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Research paper

Physico-chemical and sensory evaluation of wines from different citrus fruits of Himachal Pradesh

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Abstract

Attempt made to prepare and evaluate wines from different citrus fruits *viz;* mandarin, orange, kinnow and galgal is reported here. The must from kinnow fruits had the highest rate of fermentation while that of galgal recorded the lowest. Wines from different citrus fruits differed for various physio-chemical characteristics like aldehyde, colour, ethanol, pH and titrable acidity. All the wines except that of galgal were comparable in various physico-chemical characteristics TSS, pH and titratable acidity. All the wines recorded a score of more than 12 for their sensory qualities thus these were found to be acceptable. On the basis of Quantitative Descriptive Analysis (QDA), it was concluded that orange and kinnow wines were rich in characteristic flavour of the respective citrus fruits. While high variations in other characteristics like alcoholic, aromatic were recorded, the descriptors like sweet, molasses, yeasty, musty were comparable. Bitterness was perceptible in all the citrus wine though the extent varied. It is concluded that out of various citrus wines, those from mandarin and orange were more acceptable than others on the basis of sensory score.

Keywords: Mandarin, orange, kinnow, and galgal, wine, *Saccharomyces cerevisiae* var. *ellipsoideus*, ethanol, sensory quality, quantitative descriptive analysis,yeasty.

Citrus is as nearly a universal fruit as exits on earth with significant production in the tropical and sub tropical regions on six of the seven continents of the world; Antarctica of course is the exception. Popularity of citrus fruits juice and other products in mainly due to their flavour and nutritional value. It belongs to family Rutaceae include lemons, limes, oranges, tangrins, mandarins, Clementines and Satsumas and is predominantly grown in Brazil and U.S.A. In India, citrus occupies third position among fruits covering an area of 846, 000 hectares with an annual production of 74.64 lakh tonnes. The average yield of citrus is about 8.8 MT per hectare (Anonymous, 2011). Despite the large potential for production, there is lack of technology to preserve citrus fruits and their products though a part of the produce is converted into squash juice, juice concentrate and canned citrus fruits. Still there are large quantities of fruits that are not utilized and goes waste. Production of wine from these fruits is one of the alternatives available.

Production, importance and nutritive value of different fruit wines has been reported earlier (Joshi, 1997, Joshi *et al.*, 1999, Joshi and Kumar, 2011, Joshi *et al.*, 2011). Wines have been considered as safe and healthy drinks, besides an important adjunct to the diet. The recent years have witnessed several reports on the consumption of wine in moderation and beneficial effect on the cardiovascular system as well as the general wellbeing of the consumers (Creina, 2011). In wines, alcohol is a macro nutrient and is an energy source, capable of providing calories for all essential biological activities of the human cells, energy for physical work and thermogenesis (Bisson *et al.*, 1995). It consists of water, alcohol, pigments,

esters, vitamins, carbohydrates, minerals, acids, and tannins with medicinal and therapeutic value (Patil *et al*., 2005). Fruit wines are produced and consumed in large quantities in all advanced countries in the world. A few industries in our country produce wine but fruit wine production at this time is insignificant inspite of tremendous increase in the fruit production. In the literature, preparation of wine from orange has been described (Amerine *et al*., 1980) there is only a limited work on utilization of different citrus fruit for wine preparation (Joshi *et al*., 1997) especially for the fruits grown in Himachal Pradesh. Therefore, a need was felt to investigate the production of wines from different citrus fruits and to evaluate the same and the results are reported here.

Material and Methods

Raw material

The fruits (mandarin, orange, kinnow and galgal) used to make wines were procured from local market of Solan (Himachal Pradesh). The pectin esterase enzyme used in the studies was manufactured by M/S Triton Chemicals, Mysore, India under the brand name "Pectinol". Cane sugar was used to raise the TSS of must prior to the fermentation. DAHP was used as a source of nitrogen and was procured locally.

Preparation and maturation of wines

Juices of the above mentioned citrus fruits were extracted by the screw type juice extractor. Except galgal, the juices of these fruits were used as such; however the galgal juice was diluted ten times because of its higher acid contents. To the juices of different citrus fruits, SO_2 @ 100ppm, pectinase @ 0.5%, diammonium hydrogen orthophosphate @ 0.1% and enough sugar was added so as to raise the TSS to 24^0 B, to prepare the must. Active yeast culture (prepared 1-2 days earlier) was added @ 5% and the must was allowed to ferment. After the fermentation was completed, the wines were siphoned. To ensure better clarification, siphoning was done 2-3 times. The wines were then, blended with sugar to make these palatable. The wines were then, pasteurized and bottle matured for a period of 2 years.

Physico-chemical and sensory analysis

Wines from different treatments were analyzed for various physico-chemical and sensory quality characteristics. Total soluble solids (TSS) were determined using hand refractometer after correcting the readings for temperature variation. The results were expressed as degree Brix (^{o}B). On the basis of fall in ^{o}B/24hrs, the rate of fermentation was estimated. Titrable acidity was measured by the method of AOAC (1980). Brix/acid ratio was determined by dividing TSS (^{o}B) by titrable acidity. pH was taken with ELTOP-3030 digital pH meter. Ethanol content was estimated by potassium dichromate method of Caputi *et al*, (1968), using spectrophotometer. Total aldehyde content were measured by the method of Amerine and Ough (1979). Tintometer model E was used to measure the colour of wines which was expressed as the number of units presented in the product as Red (R) and Yellow (Y) colour (Ranganna, 1986). However, the visual colour was also recorded.

Sensory analysis was done according to the method given by Amerine *et al.* (1980). Flavour profile for different wines was also made. Sensory evaluation was done as per the method given by Joshi (2006). The flavor profiling was carried out on a scale of 10. The judges were asked to rate the extent of particular attribute in a product and give the score, accordingly. During the sensory evaluation the judges rinsed their mouth with water in-between the testing of the products. The samples of wines were given as the coded samples to judges.

Results

The results on rate of fermentation and ethanol content (Tables 1), show that the highest rate of fermentation was recorded in kinnow wine (1.52) followed by orange wine (1.50), whereas it was the lowest in galgal wine (0.94). Since the galgal juice was highly acidic and the resultant wine would be unpalatable, so the dilution of the same was carried out prior to fermentation. Consequently, the dilution of the nutrients might have caused a reduction in the rate of fermentation of galgal wine. All the wines except galgal were comparable for other characteristics like TSS, pH and titratable acidity. The TSS of the galgal wine was the highest (11.0 ^{o}B) and corroborated with the rate of fermentation, the lowest TSS was recorded in orange wine (7.80^{o}B) followed by kinnow wine (7.99^{o}B). The lowest pH was recorded in galgal wine as was expected (2.80) while it was the highest in orange wine (3.78), which may be due to the low initial pH or low buffer capacity of the juice used for the fermentation. Highest acidity was recorded in galgal wine (1.47 %) and it was the lowest in orange wine (0.70%). Ethanol content was highest in kinnow wine (12.20%) and was the lowest in orange and galgal wine (10.20%). The ethanol content was in accordance with the fermentation behaviour of the respective musts of the fruits. The ethanol content further indicated that the wine fall in the category of table wine. Since the fruit had low sugar content to make a table wine of about 11 per cent alcohol content, amelioration with sugar was carried out in all the citrus musts as is practiced for other wines (Joshi *et al*., 2011). Further, all the citrus wines differed in their aldehyde content as well as colour values. Kinnow wine and galgal wine recorded the highest free aldehyde concentration (48.4 ppm) and the mandarin wine recorded (45.0 ppm). However, the level of aldehyde was comparable to that of grape

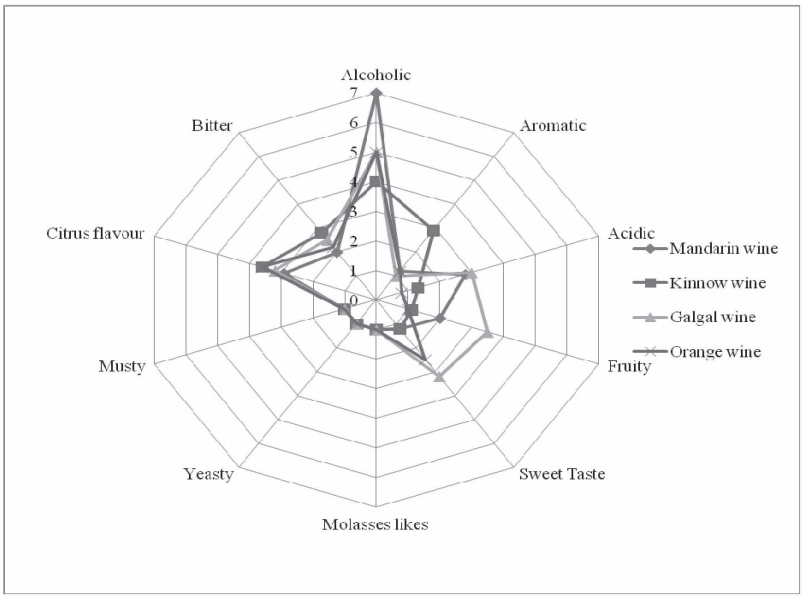

Figure 1: Comparison of flavour profiles of citrus fruit wines

wine that reportedly ranged from the 110 to 140 ppm (Amerine *et al*., 1980). Reddish yellow colour and higher units for Red and Yellow colour were recorded in kinnow and orange wines among all the citrus wines (Table 1), which may be due to the colour of the raw material used for fermentation. Red colour value was maximum in kinnow and orange wine (2.0) and minimum in case of mandarin wine (0.5), whereas, yellow colour value was maximum in kinnow wine (8.0) and was minimum in case of mandarin wine (3.5). These results are on the expected lines.

Further, characterization of wines for flavour profiling done by quantitative descriptive analysis (QDA) technique showed that the differences in the flavour characterices of the citrus wines were observed except for molasses like, yeasty and musty characteristics (Figure 1). Wine from mandarin was found to have the highest alcoholic flavour (7.0) whereas kinnow wine had the lowest (4.0). Aromatic flavor was the highest in kinnow wine (2.9) and was lowest in case of galgal wine (1.0). Galgal wine recorded the highest acidic and fruity flavor (3.0 and 3.0, respectively), whereas it was the lowest in case of orange

Table 1: Comparison of physico-chemical characteristic of citrus fruit wines

Characteristics		Wines			
		Mandarin	Orange	Kinnow	Galgal
Rate of fermentation (°B)10 days data		1.40	1.50	1.52	0.94
TSS (°B)		8.00	7.80	7.99	11.0
pH		3.72	3.78	3.74	2.80
Titratable Acidity (% CA)		0.86	0.70	0.86	1.47
Ethanol (%v/v)		11.70	10.20	12.20	10.20
Free aldehyde (ppm)		45.0	48.0	48.4	48.4
Colour units	Red	0.5	2.0	2.0	0.9
	Yellow	3.5	6.5	8.0	4.6
	Blue	0.0	0.0	0.0	0.0
Visual colour		Light pale Yellow	Radish Yellow	Radish Yellow	Straw colour
Sensory score (out of 20)*		15.0	14.0	13.0	13.0

*After blending to adjust the TSS/Acid ratio and maturation of 2 years.

wine (0.8 and 1.0 respectively). Sweet taste was prominent in case of galgal wine (3.2) and was low in case of kinnow and mandarin wine (1.2). Molasses likes, yeast and musty flavor of all the wine under study was equal in scale and scored 1. Higher values for these characteristics show that wines were prepared and matured in satisfactory manner. The original flavor of citrus was prominent in case of kinnow and orange wine and recorded a score of 3.6, whereas, it was lowest in case of mandarin wine (2.9). Kinnow wine was found to have the highest bitterness (2.8) while the mandarin wine recorded the lowest bitterness (2.0). This is indicative of proper fermentation of the fruit. In all the wines bitterness was perceivable and is on expected lines. It is because of citrus juices including kinnow become bitter and the same is carried on to the wine. An effective method of wine making without bitterness has been reported by Joshi *et al.*, (1997) by using cyclodextrin and Amberlite XAD-16 to reduce it considerably and reported that debittering the juice either prior to or during fermentation improved the sensory quality of kinnow wine. However, there is no information about other citrus fruits. All the wines recorded a score of more than 12 for their sensory qualities, so they all were found to be acceptable. The wines from mandarin and orange were found to be better on the basis of sensory scores among all the wines under study. The results of the current study is in line with findings of Canas and Unal (1994), who reported that out of sweet orange, mandarine, kinnow and lemon wines made except lemon, all the other citrus wines were acceptable. In brief, the results indicate that there is a potential for making wine from citrus fruits grown in Himachal Pradesh.

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