014) who reported 0.38 g/100 ml Titratable acidity in mango wine. Results are also in agreement with that of Ifie and coworkers (2012). They reported titratable acidity in the *Hibiscus sabdariffa* (Linn) wine ranging from 0.52 to 0.73 g/100mL. However, the acidity is higher than the acidity as observed by Mathew and coworkers (2017) was 0.020 g/100mL from *Vitis vinifera* wine. Wine produced from Indian mango indicated a titratable acidity 0.60 g/100 mL Reddy & Reddy (2009) which was slightly higher than what was obtained in this study. In the study presented by Sharma and Joshi in 2003 higher values were recorded for the various treatments of strawberry wine ranging from 0.62 mg/ml to 0.74 g/100ml. High acidity is known to favor the fermentative and competitive advantage of yeasts in the natural environment as reported by (Reddy & Reddy (2005). This implies that even if the wines are consumed in large quantities, the acidity level can easily be removed by the body system. Moreover, wine acidity is responsible for freshness, tartness and crisp taste. Wines of high acidity may appear to be very tart or acidic whereas wines of low acidity may appear flat or insipid.

Vitamin C

The ascorbic acid content in sample 1 and sample 2 were found to be 60 µg/g and 55µg/g respectively (table 3). Dates are regarded as a reasonable source of vitamins, particularly vitamin C – 3900 µg/100 g Al-Farsi & Lee (2008). A slightly higher amount of 88.57 µg/g of ascorbic acid was recorded in the assessment of dates fruit wine Awe & Nnadoze (2015). Again also Pisoschi and coworkers in 2011 reported 15.86 mg/100ml of ascorbic acid concentration in wine (*Recas vineyard*) representing a very high amount of ascorbic acid. Higher values for two apple varieties were found to be 10.23 ±0.02 mg/mL and 10.07 ±0.02 mg/mL in *Syzygium malaccensis* and *Eugenia owariensis* respectively (Enidiok & Attah, 2011). Highest was recorded in an orange wine where two treatments values were 76.78 ±0.01 mg/ml and 60.96 ±0.02 mg/ml (Schvab *et al*., 2015). The high-level ascorbic acid in the samples would be beneficial to the body since ascorbic acid has the potential of carrying out stimulation of certain enzymes, collagen biosynthesis, hormonal activation, antioxidant, detoxification of histamine, phagocytic functions of leukocytes, the formation of nitrosamine, and proline hydroxylation among others (Walingo, 2005).

Hue

The Colour of the wine is dependent on the type of variety of the fruit (Medina *et al.* (2005). They further added that white wines gain color as they age in a process called maderisation which is a process that involves the heating and oxidization of wine and through oxidation red wine loses color as they also age. The absorbance at 420 nm was higher in both samples while as at 520 nm and 620 nm there was a decrease. The intensity of the yellow color (absorbance at 420 nm) increased, while the intensity of the red and blue color (absorbance at 520 and 620 nm) decreased (Arranz *et al*., 2012; Babince *et al*., 2016). This clearly signifies that the color of the samples is straw yellow.

Protein

The concentration of protein in sample 1 was 1.17 mg/g and that of sample 2 was 1.01 mg/g. Comparably Awe and Nnadoze in 2015 reported 1.40mg/g of protein concentration in their assessment of dates fruit wine. More so, Mohammed and coworkers in 2018 reported less amount of protein content found in their honey slurry and dates fruit wine to be 0.15 mg/g. apparently, Bhusari and coworkers in 2013 obtained 60 mg/ml of protein content a wine produced from dates.

Reducing Sugar

The reducing sugar content was found to be 0.99 mg/ml which were the same in both samples as shown in table 3. Comparably, the amount obtained by Bhusari and coworkers in 2013 was 9.4 mg/ml in wine from date fruits.

In the study presented by Sharma and Joshi in 2003 comparable values were recorded for the various treatments of strawberry wine ranging from 0.8 mg/ml to 1.59 mg/ml. However, a slightly higher content was reported for reducing sugar content as observed by Soibam and coworkers in 2017 for sugarcane and watermelon wine was found to be 1.1 mg/ml. A lower amount of reducing sugar content was recorded for pineapple wine and watermelon wine at 0.80 mg/ml and 0.81 mg/ml respectively (Joshi *et al*., 2012; Okeke *et al*., 2015). The rate of sugar consumption was concluded to be related to the rate of yeast growth (Liu *et al*., 2017). This implies that less amount of reduced sugar in the samples is proportional to the alcohol produced by the yeast.

Sensory Evaluation

The sensory parameters analyzed between sample 1 and sample 2 except clarity was appearance, color, flavor, mouth feel and overall acceptability. Table 4 shows the fixed ANOVA results for the descriptive analysis data of the sensory attributes. The mean values for the various parameter for sample 1 score for appearance (8.29), colour (7.93), flavor (8.00), mouthfeel (8.43), overall acceptability (8.50) and sample 2 appearance (8.00), colour (7.07), flavour (8.14), mouthfeel (7.79), and overall acceptability (7.43). There was no significant sensorial difference observed between the two samples at $p < 0.05$ (table 4). However, the lowest sensory attribute was recorded for color which by no means has no effect on the overall acceptability. This was further proven by the homogeneity that existed between the various sensory attributes. In table 5, the significant value recorded for the homogeneity of variances among all the sensory attributes were greater than 0.05 ($p>0.05$). This implies that variances between all the sensory attributes of both samples are equivalent. The analysis of variances of all the sensory attributes which indicates there is no significant difference ($p>0.05$) between them (Table 6).

TABLE 4: Descriptive analysis of the sensory parameters

						95 % Confidence Interval for Mean			
		N	Mean	Std. Deviation	Std. Error	Lower Bound	Upper Bound	minimum	maximum
Appearance	sample 1	14	8.29	1.069	0.286	7.67	8.90	6	9
	sample 2	14	8.00	1.177	0.314	7.32	8.68	6	9
	Total	28	8.14	1.113	0.210	7.71	8.57	6	9
Colour	sample 1	14	7.93	1.685	0.450	6.96	8.90	3	9
	sample 2	14	7.07	1.730	0.462	6.07	8.07	3	9
	Total	28	7.50	1.732	0.327	6.83	8.17	3	9
Flavour	sample 1	14	8.00	1.414	0.378	7.18	8.82	4	9
	sample 2	14	8.14	1.167	0.312	7.47	8.82	6	9
	Total	28	8.07	1.274	0.241	7.58	8.57	4	9
Mouthfeel	sample 1	14	8.43	0.938	0.251	7.89	8.97	6	9
	sample 2	14	7.79	1.369	0.366	7.00	8.58	5	9
	Total	28	8.11	1.197	0.226	7.64	8.57	5	9
Overall acceptability	sample 1	14	8.50	0.941	0.251	7.96	9.04	6	9
	sample 2	14	7.43	2.174	0.581	6.17	8.68	1	9
	Total	28	7.96	1.732	0.327	7.29	8.64	1	9

TABLE 5: Test of Homogeneity of Variances of the sensory parameters

	Levene Statistic	df1	df2	Sig.
Appearance	0.644	1	26	0.429
Colour	0.000	1	26	1.000
Flavor	0.005	1	26	0.946
Mouthfeel	2.807	1	26	0.106
Overall Acceptability	2.699	1	26	0.112

The sensory evaluation of the wine samples produced from the fermentation of dates fruit and some spices revealed no significant difference ($P>0.05$) between the wine samples in terms of appearance, color, flavor, mouthfeel and overall acceptability. The wines produced can be compared to other fruit wine in sensory attributes such as mixed fruit wine from pawpaw, banana and watermelon (Ogodo *et al*., 2015), banana wine Akubor *et al.* (2003), sugarcane and watermelon wine Soibam *et al*. (2017) and mango wine Ogodo *et al*. (2018b).

TABLE 6: Analysis of Variance of the various parameters

		Sum of Squares	df	Mean Square	F	Sig.
Appearance	Between Groups	0.571	1	0.571	0.452	0.507
	Within Groups	32.857	26	1.264		
	Total	33.429	27			
Colour	Between Groups	5.143	1	5.143	1.763	0.196
	Within Groups	75.857	26	2.918		
	Total	81.000	27			
Flavor	Between Groups	0.143	1	0.143	0.085	0.773
	Within Groups	43.714	26	1.681		
	Total	43.857	27			
Mouthfeel	Between Groups	2.893	1	2.893	2.102	0.159
	Within Groups	35.786	26	1.376		
	Total	38.679	27			
Overall Acceptability	Between Groups	8.036	1	8.036	2.865	0.102
	Within Groups	72.929	26	2.805		
	Total	80.964	27			

SUMMARY AND CONCLUSION

The risk of high blood pressure, heart disease, stroke, and expensive wine has been a menace on consumers. To elucidate these general happenings on the consumers, a study was conducted to come out with wine using dates palm fruit which would be inexpensive and above all can be produced at home. The results obtained during the present investigation are summarized below:

- Healthy dates fruits were used and the pulp was extracted from them by heating for a period for 30 minutes. Baker's yeast was added together with sugar and the various spices that were added thus cloves, ginger, cardamom, cinnamon helped in improving the flavor of the drink and also integrating into the wine their medicinal properties. The must was kept for fermentation for approximately 10 days. The initial specific gravity was recorded using a hydrometer was 1.120 and 1.095 for sample 1 and sample 2, respectively.
- The AFD, Vc, Fv, were then calculated based on the specific gravity for sample 1 and 2, respectively. For sample 1 AFD= 6.25%, Vc = 14%, Fv = 0.679 and sample 2 AFD = 4.5%, Vc = 9%, Fv = 0.74.
- Biochemical analysis was carried out on both samples after the fermentation period. The ethanol content was 9.5% and 7.2% for sample 1 and sample 2, respectively. The titratable acidity for sample 1 was 0.345 mg/ml and sample 2 was 0.562 mg/ml. Both samples recorded 0.99 mg/ml for reducing sugar, the protein content in sample 1 was 1.17 mg/ml and sample 2 was 1.01 mg/ml. The vitamin C in the samples were found out be 60 µg/g and 55 µg/g for sample 1 and sample 2, respectively.
- On the bases of the scientific data of the present investigation, it can be concluded that the dates fruit pulp which was fermented with baker's yeast to produce wine was found to be organoleptically more acceptable. The organoleptic evaluation during storage study suggests that the product can be kept for one month under refrigerated storage without deterioration in taste and flavor.

Therefore, the developed dates fruit wine can be one of the upcoming health beverages. It may have a good commercial market under the current retail boom of supermarket and consumer's consciousness regarding their health. Nevertheless, consumers would be able to produce their own wine without any difficulty. Since most traditional wine and spirits are highly expensive notwithstanding the various health implications associated with their abuse.

The developed processing technology for preparation of date fruit wine is techno-economically viable and therefore can be commercially exploited. Moreover, it will be beneficial to the end user having therapeutic value. Identification of volatile compounds related to flavors would aid in explaining its therapeutic value.

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