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# RESEARCH ARTICLE

## EFFECT OF PASTEURIZATION ON ALCOHOL YIELD AND ASCORBIC ACID RETENTION IN ORANGE WINE

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**ABSTRACT**

Orange fruits are acidic fruit which contain healthy nutritional content that works wonders for the body. It acts as a fabulous source of vitamin c and a wide variety of essential nutrients required by the body. Fresh fruits and their hand-squeezed or industrially processed juices contain mostly flavonones and flavones 20, 21.Findings of experiments showed that pasteurization of juice in boiling water for 5mts is considered enough to better yield of alcohol as well as ascorbic acid retention .Time and temperature played important role in case of orange wine regarding alcohol yield and ascorbic retention.

## INTRODUCTION

The word orange derives from the Sanskrit word for "orange tree" (naranga), probably of Dravidian origin. The Sanskrit word reached European languages through Persian (nārang) and its Arabic derivative (nāranj) (*http://www.collins dictionary .com*). The word entered Late Middle English in the fourteenth century via Old French orange (in the phrase pomme d'orenge). The French word, in turn, comes from Old Provençal auranja, based on Arabic nāranj. In several languages, the initial n present in earlier forms of the word dropped off because it may have been mistaken as part of an indefinite article ending in an n sound—in French, for example, une norenge may have been heard as une orenge. This linguistic change is called juncture loss. The colour was named after the fruit, and the first documented use in this sense dates to 1542 (Paterson, 2003). Orange wine was at one time made in Florida from fruits too affected by cold spells to be marketed. It is presently produced on a small scale in South Africa. Orange wine and brandy are made in Brazil from fruits which have been processed for peel oil and then crushed. Nutritional significance of alcoholic beverages depends largely on purification and sugar contents. The wines and beers of developed countries have very limited nutritional properties except for energy.

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They usually contain no fat and only traces of protein I.e. less than 0.5 g/100gms.Ther is also no vitamin-D and usually no vitamin-C although a little may be Present in cider. Vitamin-B present in the seed is normally utilized during fermentation and therefore absent in the final products but other Vitamins may be present .it is seen that distilled wine contains neither any Vitamin nor any mineral (Muller, 1980). An alcoholic beverage has alcohol percentage in the form of ethyl alcohol.Generally the name of wine is on its fruit. Ethyl alcohol is produced by fermentation of any carbohydrate containing fermentable sugar in the form of mono, di and polysaccharide (Gaylusac, 1810). Wine fermentation is basically the transformation of the various sugars of grape by east under anaerobic condition in to ethanol, carbon dioxide and small amount of byproducts. D-glucose and D-fructose the two principle sugar of grape juice yield essentially equimolar proportion of ethanol, carbondioxide.

$C_{12}H_{22}O_{11} + H_2O \rightarrow C_6H_{12}O_6 + C_6H_{12}O_6$ $C_6H_{12}O_6$+ YEAST (*Sacchromyces cerevisiae*) → 2c2H5OH +CO2

In the fermentation process the catabolism of sugar is an oxidative process which result production of ethyl alcohol.The alcoholic fermentation took place in the yeast cell by a series of reaction usually referred to as the overall reaction are as fallow. Glucose (2ATP↔2ADP) →Glucose –di phosphate →2-triglyceric phosphate → 2 phospho acetic acid →2 pyruvic acid →2- acetaldehyde → 2C2 H5OH.

**Nutritional value per 100 g (3.5 oz) (Anonymous, 2011).**

| Energy | 197 kj(47 kcal) |
|---|---|
| Carbohydrates | 11.75 g |
| Sugar | 9.35 g |
| Dietary | 2.4 g |
| Fat | 0.12 g |
| Protein | 0.94 g |
| Water | 86.75 g |
| Vitamin A equiv | 11 µg (1%) |
| Thiamine (vit. $B_1$) | 0.087 mg (8%) |
| Riboflavin (vit $B_2$) | 0.04 mg (3%) |
| Niacin (vit. $B_3$) | 0.282 mg (2%) |
| Pantothenic acid ($B_5$) | 0.25 mg (5%) |
| Vitamin $B_6$ | 0.06 mg (5%) |
| Folate (vit. $B_9$) | 30 µg (8%) |
| Choline | 8.4 mg (2%) |
| Vitamin C | 53.2 mg (64%) |
| Vitamin E | 0.18 mg (1%) |
| Calcium | 40 mg (4%) |
| Iron | 0.1 mg (1%) |
| Magnesium | 10 mg (3%) |
| Manganese | 0.025 mg (1%) |
| Phosphorus | 14 mg(2%) |
| Zinc | 0.07 mg(1%) |

Alcohol should be regarded as food stuff because in the body it acts as concentrated source of energy in form of either carbohydrate or protein and has an available energy value equal to 29.2 Kj/gm. It is also a drug and effects the central nervous system. These two effects must considered together when assessing the desirability of alcohol as a source of energy. The nature of the effect of alcohol on body varies according to its quantity taken when a small amount is consumed less of coordination and even death when a large quantity is taken. Unlike most foods alcohol can be absorbed by the body without prior to digestion thus it provides a source of quickly available energy and it may be used for this purpose in emergency. Alcohol is almost completely absorbed during its passage through the body mainly in small intestine but also through the walls of stomach.

Absorption takes place in one half to two hours depending on concentration of the alcohol in the beverage. An average time of absorption is about an hour. After absorption the alcohol is distributed in the body through blood system and there after it is broken down in a series of oxidative steps with liberation of energy. This breakdown process is controlled by series of enzymes, each step being controlled by its own specific enzyme. Initial oxidation of alcohol to aldehyde is fairly controlled by "aldehyde de-hydrogenase" and as its name indicates that the step involves removal of hydrogen and it is followed by further oxidation to acetic acid. The most important enzyme taking part in this, is "aldehyde dehydrogenase". The initial break down process occurs in liver and thus the acid produced then becomes the part of general body- food and further oxidized in a complex process to carbon-di-oxide ($Co_2$) and water. Alcohol is oxidized in body rather slowly and only about 7gms can be oxidized in an hour. This means that alcohol is removed from the body at a slow rate and that it can make overall contribution to energy needs **(**Brion *et al*., 1986**).**

## METHODOLOGY

For experiment Fresh, mature Orange were procured from local fruit market, Lucknow.

Blemished and deformed Fruit were discarded .Fruit of each lot were washed in running water thoroughly peeled and extract juice .Starter was prepared by making a malt solution by adding 20% sugar 0.3% tartaric acid, 2% malt extract, 0.2% citric acid, 0.2% di ammonium phosphate in distilled water. The medium was just boiling, cooled and inoculated with pure of *Saccharomyces cerevissiae* variety *ellipsoideus* Bargundy 24 hour's old starter was added to the must @4% level and was allowed to ferment at room temperature. After completion of fermentation all the lots were passed through muslin cloth and both seeds and pomace were discarded. All the five lots were subjected to fermentation till sugar was consumed (to dryness). After clarification packed into clean glass bottles. After racking bottles were sealed and stored at room temperature (25-30$^0$ C) for maturation for six months.

### PREPARATION OF MUST

For the preparation of the Must fruits juice was divided into five equal lots. Lot no. 3 was diluted 1:3 ratio pulp and hot water. Lot no. 4 was diluted 1:4 ratio pulp and hot water. Lot no. 5 was diluted 1:5 ratio pulp and hot water. Sufficient sugarwas added to raise T.S.S. to 23$^0$Brix and citric acid was added to raise acidity level at 0.5%. Yeast nutrient in the form of ammonium phosphate at ratio of 0.2% and 100ppm sulfur-Di-oxide in the form Potassium Meta-bi-sulfite were added in all the 5 lots these must were inoculated with starter at the rate of 4% and fermentation was set at room temperature 23-25$^0$C.

All these lots were fermented almost all the sugar was consumed, after setting the wine were racked in glass bottles. The bottles stored at room temperature (25$^0$C) for maturation.
Juice must and wine sample were analyzed for chemical composition. T.S.S.in B$^0$ was determined with hand refractometer and pH by using a pH meter. Total acidity % (as citric acid), Reducing sugar, Non reducing sugar, Total sugar and Tannin (as tannic acid) were estimation by A.O.A.C. method, volatile acidity %s (as acetic acid), esters (as ethyl acetate), alcohol % v/v(as ethyl alcohol) (Bessey, 1933).

### FERMENTATION

After vigorous fermentation all the lots were passed through muslin clothes and both seed and Pomace discarded. All the 5 lots of different treatments were fermented till all the sugar consumed (to dryness). After settling the wines were racked into clean glass bottles of 200 ml capacity and filled up to the brim.

### SIPHONING/ RACKING

After settling the fermented wine is siphoned off to separate the wine from the solid deposits.

### FINING / FILTERATION

It is a method of clarifying or chemically stabilizing wine. Procedure begins by stirring in to container of wine a fining agent that is heavier than both water and alcohol and does not dissolve in the water. Agent ultimately settle to bottom cause suspended particles to precipitate out along with agent, clarified wine is separated by siphoning off the settling .It can lower the high level of tannin, remove haze and reduce colour.

## AGEING/MATURATION

The clear wine is filled into bottles, these are sealed air tight and stored at room temperature for maturation ($34^0$ – $37^0$C). The wines were racked at for 3 months, these are pasteurized at $65^0$c for about 20 minutes, then cooled and stored

**Table-1. Physical Parameters of fresh Orange**

| S.NO. | CHARACTERS | VALUE |
|---|---|---|
| 1 | Colour | Orange |
| 2 | Weight | 105.2 |
| 3 | Length(cm) | 11.4 |
| 4 | Circumference(cm) | 22.8 |
| 5 | Specific gravity | 0.96296 |
| 6 | Flavour | Pleasant |

**Table 2. Chemical Composition of fresh Orange**

| S.NO. | CHARACTERS | MEAN VALUE |
|---|---|---|
| 1 | pH | 3.5 |
| 2 | T.S.S.($^0$Brix) | $9^0$ brix |
| 3 | Acidity %(as citric acid) | 0.75 |
| 4 | Ascorbic acid(mg/100gm) | 107.50 |
| 5 | Reducing Sugar % | 4.60 |
| 6 | Non Reducing Sugar % | 3.25 |
| 7 | Total Sugar % | 7.85 |
| 8 | Tannin % (as gallotannic acid) | 0.35 |

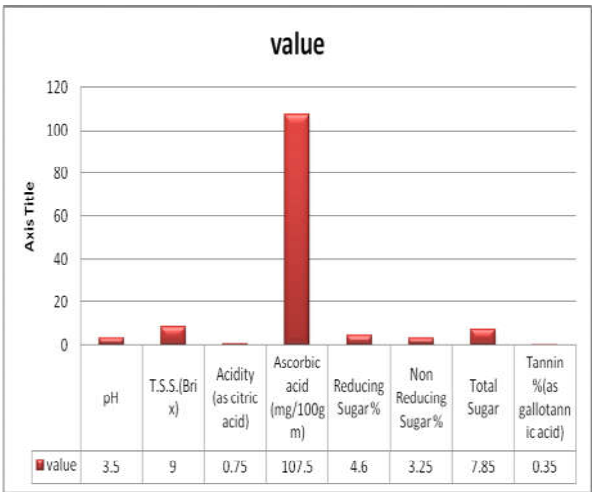


**Figure. 2**

## RESULT AND DISCUSSION

Orange were physically and chemically analyzed for colour, weight, length, circumference, specific gravity and flavor were found orange colour, 105.02gm,11.4cm,22.8 and pleasant flavor respectively.

Whereas chemical parameters like pH, T.S.S., acidity, ascorbic acid reducing sugar, non reducing sugar, total sugar and tannin was observed 3.5,$9B^0$,0.75%,107.50mg/100gm, 4.60%,3.25%,7.85%and0.35 respectively. Before setting for fermentation must were also estimated for chemical composition. pH of the must was observed in the range between3.50-3.75.Total soluble solids were found $22B^0$ in each treatment. Acidity (as citric acid) was found same 0.5% in each treatment. Ascorbic acid was estimated between 65.50-90.25mg/100ml. Reducing sugar was observed maximum 14.25% in $T_3$ while 10.25 % minimum in $T_3$.Non reducing sugar was estimated in range of 20.75% in $T_4$ and $T_1$ respectively. Whereas total sugar was found 20.75% in $T_4$ maximum and 18.00% minimum in $T_5$.Tannin % as gallotannic acid was varied between 0.60-0.75. After 6 month of maturation of Orange wine was analyzed for chemical composition .pH of the wine was found 3.75% maximum in $T_5$,where as 3.6% minimum in$T_1$ $T_2$ . T.S.S. was ranges between 3-6Brix. Acidity ( as citric acid ) was found 0.20% maximum in $T_2$ where as 0.18% 0.10% minimum in $T_3$,Ascorbic acid observed ranges between 4.66%-7.80 Residual sugar was found 5.50 maximum in $T_3$ where as 4.50 4.25 3.50 2.50 minimum in $T_2$. Volatile acidity (acetic acid) was found 0.9maximum in $T_1$ where as 0.010 minimum in $T_2$.Alcohal % was found 9.2% maximum in $T_1$ where as 9.0 minimum in T5.

Esters was found ranges between 25.50%-0.45%. Tannin (as gallotannic acid) was found 0.65% maximum in $T_5$ where as 0.35% minimum in $T_1$T2.T3.&T4 .After maturation of wine finally organoleptic evaluation of wine was conducted by a Penal of five judges team. Clarity of wine was found 10 mark maximum for $_{T1}$where as 8.0 minimum for $T_5$.Colour was found maximum 16.3 marks for $T_3$ where as 5.8 minimum for $T_1$.Aroma was ranges between 16-13.8, freedom from acetic acid was found 10 marks maximum in $T_3$ where as 8.5in $T_1$.Total acid taste was found maximum 8.5 marks in$T_5$ where as 7.3,6.8,5.5, in $T_4$, T2,T5,&T3 astringency was found ranges between 8-5.

Extract body found ranges between 4-2, sugar was found 4.1 maximum for $T_1$ where as 3.8 minimum for $T_3$, general taste found 3 maximum in $T_3$ where as 3 mark overall impression found 3.8 marks for $T_1$ where as 2.6 minimum for $T_5$,Total score was recorded 83.80 marks maximum for $T_1$ where as 59.80 minimum for $T_3$.T1 got highest score 83.8 marks in organoleptic evaluation and alcohol %(v/v) 9.2, ascorbic acid retention in wine 5.10 mg /100 ml were estimated among the treatments .These quantities of alcohol and ascorbic acid were highest in comparison to T4,T5,T2 and T3. Findings of T1 showed that pasteurization of juice in boiling water for 5mts is considered enough to better yield of alcohol as well as ascorbic acid retention.

**Table 3.Chemical Composition of Must**

| S.No. | Character | Treatment | | | | |
|---|---|---|---|---|---|---|
| | | T1 | T2 | T3 | T4 | T5 |
| 1 | pH | 3.50 | 3.60 | 3.50 | 3.75 | 3.50 |
| 2 | T.S.S.($B^0$) | 22.00 | 22.00 | 22.00 | 22.00 | 22.00 |
| 3 | Acidity%(as citric acid) | 0.50 | 0.50 | 0.50 | 0.50 | 0.50 |
| 4 | Ascorbic acid(mg/100gm) | 80.25 | 75.10 | 90.25 | 65.50 | 72.40 |
| 5 | Reducing sugar % | 12.50 | 13.10 | 10.50 | 14.25 | 12.50 |
| 6 | Non reducing sugar% | 6.75 | 5.25 | 7.25 | 6.50 | 5.50 |
| 7 | Total sugar% | 19.25 | 18.35 | 17.75 | 20.75 | 18.00 |
| 8 | Tannin% as( gallotannic acid) | 0.60 | 0.75 | 0.66 | 0.75 | 0.65 |

**Table 4. Chemical Composition of Orange wine after 6 Month of Maturation**

| S.NO. | Characters | TREATMENTS | | | | |
|---|---|---|---|---|---|---|
| | | $T_1$ | $T_2$ | $T_3$ | $T_4$ | $T_5$ |
| 1 | pH | 3.50 | 3.60 | 3.60 | 3.50 | 3.75 |
| 2 | T.S.S.($B^0$) | 4.00 | 5.00 | 6.00 | 5.00 | 3.00 |
| 3 | Acidity%(as citric acid) | 0.15 | 0.20 | 0.18 | 0.15 | 0.10 |
| 4 | Ascorbic acid (mg/100gm) | 6.50 | 4.50 | 3.10 | 4.00 | 5.10 |
| 5 | Residual sugar % | 3.50 | 4.50 | 5.50 | 4.25 | 2.50 |
| 6 | Volatile acidity %(acitic acid) | 0.09 | 0.01 | 0.08 | 0.01 | 0.10 |
| 7 | Alcohol %(v/v) | 9.20 | 6.50 | 2.25 | 8.50 | 9.00 |
| 8 | Esters(mg/100 ml ethyl acetate) | 18.50 | 22.25 | 20.50 | 25.50 | 17.50 |
| 9 | Tannin % (as Gallotannic acid) | 0.60 | 0.55 | 0.50 | 0.45 | 0.65 |

**Table 5. Organoleptic Evaluation**

| | CHARACTERS | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Treatment | Clarity & Freedom From Sediment | Colour | Aroma& Bouquet | Freedom from Acetic Odour | Total Acid to Taste | Astringency | Extract Body | Sugar | General Taste | Overall Impression | Total |
| Marks | 10 | 10 | 20 | 10 | 10 | 10 | 5 | 5 | 10 | 10 | 100 |
| $T_1$ | 8.60 | 8.2 | 16.30 | 8.50 | 8.50 | 8.50 | 4.10 | 3.80 | 8.50 | 8.80 | 83.80 |
| $T_2$ | 6.80 | 7.00 | 14.30 | 6.80 | 6.10 | 7.00 | 2.80 | 3.00 | 6.10 | 6.50 | 63.40 |
| $T_3$ | 5.80 | 5.80 | 13.10 | 5.50 | 5.80 | 6.10 | 2.60 | 2.80 | 5.80 | 6.50 | 59.80 |
| $T_4$ | 8.00 | 7.80 | 14.80 | 7.30 | 5.80 | 7.80 | 4.10 | 3.30 | 8.10 | 8.00 | 75.00 |
| $T_5$ | 7.80 | 7.80 | 15.80 | 6.80 | 7.10 | 7.00 | 3.80 | 2.60 | 7.10 | 7.10 | 72.20 |

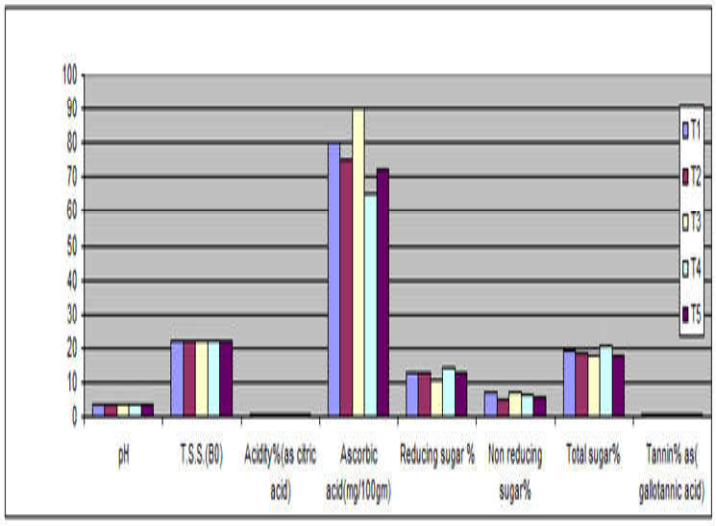


**Figure 3.**

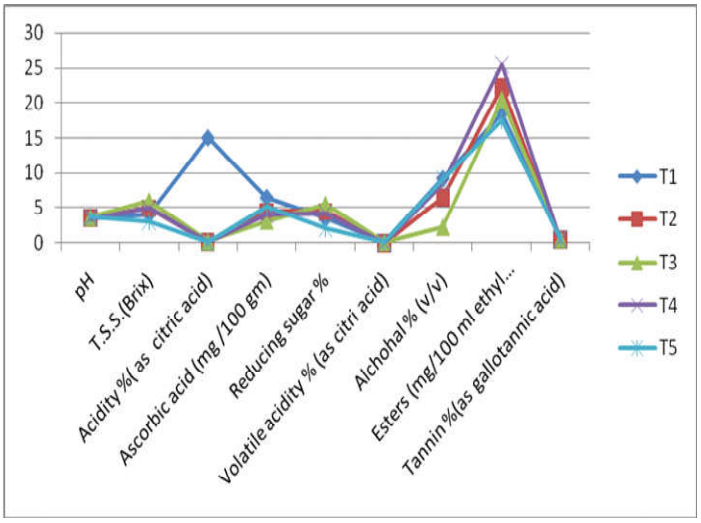


**Figure 4.**

Time and temperature played important role in case of orange wine regarding alcohol yield and ascorbic retention .The experiment based on fermentation of sugars in to $C_2H_5OH$ and $CO_2$ (Gaylusac, 1810). The must and wine samples were analyzed for different constituents (Amerine *et al*., 1980). In present study *Saccharomyces cerrivissae var. ellepsoideus* was inoculated in must for fermentations (Ndip *et al*., 2001). Best Yeast strain producing wine with the highest acceptable score 7.41 from orange volatile component of wine eg. Alcohol and esters were found must abundant volatile compound (Gang Fan *et al*., 2009). The different parameters are resemble with requirement of base wine to be made has been reported (Sukla *et al*., 1991). For the preparation of palatable orange wine ameliorated the orange juice with cane sugar (Schandrel, 1957)**.** Ascorbic acid showed decreases in wine than fresh orange juice. found negligible vitamin-C in wine because it is utilized during fermentation (Gastineau, ?). Volatile acidity was detected very low. Lower volatile acidity is desirable, indicating soundness of alcoholic fermentation and absence of any acetification (Onkarayya, 1985). The sum of scores of different attribute for each treatment clearly reveals that the highest score has been awarded to the product with 9.20 percent alcoholic content. In an earlier findings sweet product with 15% alcohol were considered the best for plum and sand pear vermouth (Joshi *et al*., 1991; Attri *et al*., 1994). The alcohol yield in orange wine is on conformity with the findings (Braverman, 1949). Sensory evaluation showed significant difference in all characteristics in $T_3$ got highest score among treatments. It was done by a penal of five judge (Amerine, 1960)**.**

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