

Study on Tomato Wine Production and Optimization

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Abstract: Wine is a typical alcoholic beverage produced by natural alcoholic fermentation of fruit juice of sound quality. Wine consists of (10-12%) of ethanol. The suitability of tomato fruit was investigated for the production of tomato wine. Fermentation of tomato juice was carried out by a potent yeast strain *Saccharomyces cerevisiae* (MTCC 180). The production of tomato wine was standardized with reference to different variables such as, size of inoculums, pH of tomato juice, time of fermentation (1-10 days), adjustment of brix, Incubation temperature, effect of alcohol adapted & non-adapted cultures and age of culture. The tomato wine was analysed for pH, total soluble solids (TSS), titratable acidity (TA) and ethanol concentration.

The maximum production of ethanol was achieved on 4th day of fermentation with 24°Brix at 5% inoculums level. The production of wine using alcohol adapted culture and non-adapted cultures showed no significant change in ethanol content. Hence, better quality wine can be prepared using non-adapted culture on 4th day of fermentation is considered optimum.

Keywords: *Saccharomyces cerevisiae*, Potassium meta bisulphate, total soluble solid, fermentation and titratable acidity.

I. Introduction:

Tomato is the world's largest vegetable crop, because of its wide spread production and special nutritive value. It is a rich source of vitamin A and C, it also contains minerals like iron, phosphorus and pigments such as Lycopene and Beta-carotene. Tomato is commonly used in preserved products like ketch-up, sauce, chutney, soup, paste, puree etc. Apart from these food products, tomato is also used to prepare wine due to its easy availability and its nutritional property. Wine is an alcoholic beverage made from fermented fruit juice usually that of grapes. The consumption of wine has several health benefits like lowering the mortality from cardiovascular disease and cancer, delaying dementia and preventing arthritis (Robinson, 2006). The studies related to tomato wine was very few so, the suitability of tomato juice for wine making was tested.

OBJECTIVES

- To prepare tomato wine.
- To optimize tomato wine with different variables.

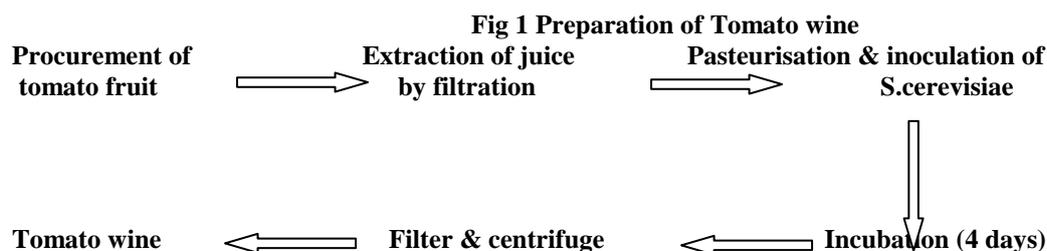
II. Methodology:

Ripe tomato fruits (1kg) was purchased from local market and washed in tap water. The tomato were cut into pieces and made into pulp by grinding (5min) in a mixer. The pulp was strained through a tea strainer to collect the juice (500ml) and the pH was 4.6. The juice was adjusted to 22°Brix by adding sugar (275g/lit). Then required volume of juice was dispensed into boiling tubes and pasteurised at 80°C for 4-5 minutes. The tubes were inoculated with 24hour old *Saccharomyces cerevisiae* (MTCC 180) to get a final concentration of 7% and incubated at 28±2°C for definite period. It was analysed further for its pH, titratable acidity (TA), total soluble solids (TSS) and ethanol content. The following schematic diagram enumerate the tomato wine making process in the fig 1.

Optimization of fermentation process: Tomato wine fermentation was tested considering the following parameters.

The following variables were optimized to prepare good quality wine. They are as follows:

- Incubation period (1 to 8 days)
- Size of inoculums (5, 7, 10, 12 and 15%)
- pH of the juice (3.5, 4.5, 5.5 and 6.5)
- Adjustment of brix (20, 22, 24 and 26°B)
- Incubation temperature (20, 25 and 30°C)
- Alcohol adapted and Non-adapted culture
- Age of culture (24 hour and 48 hour culture)



RESULTS:

Physicochemical characteristics of wine after completion of fermentation under optimized environmental condition were studied. pH, titratable acidity, total soluble solids and ethanol content were recorded for all the variables. The quality of wine can be characterised by its ethanol content which is the chief component found in all types of wine (Joshi, 1998).

III. Results And Discussion

Optimization of incubation period for tomato wine preparation:

The incubation time for tomato wine was standardised by analysing for a period of 1 -8 days which is given in the table 1.

Table 1 - Optimization of incubation period for tomato wine preparation

	pH	TSS	TA	Ethanol
1	4.13	12.6	0.32	10.90
2	4.15	5.4	0.48	14.79
3	4.15	5.1	0.61	17.03
4	4.33	5.0	0.38	18.71
5	4.36	4.8	0.38	15.61
6	4.28	4.8	0.48	14.18
7	4.28	4.7	0.45	13.52
8	4.39	4.7	0.48	9.13

The longer the incubation time, the resulting ethanol content increased. The highest level of ethanol was produced on 4th day with ethanol content of 18.71%. Results of research from Putri and Sukandar showed that ethanol production from canna starch using *S.cerevisiae*, the maximum ethanol concentration achieved during fermentation at the 24th, and began to decline at the 36th hour. This is because on the 24th hour yeast entered the phase exponentially, while at the 36th hour yeast cell begin to enter stationary phase. And also the ethanol content in wine is influenced by method of wine preparation, type of yeast used and initial TSS in juice.

Size of inoculum on tomato wine production

The size of inoculum on wine fermentation is of great importance in completing the fermentation process. Different levels of inoculum (5, 7,10, 12 & 15%) were used to inoculate the fermentation mixture.

Table 2 - Effect of inoculums size on tomato wine production

Inoculum size (%)	pH	TSS (%)	TA	Ethanol (%)
5	3.90	5.4	0.32	15.50
7	3.93	5.2	0.35	9.18
10	3.99	5.2	0.32	11.02
12	3.98	5	0.32	13.90
15	3.98	5	0.35	15.50

It was observed from the table 5 that maximum ethanol production was observed at 5% inoculum size. Further increase in inoculum size did not favour ethanol production. It was, therefore, concluded that 5% inoculums is the optimum and selected for further studies.

Effect of pH of tomato juice

The pH of juice is important parameter for the successful progress of fermentation. Control of pH during wine fermentation is important for two reasons (a) the growth of harmful bacteria is retarded by acidic

solution (b) yeast grows well in acidic conditions (Mathewson, 1980). So, different pH ranges from 3.5 to 6.5 was tested for tomato juice concentrate.

Table 3 - Optimization of pH of tomato juice for wine making

pH of the juice	pH	TSS	TA	Ethanol
3.5	3.44	5	0.55	19.69
4.5	3.91	5	0.45	18.46
5.5	4.10	5	0.51	17.09
6.5	4.30	4.6	0.45	14.38
Control (pH = 3.82)	3.54	5.1	0.64	13.97

The result showed that the maximum alcohol content was achieved during the pH of 3.5. With increase in pH the ethanol content was reduced gradually, because yeast produce acid rather than alcohol with increase in pH (Hodge & Hilderbrandt, 1954). So, 3.5 pH was considered optimum for further studies.

Effect of Total soluble solid concentration of tomato wine

The effect of total soluble solid on tomato wine preparation was studied after 4 days of incubation by carrying out at various soluble solid concentration of 20°Brix to 26°Brix. The results were presented in the table 4.

Table 4 – Effect of Total Soluble solid (TSS) on alcohol content

Brix (%)	pH	TSS (%)	TA	Ethanol (%)
20	4.49	4.5	0.35	10.86
22	4.47	5	0.32	11.17
24	4.47	5	0.32	12.8
26	4.44	5	0.32	12.14
Control	4.7	2	0.32	1.58

The result shows that increase in ethanol production was observed with increase in total soluble solid upto 24°Brix and then decreased. It has been observed that initial sugar level (control) greatly affects the rate of fermentation. The use of sugar substrate is one of the ways to obtain high ethanol yield during fermentation. But, higher sugar concentration is inhibitory to fermentation due to osmotic stress (Jones et al, 1981). There are reports that high sugar sensitivity (osmotolerance) in *S.cerevisiae* is due to higher intracellular accumulation of ethanol (Strehlaiano et al, 1983).

Optimization of Incubation temperature

Different levels of temperature was studied to optimize wine preparation. They are 20, 25 and 30°C and illustrated in the table below:

Table 5 – Optimization of incubation temperature to prepare wine

Temperature (°C)	Parameters			
	pH	TSS	TA	Ethanol
20	3.88	6.9	0.45	16.47
25	3.80	5.8	0.51	20.96
30	3.88	5.9	0.45	19.20

The table shows the effect of changing temperature on fermentation rate and reduction in TSS content. As the temperature increases initial fermentation rate are increased due to the enzyme activity of the metabolic pathway. And also higher temperature had negative effect on stability of enzymes or any other biomolecules and decrease the enzyme activity (Journal of Food Processing and Technology, 2011). So, at 25°C gives the higher alcohol yield as well as the fermentation rate is constant when compared to other temperature.

Utilization of alcohol adapted and non adapted S.cerevisiae culture in wine preparation:

The term adapted is referred as modifying the environment of microorganism (*S.cerevisiae*), such that the *S.cerevisiae* develop the ability to live and thrive in different environmental conditions (Randall Padgett, 2012). *S.cerevisiae* was in adapted in 10 percent concentration of ethyl alcohol during culture preparation to produce alcohol more efficiently than acclimated (non adapted) culture. These alcohol adapted culture was used in wine making to analyse the difference in alcohol content of adapted and acclimated culture (table 6).

Table 6 - Analysis of tomato wine with alcohol adapted and non adapted culture

Days	pH	TSS (brix %)	TA	Ethanol(%)
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	AA	NA	AA	NA	AA	NA	AA	NA
0	4.24	4.23	22	22	0.32	0.32	-	-
5	3.88	3.88	5	5	0.90	0.83	18.21	17.42
10	3.86	3.84	4.7	4	0.90	0.90	14.38	11.17
15	3.60	3.38	3.2	4	0.51	0.51	10.81	10.61

*AA – Alcohol Adapted

*NA – Non Adapted

The table 6 shows that the pH, TSS, TA and alcohol content of both the AA & NA culture. Alcohol content was slightly higher in alcohol adapted culture fermentation than the normal culture. However, the increase was not significant. The alcohol content was maximum at 5th day of incubation and then decreased for both cultures. Therefore, NA culture was used for further study, because alcohol adapted culture has not provide rapid growth in fermentation rates as well as in alcohol production.

Age of culture

The age of culture (24 hour or 48 hour old culture) for tomato wine preparation was optimized by analyzing different parameters (table 5)

Table 7 – Effect of Age of culture on tomato wine preparation

Culture age	pH	TSS	TA	Ethanol
24 hour	4.00	5	0.38	14.38
48 hour	4.00	5.4	0.38	12.34

The table shows that 24 hour old yeast culture shows maximum (14.38%) alcohol production when compare to 48 hour old culture. This may be due to decline in the growth rate of cells after 24 hour and also the transition of population into the stationary phase. (Polish journal of food and nutrition sciences) So, for further study 24 hour old yeast culture was used.

IV. Conclusion:

Tomato is a common and cheap vegetable available throughout the year and in huge quantities during the season. Excess production of tomato during the early summer seasons is wasted due to low market price. The present study indicates that the tomato can be converted into value added product through fruit fermentation.. From the study following conclusions were drawn. The tomato wine can be fermented at 4 days of incubation by adjusting the pH of the juice at 3.5 and utilizing 5% inoculum level. The optimum temperature for tomato wine fermentation was 25°C. The 24 hour old non-adapted *Saccharomyces* culture was suitable for the study. So, it is possible to prepare acceptable quality of wine by optimizing the mentioned parameters.

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