Production, optimization and characterization of wine from Mango (*Mangifera indica* Linn.)

L Veeranjaneya Reddy[1]* and O Vijaya Sarathi Reddy[2]

[1]Department of Microbiology, Yogi Vemana University, Kadapa-516 003, Andhra Pradesh, India

[2]Department of Biochemistry , Sri Venkateswara University, Tirupati-517502, Andhra Pradesh

*Correspondent author, E-mail: lvereddy@yahoo.com

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Abstract

Ten mango cultivars which are commonly found in the region were selected for the study. Optimization of fermentation conditions (like yeast strain, pectinase enzyme, *p*H and temperature) and production of higher alcohols and other volatile compounds during wine fermentation were investigated. To prepare wine, the fruits were peeled and juice (must) was extracted immediately after crushing (control) and also after 10h of pectinase treatment. The cv. 'Raspuri' gave the highest juice yield (600 ml/kg) followed by cv. 'Banganpalli' (570 ml/kg). The sugar content of must ranged from 15 to 18% (w/v). The recovered juice was fermented at 15 and 20°C and the ethanol concentration of mango wine ranged from 6.3 to 8.5 per cent. Fermentation efficacy of three yeast strains, viz. *Saccharomyces cerevisiae* CFTRI 101, Palm Wine Isolate and Baker's Yeast was done and highest score was obtained for 'Banganpalli' wines with yeast strain *S. cerevisiae* CFTRI 101 followed by 'Alphonso' and 'Totapuri'. Pectinase enzyme treatment increased the yield of juice and ethanol production also. Total volatile composition of mango wine was evaluated using GCMS and identified 33 compounds having fruity aroma characters. More volatiles were observed in wine produced from 'Banganpalli' cultivar (343 mg/l) than wine from 'Totapuri' cultivar (320 mg/l).

Keywords: Mango juice, Pectinase treatment, Wine production, Volatile composition, Sensory evaluation.

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Introduction

Wine is a popular drink being enjoyed all over the world. Historians believe that wine was being made in Caucasus and Mesopotamia as early as 6000 BC[1]. Rigveda amply testifies that the wine is perhaps the oldest fermented product known to man. Wine has been made in India for as many as 5,000 years. It was the early European travellers to the courts of the Mughal emperors Akbar, Jehangir and Shah Jahan in the sixteenth and seventeenth centuries who reported tasting wines from the royal vineyards. In general, grapes are the main fruit that has been used for wine production. Though, the suitability of fruits other than grapes has been investigated all over the world[2], the amount of wine produced from non-grape fruits is insignificant. In many countries, other fruits wine like apple (Spain, France, Belgium, Switzerland and England), plum (Germany) and cashew apple (India) are in large demand.

Mango is one of the most highly priced desert fruits of the tropics. It has rich luscious, aromatic flavour and a delicious taste in which sweetness and acidity is delightfully blended. Mango production has experienced continuous growth in the last decades of the 20th century. The world's total annual mango fruit production was estimated at 22 million metric tonnes. Global production of mangoes is concentrated mainly in Asia and more precisely in India that produced 12 million metric tonnes per annum. In India, mango is grown in 10.85 million hectare and it occupied 39% of total fruit production. More than 25 cultivars of mango are cultivated commercially in various regions of India[3-5].

Mango contains a high concentration of sugar (16-18%w/v) and acids with organoleptic properties and also contains antioxidants like carotene (as Vitamin A, 4,800 IU). Sucrose, glucose and fructose are the main sugars in ripened mango. The un-ripened fruit contains citric acid, malic acid, oxalic acid, succinic and other organic acids, whereas in ripened fruit, the main acid source is malic acid. Mango juice along with aromatics is recommended as a restorative tonic; as it contains good amount of vitamin A and C which are useful in heat apoplexy. Mangoes with higher initial concentration of α-carotene are helpful as cancer-preventing agents[5].

In developing countries like India 20-30% of fruits produced are wasted due to lack of proper utilization, post-harvest and processing technology. By converting the waste into value added products like wine is a smart solution for this problem. There are few reports on the suitability of mango for wine production. The research on this facet was initiated by Czyhrinciwk[6] in 1966 suggesting that the mango is well suitable fruit for the production of fruit wine. In India, Kulkarni *et al*[7] and Onkarayya and Singh[8,9] have screened 20 mango cultivars for the production of wine. Strains of *Saccharomyces cerevisiae* yeast which are known to produce different volatile profiles have been commonly used for alcoholic fermentation. But there is lack of information on mango wine production especially dealing with the suitability of local mango cultivars for wine production, other yeast strains, optimization of conditions of fermentation and characterization of its wine produced (both chemical and physical factors for quality). Accordingly, these aspects were investigated and the results are reported in this communication.

Materials and Methods

Mango fruits and processing

Ten cultivars of mango, viz.'Alphonso', 'Raspuri', 'Banganpalli', 'Totapuri', 'Allampur Banesha', 'Neelam', 'Mulgoa', 'Suvarnarekha, 'Rumani' and 'Jahangir', commonly available and grown in South India, were selected and procured from local market for the study. For processing, pulp and juice preparation and enzyme treatment was done as mentioned in Reddy and Reddy[10]. The pulp was divided into two portions. The first portion was left as a control and the second portion was treated with previously optimized enzyme concentration and conditions (0.8 % and *p*H 5) of Trizyme P 50, pectinolytic enzyme procured from M/S Triton Chemicals, India, Mysuru. The juice obtained in this manner was then subjected for analysis for various physico-chemical characteristics. None of the varieties was ameliorated with sucrose or any other fermentable sugar.

Preparation of mango wine

Microorganism and inoculum preparation: *S. cerevisiae* var. *ellipsoideus* CFTRI 101 (wine yeast) was received from Central Food Technological Research Institute (CFTRI), Mysuru (India). Culture maintenance and inoculums preparation was done as mentioned in Reddy and Reddy[10]. The culture was maintained on MPYD (Malt extract 0.3%, Peptone 0.5%, Yeast extract 0.3%, Dextrose 2% and Agar 1.5%) slants at 4°C. The inoculum was prepared by inoculating the slant culture into 25 ml of the sterile MPYD liquid medium taken in 100 ml Erlen Mayer flask and allowed to grow it on a rotary shaker (100 rpm) for 48 h at 37°C. This inoculum (3×10^6cells/ml) was transferred to 250 ml conical flasks having 100 ml mango juice.

Mango wine production by different mango cultivars during active fermentation at 22 ± 2°C and *p*H 5

For the evaluation of efficacy of yeast strains on fermentation performance three types of yeast strains including *S. cerevisiae* var. *ellipsoideus* CFTRI 101, Palm Wine Isolate (PWY1) and Baker's Yeast were taken up.

Fermentation

Batch fermentation of the inoculated must was carried out in conical flasks by incubating at *p*H 4.5 and at temperature 20°C for 15 days at 22 ± 2°C. The samples were collected by separation of the cells by centrifugation at 5,000 × g for 10 minutes. The fermented samples were kept at –20°C for a few weeks for chemical and sensory analyses. In the case of mango variety and yeast strain screening experiments fermentation was carried with individual variety and with yeast strain, separately. The musts were not ameliorated with sugar prior to fermentation. Except for the variables being studied, other conditions of wine preparation remained the same.

Effect of enzyme treatment

Combined effect of pectinase enzyme treatment and fermentation by yeast cultures using three different yeast strains on ethanol production was investigated. The pectinase enzyme concentration used was 0.6% and fermentation was conducted at 30°C at *p*H 4.5 in mango must for a period of 12 to 120hours. Observations were taken at an interval of 12hours. Composition of volatiles from three mango cultivars ('Banganpalli', 'Alphonso' and 'Totapuri'), fermented at 25±2°C and *p*H 4.5 for 10 days was also studied. 'Banganapalli' which has shown better results in the course of both screening and optimizing fermentation conditions was selected for GCMS. The wine was produced at optimized conditions. The liquid-liquid extraction procedure was followed for the preparation of samples for GCMS analysis. Other procedure of wine fermentation remained the same.

Effect of different conditions on the storage of wine

Mango wine was packed in bottles of different colours, viz. brown, green, white and was stored at a temperature of 6, 16 and 26° C. The changes in optical density at 420 nm were monitored.

Physico-chemical, micro-biological and sensory analysis

The concentration of reducing sugars was estimated by Shaffer & Somogyi[11] method. Total dissolved solids were measured by estimating specific gravity of water soluble portion of the juice obtained by the centrifugation at 10,000 × g for 15min. The specific gravity was determined at 20°C with densitometer. With the aid of approximate tables the results were converted to grams of dissolved solids per 100 ml and expressed as grams of sucrose. Total acidity was determined by titration with 0.1 N NaOH expressed in tartaric acid and volatile acidity within the distillate samples expressed in acetic acid mg/100ml. Phenols of the mango juice and wines were estimated by Folin-Ciocalteau method[12]. Effect of storage, colour stability and browning index of stored wines was measured as wine colour OD at 420nm.

Ethanol and other metabolites (glycerol, methanol and total esters) were determined with the help of Gas Chromatography[13, 14]. The fermented samples were centrifuged at 5000 × g for 10min. The supernatant was used for ethanol analysis. Agilent systems Gas Chromatograph (GC-FID) Model 6890 plus instrument was used and conditions were as follows: 5% Carbowax 20M glass column on Carbopack-B 80/120 mesh. Nitrogen was used as carrier gas and 2 m, 2 mm ID1/4 mm quantity with a flow of 20 ml/min was applied. The eluted compounds were detected by flame ionization detector (FID), for this the fuel gas was hydrogen with a flow rate of 40 ml/min. and the oxidant was air with a flow rate of 40ml/ min. and n-propanol was used as internal standard. The analysis of total volatile compound composition was carried out on a Hewlett-Packard series 6890 gas chromatograph linked to an HP-5973 mass-selective detector, with A 30m × 0.25mm i.d., 0.25 µm film thickness HP-5MS (Agilent, Palo Alto, CA) fused silica capillary column. The compounds were preliminarily identified by the use of NIST, Wiley, NSB mass libraries, as well as mass data from literature[14]. All the experiments were carried out three times (triplicate) and the mean value of the three experiments are presented.

Sensory evaluation of wine samples was performed by 6 well trained panellists. Different attributes of produced mango wine included were: visual, aroma, taste and harmony. The system used was Bux-Baum that contains total 20 points including, 2 points for colour, 2 points for clarity, 4 points for smell and 12 points for taste[15].

Results and Discussion

Screening of mango cultivars

The results of juice yield, physical and chemical composition is presented in Table 1. The fruits of different cultivars vary in sugar concentrations and other physico-chemical characteristics.

Table 1: Physico-chemical characteristics of mango juice of different mango cultivars

Mango cultivar	Juice yield (ml/kg)	Reducing sugars (% w/v)	Titrable acidity (%)	*p*H	TSS* (%)
'Alphonso'	570± 10	16.3±1.32	0.33	4.1±0.53	16.0±1.2
'Raspuri'	600 ± 13	15.5±2.21	0.43	3.9±0.86	14.2±1.8
'Banganpalli'	550 ± 17	18.5±1.24	0.32	4.0±0.6	20.5±0.79
'Totapuri'	500 ± 22	16.0±1.0	0.31	4.2±1.0	16.5±1.2
'Allampur Banesha'	500 ± 15	18.0±0.8	0.32	4.5±0.45	20.1±1.42
'Neelam'	480 ± 20	15.5±1.7	0.42	4.3±0.8	15.5±1.5
'Mulgoa'	468 ± 8	14.3±1.4	0.42	4.3±0.5	15.0±1.24
'Suvarnarekha'	470 ± 12	15.0±0.55	0.40	3.9±1.3	14.4±0.58
'Rumani'	475 ± 14	14.5±1.0	0.39	4.2±0.72	14.6 ±1.43
'Jahangir'	460 ± 10	15.6±1.62	0.46	4.6±0.56	14.2±1.3

'Raspuri' gave highest juice yield (600ml/kg) followed by 'Alphonso', 'Banganpalli', 'Allampur Banesha' and least by 'Jahangir'. The main prerequisite character of juice for fermentation is sugar content. The total soluble solids (TSS) of the mango must range from 14.2 to 20.5 per cent. The high TSS was from 'Banganpalli' (20.5%) followed by 'Allampur Benesha' and Totapuri (20.1 and 16.5%, respectively). The sugar content of must range from 15 to 18% (w/v) while titrable acidity as tartaric acid range from 0.310 to 0.462% (w/v). The *p*H of the musts was 3.8 to 4.5. The low *p*H (3.8) was recorded in 'Neelam' variety that tasted acidic[16].

The physical and chemical characters of mango wines fermented by *S. cerevisiae* CFTRI 101 are shown in Table 2. The concentration of higher alcohols differed with mango cultivars (131 to 343 mg/l) (Table 2) and highest content was in the wine produced from 'Banganpalli' and lowest in 'Neelam'. Fruit maturity influenced the synthesis of higher alcohols during fermentation. Their concentration in Semillon wine tends to be lower in wine made from later harvested grape[17]. Our results also confirmed the previous reports[18,19]. Higher alcohols may influence certain sensory characteristics although they constitute a relatively lesser quantity of the total substances. Fermentation changed the aroma of fruit juice, because of the production of yeast volatiles and the metabolism of original fruit volatiles.

The concentration of esters in wine varied from 15 to 35mg/l (Table 2) and it was affected by many factors like variety of fruit, clarification and fermentation conditions. The results obtained confirmed the previous published reports[20]. The concentration of total polyphenols was different in wine from cultivar to cultivar of mango. The highest concentration was detected in wine produced from 'Totapuri' followed by 'Alphonso' and 'Banganpalli' (1050mg/l, 725mg/l and 610mg/l, respectively). The quantity of phenolic compounds present in mango wine is comparable with commercial white wines. In all the cases the phenolic concentration increased after the fermentation. Phenolic compounds are among most important compounds in determining the quality of the wine, because they greatly influence colour, bitterness, astringency and chemical stability of the wine[21]. The sensorial results (Table 3) show that different cultivars produced different types of wines. Highest score was obtained for 'Banganpalli' wine with yeast strain CFTRI 101 followed by 'Alphonso' and 'Totapuri'.

Effect of pectinase on juice yield and ethanol production

Pectinase treatment increased the yield of juice in all mango cultivars. The optimized pectinase enzyme concentration was 0.6% and treatment time was

Table 2 : Physico-chemical characteristics of mango wine

Mango cultivar	Ethanol (%w/v)	T.A* (%v/v)	V.A* (%v/v)	*p*H	Residual sugars (g/l)	Higher alcohols (mg/l)	Total esters (mg/l)	Tannins % (w/v)	Colour OD at 590nm
'Alphonso'	7.5	0.650	0.100	3.8	2.1	300	25	0.011	0.22
'Raspuri'	7	0.735	0.210	3.8	2.4	200	29	0.072	0.18
'Banganpalli'	8.5	0.600	0.181	3.7	2.0	343	35	0.012	0.23
'Totapuri'	7	0.622	0.121	4.0	2.0	320	20	0.012	0.17
'A. Banesha'	8	0.610	0.110	4.0	2.0	320	30	0.013	0.25
'Neelam'	6.5	0.826	0.234	3.6	2.5	131	15	0.014	0.21
'Mulgoa''	6.3	0.621	0.109	3.9	3.0	152	18	0.065	0.28
'Suvarnarekha'	6.8	0.630	0.153	4.1	2.3	175	22	0.025	0.19
'Rumani'	6.9	0.618	0.125	4.0	2.1	212	15	0.027	0.24
'Jahangir'	7.1	0.646	0.138	3.8	2.0	256	21	0.042	0.16

T.A = Titrable acidity
V.A = Volatile acidity

12 hours. It was considered very important because higher concentration may result in increased methanol accumulation due to the hydrolysis of methyl pectin by methyl pectin esterases (unpublished data). Pectinase treatment significantly increased the ethanol production from mango pulp by all three yeast strains. The increase in ethanol may be because of must clarity and increased sugar concentration in pectinase treated samples (Fig. 1). Clarification of must prior to the onset of alcoholic fermentation improves sensory characteristics of white wine. Bosso[22] has observed higher levels of alcohols in fermented grape must pre-treated with endogenous pectolytic enzymes and observed increases in iso-amyl alcohol and 2-phenyl ethanol and a decrease in n-propanol concentrations in fermented macerated grapes pre-treated with pectolytic enzymes. Removal of grape solids from must enhances ester production and limits the release of fusel alcohols (higher alcohol) during alcoholic fermentation which results in a global increase of wine aroma quality.

Effect of yeast strains on wine production

To evaluate the fermentation performance, the yeast strains were subjected to different temperatures and *p*H during fermentation. Out of the three yeast strains *S. cerevisiae* CFTRI 101 gave promising results at all conditions (Table 4a and b). The yeast strain isolated from palm wine (PWY1) also showed somewhat better results than the yeast strain that was purified from commercial Baker's yeast (Fig. 2). The Baker's yeast could not ferment or utilize the complete sugar

Table 3 : Sensorial evaluation of ten mango wines produced from ten different mango varieties

Mango cultivars	Visual	Aroma	Taste	Harmony
'Alphonso'	6	7	6	5
'Raspuri'	4	5	5	4
'Banganpalli'	7	8	7	6
'Totapuri'	6	6	5	5
'A. Banesha'	6	5	5	4
'Neelam'	5	4	5	4
'Mulgoa'	4	5	4	4
'Suvarnarekha'	5	4	5	4
'Rumani'	4	3	4	3
'Jahangir'	4	4	5	4

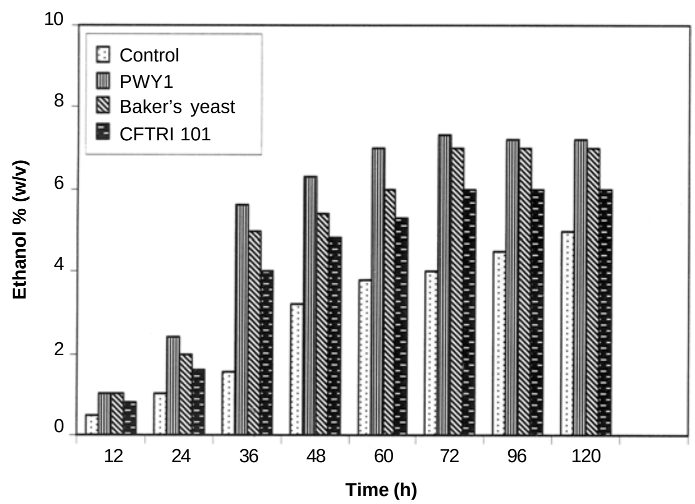

Fig.1: Effect of pectinase treatment on ethanol production during mango fermentation by three different yeast strains at 30°C and *p*H 4.5

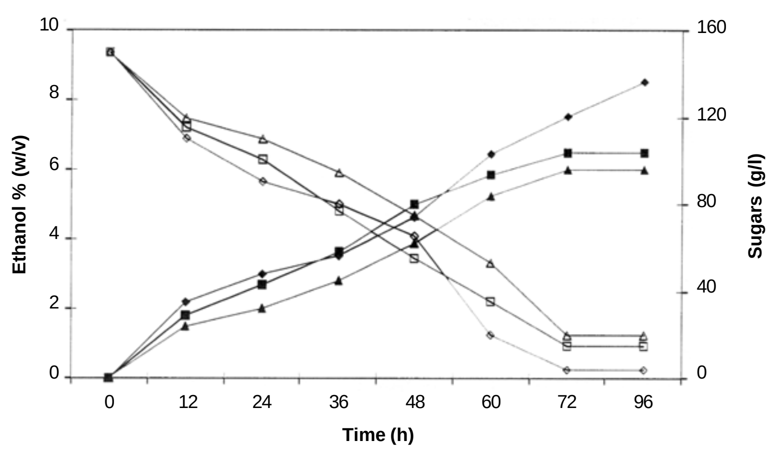

Fig. 2: Ethanol formation kinetics of three yeast strains (Yeast strains: ◆ CFTRI 101; ■ PWY1 and ▲Baker's Yeast; same open symbols are for residual sugars)

Table 4a: Performance of yeast strains during mango must fermentation

Yeast strain	Day of maximal population	Maximal population (cells/ml)	Duration of fermentation (Days)	Ethanol fermentation rate (g/l/day)
Baker's yeast	6	0.98×10^8	15	24.83
PWY1	4	1.15×10^8	15	36.74
CFTRI 101	3	1.76×10^8	12	42.87

Table 4b: Composition of mango wine ('Banganpalli') fermented by three different yeasts at 20°C

Compound (ppm)	*S. cerevisiae* CFTRI 101	PWY 1	Baker's yeast
Acetaldehyde	22 ± 2.5	18 ± 2	15 ± 1.8
n-Propanol	45 ± 2.8	30 ± 2.4	50 ± 3.2
Isoamyl alcohol	150 ± 9.4	214 ±12	240 ± 10.5
Isobutanol	103 ± 10	83 ± 5.6	90 ± 11
Methanol	245 ± 8.5	260 ± 12	310 ± 10
Ethyl acetate	30 ± 2.4	26.3 ± 1.2	20 ± 2.2

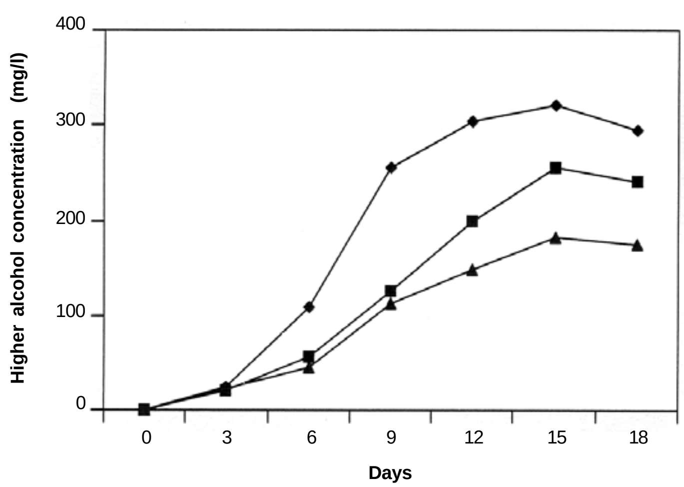

Fig. 3: Effect of yeast strain on higher alcohols production at 22 ± 2°C and *p*H 4.5 (Yeast strains: ◆CFTRI 101; ■PWY1 and ▲Baker's Yeast)

from the mango must and the fermentation rate was also slow. The palm wine yeast strain's fermentation rate was comparable to that of CFTRI 101, but it could not tolerate high concentration of ethanol, which is the most desirable character for wine fermentation. The characteristic feature of less ethanol tolerance might be the reason for low ethanol production by the remaining yeasts.

The CFTRI 101 strain showed vigorous fermentation capacity during wine production and it adapted well to the conditions of must and started ethanol production within 4h of inoculation and completed the fermentation within 70-76h and it showed good ethanol tolerance capacity up to 10% (w/v). The CFTRI 101 yeast strain completely converted the sugar in mango must into ethanol (residue 1-2g/l).

The higher alcohol concentration varied in wines produced by three yeast strains. The strain CFTRI 101 produced higher concentrations of higher alcohols compared to the other two strains that ranged between 150-300 mg/l by CFTRI 101 followed by Baker's yeast 123- 200 mg/l and PWY1 100-185mg/l (Fig. 3). The evaluation of total esters during fermentation is shown in Fig. 4. Ethyl acetate, along with the total esters, contributes to the distinct aroma of wine. The concentration of total esters ranged between 15-35 mg/l in different mango wines fermented with strain CFTRI 101, 10-27mg/l in the wines fermented with PWY1 and 8-15mg/l in the wines fermented with Baker's yeast. Esters have been mainly synthesized in all mango must samples after consumption of the first 20-30% of sugars by the yeast. The greatest synthesis took place during the fermentation at 50-75% of the sugars, more as in the samples inoculated with CFTRI 101 yeast strain, which showed a greater capacity for generating these volatile compounds than the other two.

The levels of higher alcohols in

wines produced from same variety of fruits will differ with yeast employed for the fermentation and the yeast cell plays a decisive role in formation of fusel oils of higher alcohols[23]. Kunkee & Vilas[24] have reported that the synthesis of acetic acid, iso-butanol and iso-amyl alcohol during fermentation depending primarily on yeast strain. Several authors have studied the influence of the yeast added to an alcoholic fermentation on wine quality[23, 25]. According to Ough *et al*[26] fermentation temperature and technological procedures, such as aeration during maceration affects the synthesis of higher alcohols.

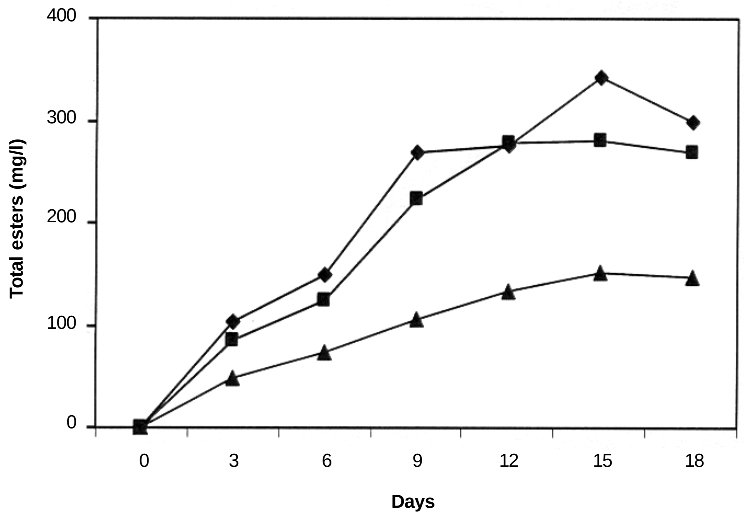

Fig. 4: Effect of yeast strain on total ester production at 22 ± 2°C and *p*H 4.5 (Yeast strains: ◆CFTRI 101; ■PWY1 and ▲Baker's Yeast)

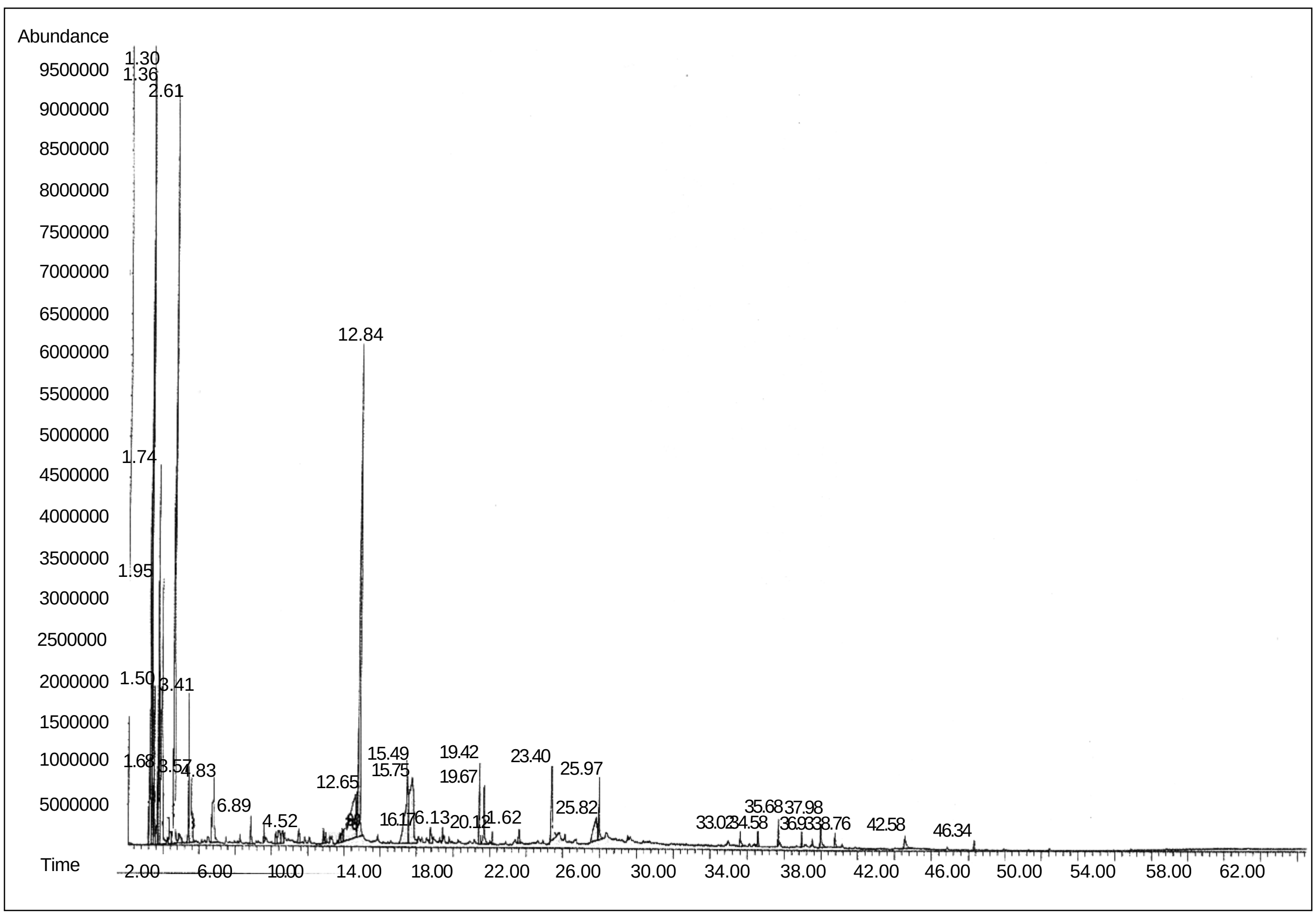

Fig. 5: Typical GC-MS chromatogram of the volatile compounds in 'Banganpalli' mango wine

Table 5: Composition of volatiles from 'Banganpalli' wine fermented at 25±2°C and *p*H 4.5 for 10 days

S. No	Retention Time (RT)	Name of the compound	'Banganpalli' (mg/l)
1	1.271	Ethanol %	8.5
2	1.350	Ethyl ether	solvent
3	1.492	1-propanol	54.11
4	1.729	Isobutyl alcohol	102.40
5	2.581	Isoamyl alcohol	125.23
6	2.850	Pentane-2 one	1.43
7	4.823	2-furan methanol	0.123
8	6.535	Hexane-1-ol	1.42
9	12.900	Phenethyl alcohol	22.15
10	19.414	Cyclohexane methanol	1.13
11	42.58	n-Pentanedecanol	0.610
12	1.665	Ethyl aetate	35.15
13	6.876	Ethyl hexanoate	0.942
14	15.92	Ethyl octanoate	1.150
15	20.124	Ethyl decanoate	2.34
16	19.67	Dimethyl styrene	1.11
Acids			
17	1.950	Acetic acid	0.201
18	3.292	Propanoic acid	0.145
19	3.829	Butanoic acid	0.932
20	12.655	2-furoic acid	0.910
21	15.482	Benzoic acid	1.08
22	15.750	Phenyl formic acid	0.643
23	16,723	Octanoic acid	0.735
24	37.99	Decanoic acid	1.18
Ketones			
25	2.850	Pentane- 2 one	1.43
26	6.245	Furanone	1.12
27	11.489	Hydroxy-dimethyl furanone	0.238
28	25.967	Phenol 2,6-bis-4-methoxy- one	0.451
Unknown			
29	15.165	Unknown	0.183
30	23.377	Benzene methane -4-hydroxy	0.531
31	35.68	Unknown	0.441
32	38.86	Unknown	0.12
33	46.34	Unknown	tr

The amount of ester production varied with the three yeasts. These esters at higher concentrations, which are above a threshold value of 150 mg/l, would impart vinegar smell to the wine[27]. In the present study, none of the strain produced high quantities of these esters in wine. The formation and concentration of the volatile compounds found in mango wine were dependent on the mango cultivar and *S. cerevisiae* strain used.

Characterization of mango wine by GCMS

The composition of wine prepared from 'Banganpalli' is shown in Table 5 and corresponding GCMS chromatogram are shown in Fig. 5. The three major compounds (alcohols, esters and organic acids) were present in different concentration. The isoamyl alcohol (125mg/l) was higher in quantity as compared to all the compounds detected by GCMS, followed by isobutyl alcohol (102mg/l), n-propanol (54.11mg/l) ethyl acetate (35.15 mg/l) and phenyl ethanol (24.15mg/l) (Table 5). Ethyl hexanoate, ethyl decanoate and ethyl octanoate are produced in higher quantities (1.150 and 2.34g/l, respectively) in 'Banganpalli' (data not presented). The volatile acids present in mango wine are acetic acid, propanoic acid, benzoic acid. It is clear from this study that higher alcohols and esters were the main constituents in wine produced from mango fruits. Wine made from 'Banganpalli' showed good number of aroma components. Therefore, it is important to know the potential differences in volatile production by various yeast strains and fruit varieties in order to select the best one to produce

Table 6: Effect of storage temperature and bottle colour on browning of mango wine

Type of effect	OD at 420nm
Temperature (°C)	
8	0.18
16	0.21
26	0.26
Bottle colour	
Brown	0.21
Green	0.25
White	0.28

desirable wine.

Effect of storage temperature and bottle colour on mango wine colour

The changes (Table 6) in the colour of the mango wine stored at different temperatures (8, 16 and 25°C) in bottles of different colours were monitored by the browning index. Wine that was stored in darker brown bottles at low temperature showed low browning indices when compared to wine stored in white bottle. Wines stored in brown bottles had the lowest browning index. These findings are in accordance with previous report[28]. The mango wines in clear white bottles stored at 26°C had an undesired colour and a higher browning index.

Conclusions

It can be concluded that 'Banganpalli', 'Totapuri' and 'Alphonso' cultivars are most suitable for mango wine production. The sensory evaluation has indicated that the wine possesses novel characteristics in aroma and taste and good acceptability. 'Banganpalli' wine fermented with yeast strain CFTRI 101 was most acceptable followed by 'Alphonso' and 'Totapuri'. Information on an adequate process for both juice and wine production from mango and other tropical fruits and the findings regarding pectinase treatment, formation of major volatile compounds, GCMS characterization and sensory evaluation can be valuable references to the wine industry.

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