

# Preparation of blended wine from fruits *Vitis Vinifera* and *Citrus X Sinensis*; its physico chemical analyses and sensory evaluation

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## Abstract

Wine is traditionally used as fermented drink arise from fresh grape. In this study preparation of blended wine from grapes and orange juice. The average range of grapes juice 60 to 80 % and orange juice 40 to 70 %. Fresh grape and orange juice encompass, combination of fructose and glucose of an average thirty percentage and left over nine percentage was combination of fructose, glucose and sucrose. Fermentation initiate from yeast and sugar to form acetaldehyde and alcohol. As per the recommended process, preparation of wine from grape and orange blends with incorporation of *Saccharomyces cerevisiae* at 22°C. The percentage of grapes and orange increases the alcohol, pH, tartaric acid and overall acceptability of blended wine also increases and it shows positive result ( $p > 0.05$ ) by using response surface methodology (ANOVA).

**Keywords:** Wine, grapes, orange, yeast, *Saccharomyces cerevisiae*

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## Introduction

India was the seventh largest producer of green grape (*Vitis Vinifera*) and third largest producer of orange (*Citrus X Sinensis*) in the world. Grapes and oranges both make healthy source of nutrients overall, this doesn't mean should give up grapes, since these fruits with several health benefits and major nutritional sources like vitamin, mineral and carbohydrate. Major problems were post harvesting loss of fresh fruits about 30% in India. Maharashtra was the India's largest producer of grapes and orange. Non-grape fruits offer distinctive sensory things and possible healthiness aids, providing auxiliary importance to fruit-wine manufacture (Zhu et al., 2023). Blended fruit wines are innovative beverages that combine different fruits or fruit juices to create unique flavor profiles and enhance the overall value of the ultimate manufactured goods. The approach allows winemakers to leverage the strengths of various fruits and optimize the sensory characteristics of product (Zhu et al., 2023; Tsegay et al., 2020).

Due to high loss of these fruits during harvesting and particularly at ultimate importance increases at a specific season then need to preserve fruits for long time without affecting undesirable changes. When after harvest proper care and utilization reduced chances of raw material losses and increases product quality and quantity of wines (Okoro, 2007; Aloba and Offonry, 2009). After addition of certain amount of sugar in orange juice allow to ferment and orange oil helps to stop fermentation (R.P.Srivastava et al., 2017). Jaggery was a traditional prepared product inspired over a time in Asia. Composition of its 70% sucrose, 20% invert sugars and up to 20% moisture.

Grapes themselves harbor a natural flora of microorganisms. During manufacture of wine, most common used yeast *saccharomyces cerevisiae* is used (Nwachukwu et al., 2006, 2008). Yeast is a unicellular fungus, usually spherical, oval in shape. Yeast utilizes the sugars and produce alcohol under anaerobic condition. The activation temperature range of yeast was zero to fifty degree Celsius and elevated ranges 20 °C to 30°C. The basic temperature range for microorganism to fermentation is 25°C to 30°C (Ukwuru and Awah, 2013). Wine is undistilled beverage rich in natural sugar, contain high amount of nitrogen compound. Greater amount of alcohol to acid ratio improve rate of fermentation and keep wine stable and safe for prolonged storage (R.P.Srivastava et al., 2017).

The manufacturing of wine includes ageing, fermentation and packaging, as storage time raised nutritional and aroma enhanced. The basic component sugar breaks into simple compound with action of certain yeast alcohol produced. Grapes wine has lot of demand in global market because of its stable sugar and alcohol content 10-14%. Winemaking is complex process categories into three basic unit operation like pre-fermentation, fermentation and post fermentation. The basis step of pre-fermentation received grapes, grading, sorting and crushing similar steps involved in oranges juice. Separated juice were undergo clarification to separate slug present in juice, yeast added in clarified juice. Fermentation process carryout in anaerobic condition to converted sugar into alcohol and carbon dioxide. Then, post fermentation process start after completion of fermentation, bottle racked of or kept wine in oak barrel (D. Kasabwala et al., 2023)

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The research explore the process and factors affecting on change in percentage of grapes and orange juice. As increases the juice percentage of grapes and oranges, alcohol, pH, tartaric acidity and overall acceptability changes and this identified, evaluated by using analysis of variances.

### Wine Making Procedure:

#### A. Inoculums preparation:

1. The 25 ml of MGYP medium is inoculated with a loop full of culture and retained in incubated with rotatory shaker placed inside, with internal temperature 30°C and 200 rpm for 24 hrs. Then add 5 ml of media transfer to centrifugation machine.

#### B. Preparation of Wine

1. Select green grapes and orange should be ripe and fresh for preparation of wine.
2. Remove of stems and orange seed of fresh grapes and orange. Cleaning with normal water. Crushing in basket press and blender (Orange seed remove before crush).
3. Basket press used to strain juice but care must be taken that remove orange seeds before crushing.
4. Add jaggery (7gm/100ml of wine preparation, 70% sucrose with 20% TSS). However pasteurization carryout at 60°C for 30 min.).
5. pH of the juice has to be adjusted and usually an acid content of 0.7 % is maintained.
6. Potassium metabisulphite (KMS) is added to the juice to inhibit growth of wild yeasts and spoilage organisms.
7. Add the all mixture and keeping for a one to two hours.
8. Wine yeast "*saccharomyces cerevisiae*" is added to the juice.

ii. pH was determined by placing the drop of sample in Atago's pocket pH meter and readings of the samples were taken in triplicates.

iii. Alcohol content of all the formulations were determined by using distillation method by comparing apparent specific gravity of obtained distillate with values given in AOAC chart and reported as % alcohol by volume AOAC (2000).

iv. Overall Acceptability: The wine samples were estimated by organoleptic property like color, flavour, taste, and overall acceptability by semi-trained panel followed by 9-point Hedonic rating scale.

9. Grapes and orange juice are allowed for fermentation for five days at a room temperature.
10. Filtration was done by using a filter paper (12.5 cm) and filtrate was permissible to ferment at a room temperature for added twelve days not affecting any disruption. After twelve days, the solids are settled down at the bottom.
11. After the filtration racking was done to obtain the clear liquid.
12. Bentonite a fining agent was used to settles down the colloidal material and then clear liquid was obtained.
13. The clear wine was filled in sterilized glass bottles airtight. Then wine was permissible to matured for ten months at a room temperature.
14. After aging, the wine was pasteurized at 88°C for 1 minute.
15. The previous sterilized can or bottles were tight (crown cork) to maintain product quality.
16. After crown corks then pasteurized at 65°C for 20 minutes. Storage at cooled environment.

### Material and Methods

#### Physico-Chemical analysis

i. Tartaric acidity: It is determine acid base titration, where a known volume of standard base usually sodium hydroxide (NaOH) using indicator phenolphthalein. A known volume of wine kept in flask with water added few drop of phenolphthalein indicator and titrate with standard solution of sodium hydroxide from burette until change in color. Record the sodium hydroxide in burette, calculate performed to determine concentration of tartaric acid express in mass per volume percentage. Formula for determination of tartaric acid (AOAC, 2005).

$$TA(g/L) = \frac{(N_{NaOH} \times mL_{NaOH}) \times 75}{mL_{sample}}$$

v. Data Analysis: It was analyzed using statistical analysis, Analysis of Variance (ANOVA) and a significant difference was  $P < 0.05$ .

#### Experimental combinations for Blended Wine Sample

Grapes and Orange was used for the preparation of the fermented wine. Variables used were lower and upper limit for grapes ranges from 60 to 80 % and orange ranges 40 to 70 %. For this analysis (CCRD) central composite rotatable design was applied using design expert 6.0. The experimental combination show in table 1.

**Table 1: Experimental combinations for Blended Wine Sample**

Sample No.	Grapes (ml)	Orange (ml)
S1	60.00	40.00
S2	70.00	55.00

S3	70.00	55.00
S4	70.00	76.21
S5	55.86	55.00
S6	70.00	55.00
S7	80.00	70.00
S8	70.00	55.00
S9	70.00	33.79
S10	60.00	70.00
S11	84.14	55.00
S12	70.00	55.00
S13	80.00	40.00

The blended sample of grapes and orange juices after optimization get thirteen combinations, the each of sample being blended to prepared single sample each and analyzed for alcohol, pH, tartaric acidity and overall acceptability. Below table no 2 shows the result after analysis of each of sample and get optimized sample.

**Table 2 : Experimental result for Blended Wine Sample**

Sample No.	Alcohol	pH	Tartaric Acid	Overall Acceptability
S1	12.2	3.6	0.94	8
S2	13.7	3.5	0.88	8
S3	13.7	3.3	0.87	9
S4	13.9	3.4	0.84	8
S5	12.1	3.8	0.99	9
S6	13.6	3.3	0.88	9
S7	14.1	3.8	0.78	8
S8	13.6	3.3	0.88	9
S9	12.3	3.3	0.91	8
S10	13.2	3.4	0.85	9
S11	13.4	3.9	0.83	9
S12	13.6	3.6	0.8	9
S13	13.3	3.6	0.8	9

### Result and Dissuasion

Blending of green grapes and orange carried in batch reactor used in laboratory. Process monitoring and final analysis of blended wine has been conducted. Formulated fruit wine were tested for various physicochemical attributes like tartaric acidity, pH and Alcohol (%), and overall acceptability indicators of the quality of the wine (Joshi et al., 2022).

Wine tartaric acidity is a crucial factor in determining its quality and stability. The total tartaric acidity of wine typically ranges from 2.8 to 3.8% (Ohoke et al., 2019). The acidity of wine identify the quality, overall stability of wine along with physical and biological stability of wine. This recent research it was identify that range of the acidity present 0.94 to 0.8 %. The tartaric acidity of wine can be increases with respect to blended sample as the percentage of acidity is increases. This was thought to be due to the higher acidity of pomegranate juice than red dragon fruit juice. One of the previous Study reported a similar percent acidity in pomogrante wine with values ranging from 0.62 to 0.67 (Rios-Corripio et al., 2019). In a study comparing different blends of grapes ranges from 60 to 80 % and orange ranges 40 to 70 % (Ohoke et al., 2019).

pH is a critical factor affecting various aspects of winemaking, including bacterial growth, tartrate salt solubility, sulfur dioxide effectiveness, protein solubility, color pigment polymerization, and oxidative reactions (Comuzzo et al., 2019). The pH of wine typically falls between 3.3 and 3.9, with an average of about 3.4 (Pathak et al., 2023). The mean pH of prepared wine samples 3.4.

The alcohol content in wine is a crucial factor affecting its quality, sensory properties, and consumer perception. High alcohol levels can negotiation superiority of product by generating sensory inequities and reducing the perception of certain flavours (Grazia et al., 2019). In present study it was shows that as per sample from one to thirteen the range of alcohol content from 12.2 to 14.1. Similar results concerning the physicochemical properties were reported by Yadav et al., 2022; Nagoc et al., 2024.

Overall Acceptability: The wine samples were estimated by organoleptic property like color, flavour, taste, and overall acceptability by semi-trained panel following 9-point Hedonic rating scale. The acceptability of blended sample were increases as the percentage of grapes and orange content increases.

### Effect of method variable on Alcohol Content.

The experimental outcomes were calculated using the regression model depicting that the significance of the Model. F value was at 36.68. The Lack of Fit F value 20.14 was significant ( $P > 0.05$ ) relative to pure error. This model to fit has been also stated by the

determination coefficient  $R^2$  which was observed to be 0.9632 the Adj.  $R^2$  were 0.9370 where the pred R-square is 0.7512.

**Table 3 : ANOVA for blended wine determination of alcohol content**

Source	Sum of Squares	DF	Mean Square	F Value	Prob > F	
Model	5.06	5	1.01	36.68	< 0.0001	significant
<i>X</i> 1.84	1	1.84	66.70	< 0.0001		
<i>Y</i> 2.06	1	2.06	74.72	< 0.0001		
<i>X</i> <sup>2</sup> 0.98	1	0.98	35.67	0.0006		
<i>Y</i> <sup>2</sup> 0.28	1	0.28	10.20	0.0152		
<i>XY</i>	1.000E-002	1	1.000E-002	0.36	0.5663	
Residual	0.19	7	0.028			
Lack of Fit	0.18	3	0.060	20.14	0.0071	significant
Pure Error	0.012	4	3.000E-003			
Cor Total	5.26	12				
(R-Squared	0.9632	Adj R-Squared	0.9370	Pred R-Squared	0.7512)	

Where X and Y are the coded variable for grapes and orange respectively. Data from Table 2.2 indicated that alcohol of grapes and orange gave significant model ( $P < 0.05$ ).

In linear term, grapes (X) and orange (Y) are observed to be significant ( $P < 0.05$ ). F value for linear terms grapes (X) and orange (Y) were 66.70 and 74.72 and P-value was found to be <0.0001 and <0.0001 ( $P < 0.05$ ) respectively (Table 3).

Quadratic terms of grapes ( $X^2$ ) and orange ( $Y^2$ ) has shown significant ( $P < 0.05$ ). F value for quadratic terms grapes ( $X^2$ ) and orange ( $Y^2$ ) were 35.67 and 10.20, P-

values has been found to be 0.0006 and 0.0152 ( $P < 0.05$ ) shown significant effect respectively.

The interaction term grapes and orange (XY) significant effect P-value was found to be 0.5663 ( $P > 0.05$ ) and it showed the positive effect on the interaction term and F-value found to be 0.36. As show in below image A consider as X and B consider as Y, shown in design expert plot.

Fig 1 showed the effect of grapes (X) and orange (Y) on alcohol content of wine. According to graph studied it was observed that grapes and orange content increases alcohol content increases.

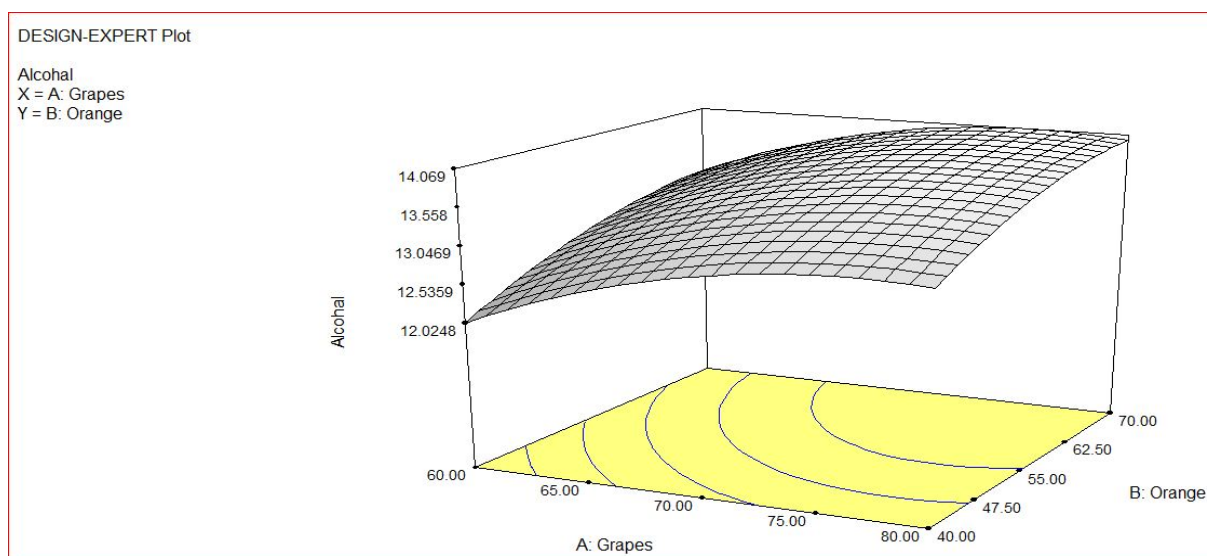


Fig.1: Effect of method variable on alcohol content.

**Effect of method variable on pH.**

The experimental outcomes were calculated using the regression model depicting that the significance of the Model. F value was at 6.97. The Lack of Fit F-value

0.18 was non-significant ( $P > 0.05$ ) relative to pure error. This model to fit has been also stated by the determination coefficient  $R^2$  which was observed to be 0.8327, Adj.  $R^2$  was 0.7132, Pred. R-square is 0.6277.

Where X and Y are the coded variable for grapes and orange respectively. Data from Table 2.3 indicated that alcohol of grapes and orange gave significant model (P<0.05).

In linear term, grapes (X) and orange (Y) are observed to be significant (P<0.05). F-value for linear terms grapes (X) and orange (Y) were 2.82 and 0.19 and P-value was found to be 0.1368 and 0.6740 (P<0.05) respectively (Table 4).

Quadratic terms of grapes (X<sup>2</sup>) and orange (Y<sup>2</sup>) has shown significant (P<0.05). F-value for quadratic terms

grapes (X<sup>2</sup>) and orange (Y<sup>2</sup>) were 27.13 and 0.33, P-values has been found to be 0.0012 and 0.5809 (P<0.05) shown significant effect respectively.

The interaction term grapes and orange (XY) significant effect P-value was found to be 0.1226 (P>0.05) and it showed the positive effect on the interaction term and F-value found to be 3.08.

Fig 2 showed the effect of grapes (X) and orange (Y) on alcohol content of wine. According to graph studied it was observed that grapes and orange content increases pH increases.

**Table 4 : ANOVA for blended wine determination of pH**

Source	Sum of Squares	Mean Square	DF	F	Value	Prob > F
Model	0.45		5	0.090	6.97	0.0121 significant
X	0.037		1	0.037	2.82	0.1368
Y	2.500E-003		1	2.500E-003	0.19	0.6740
X <sup>2</sup>	0.35		1	0.35	27.13	0.0012
Y <sup>2</sup>	4.348E-003		1	4.348E-003	0.33	0.5809
XY	0.040		1	0.040	3.08	0.1226
Residual	0.091		7	0.013		
Lack of Fit	0.011		3	3.619E-003	0.18	0.9041 not significant
Pure Error	0.080		4	0.020		
(R-Squared	0.8327	Adj R-Squared	0.7132	Pred R-Squared	0.6277)	

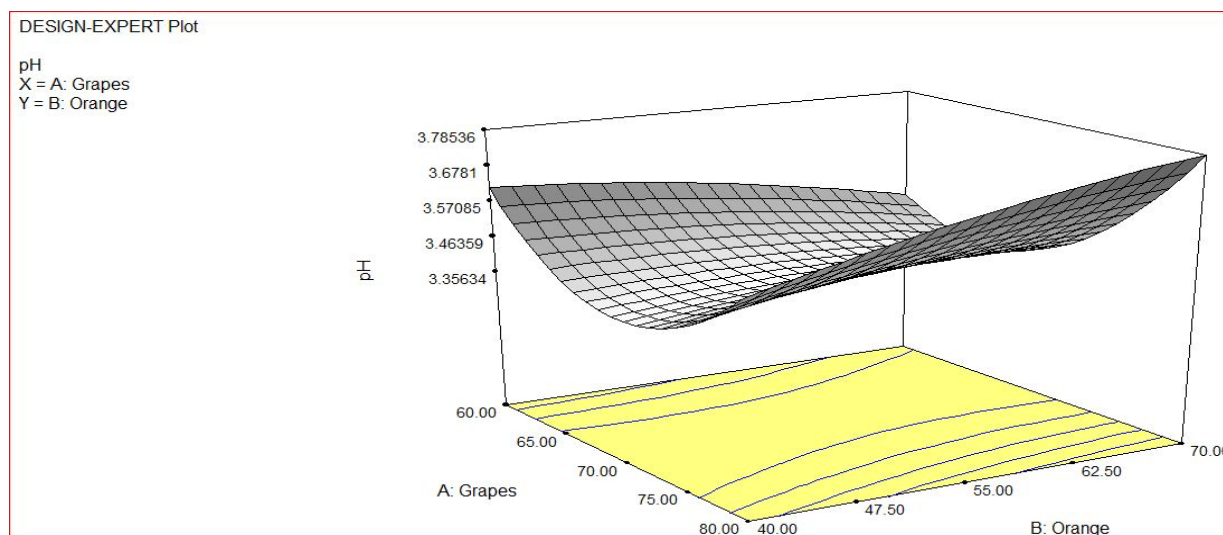


Fig.2: Effect of method variable on pH.

**Effect of method variable on Tartaric Acidity**

The experimental outcomes were calculated using the regression model depicting that the significance of the Model. F-value was at 4.48. The Lack of Fit F-value 1.38 was non-significant (P>0.05) relative to pure error. This model to fit has been also stated by the determination coefficient R<sup>2</sup> which was observed to be 0.7620, Adj. R2 was 0.5921, Pred. R-square is 0.0432.

Where X and Y are the coded variable for grapes and orange respectively. Data from Table 2.4 indicated that alcohol of grapes and orange gave significant model (P<0.05).

In linear term, grapes (X) and orange (Y) are observed

to be significant (P<0.05). F-value for linear terms grapes (X) and orange (Y) were 16.77 and 3.85, P-value was found to be 0.0046 and 0.0905 (P<0.05) respectively (Table 5).

Quadratic terms of grapes (X<sup>2</sup>) and orange (Y<sup>2</sup>) has shown significant (P<0.05). F-value for quadratic terms grapes (X<sup>2</sup>) and orange (B<sup>2</sup>) were 0.65 and 0.18, P-values has been found to be 0.4471 and 0.6869 (P<0.05) shown significant effect respectively.

The interaction term grapes and orange (XY) significant effect P-value was found to be 0.3836 (P>0.05) and it showed the positive effect on the interaction term and F-value found to be 0.86.

Fig 3 showed the effect of grapes (X) and orange (Y) on tartaric acid content in wine. According to graph

studied it was observed that grapes and orange content decreases as tartaric acid content increases.

**Table 5 : ANOVA for blended wine determination of tartaric acidity**

Source	Sum of Squares	Mean DF	F Square	Value	Prob > F
Model	0.032	5	6.359E-003	4.48	0.0376 significant
X	0.024	1	0.024	16.77	0.0046
Y	5.460E-003	1	5.460E-003	3.85	0.0905
X <sup>2</sup>	9.200E-004	1	9.200E-004	0.65	0.4471
Y <sup>2</sup>	2.504E-004	1	2.504E-004	0.18	0.6869
XY	1.225E-003	1	1.225E-003	0.86	0.3836
Residual	9.928E-003	7	1.418E-003		
Lack of Fit	5.048E-003	3	1.683E-003	1.38	0.3701 not significant
Pure Error	4.880E-003	4	1.220E-003		
(R-Squared 0.7620      Adj R-Squared 0.5921      Pred R-Squared -0.0432)					

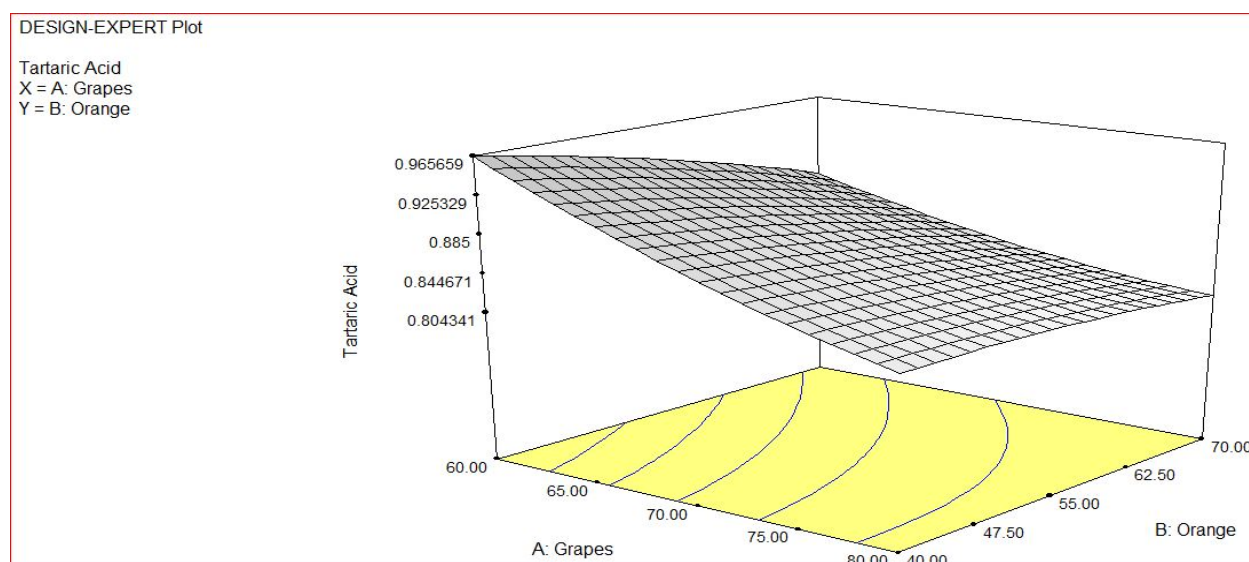


Fig.3: Effect of method variable on tartaric acidity

**Effect of method variable on Overall Acceptability**

The experimental outcomes were calculated using the regression model depicting that the significance of the Model. F-value was at 3.98. The Lack of Fit F-value 0.00 was non-significant (P>0.05) relative to pure error. This model to fit has been also stated by the determination coefficient R<sup>2</sup> which was observed to be 0.7400, Adj. R<sup>2</sup> was 0.5543, Pred. R-square is 0.5937. Where X and Y are the coded variable for grapes and orange respectively. Data from Table 2.5 indicated that of grapes and orange gave significant model (P<0.05). In linear term, grapes (X) and orange (Y) are observed to be significant (P<0.05). F-value for linear terms grapes (X) and orange (Y) were 0.00 and 0.00, P-value was found to be 1.0000 and 1.0000 (P<0.05)

respectively (Table 6).

Quadratic terms of grapes (X<sup>2</sup>) and orange (Y<sup>2</sup>) has shown significant (P<0.05). F-value for quadratic terms grapes (X<sup>2</sup>) and orange (Y<sup>2</sup>) were 0.61 and 9.74, P-values has been found to be 0.4608 and 0.0168 (P<0.05) shown significant effect respectively. The interaction term grapes and orange (XY) significant effect P-value was found to be 0.0212 (P>0.05) and it showed the positive effect on the interaction term and F-value found to be 8.75.

Fig 4 showed the effect of grapes (X) and orange (Y) on overall acceptability in wine. According to graph studied it was observed that grapes and orange content decreases as overall acceptability increases.

**Table 6 : ANOVA for blended wine determination of tartaric acidity**

Source	Sum of Squares	Mean DF	F Square	Value	Prob > F	
Model	2.28	5	0.46	3.98	0.0496	significant
<i>X</i> 0.000	1	0.000	0.000	1.0000		
<i>Y</i> 0.000	1	0.000	0.000	1.0000		
<i>X</i> <sup>2</sup> 0.070	1	0.070	0.61	0.4608		
<i>Y</i> <sup>2</sup> 1.11	1	1.11	9.74	0.0168		
<i>XY</i> 1.00	1	1.00	8.75	0.0212		
Residual	0.80	7	0.11			
Lack of Fit	0.000	3	0.000	0.000	1.0000	not significant
Pure Error	0.80	4	0.20			
(R-Squared 0.7400 Adj R-Squared			0.5543	Pred R-Squared	0.5937)	

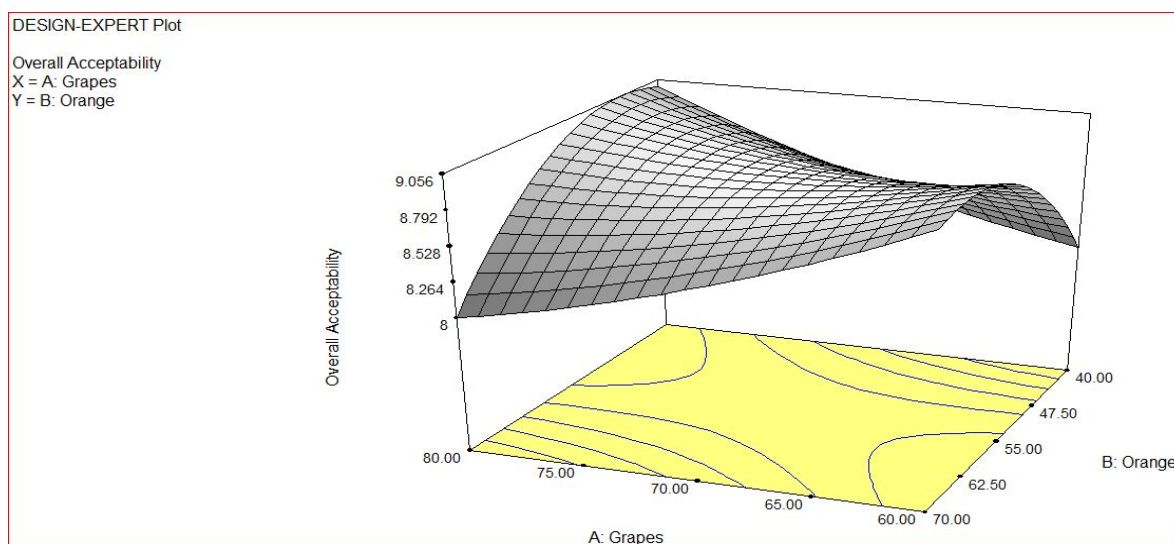


Fig. 4: Effect of method variable on overall acceptability.

**CONCLUSION**

Blended wine was prepared and the various physicochemical and sensory properties were studied and it is concluded that the variable grapes and orange shows positive and negative effect on different responses, it was observed that as grapes and orange content increases the alcohol content also increases in wine similar result show in pH value also increases. While in tartaric acid it was observed that as grapes and orange content decreases tartaric acid was increased. Simultaneously it was observed that grapes and orange content decreases overall acceptability increases.

**References**

1. A.O.A.C. (2005). Official Methods of Analysis of the A.O.A.C. International, 18<sup>th</sup> edition.

Association of Official Analytical Chemists, Gaithersburg, MD

2. AOAC 2000, Official methods of analysis (16th ed.) (pp. 27–29). Washington, DC: Association of Official Analytical Chemists.

3. Comuzzo, P., & Battistutta, F. (2019). Chapter 2 - Acidification and pH Control in Red Wines. In *Red Wine Technology* (pp. 17–34). Elsevier. <https://doi.org/10.1016/b978-0-12-814399-5.00002-5>

4. Devanshi Kasabwala and Vaishnavi V. More 2023. Production of Home-made Wine from Citrus Citrullus Lanatus Linn and Prunus Domestica Linn. International Journal for Multidisciplinary Research (IJFMR), 5 (2): 1-21.

5. Grazia, A., Pietrafesa, A., Capece, A., Pietrafesa, R., Siesto, G., & Romano, P. (2019). Exploitation

- of technological variability among wild non-Saccharomyces yeasts to select mixed starters for the production of low alcohol wines. In *BIO Web of Conferences* (Vol. 15, p. 02031). EDP Sciences
6. Joshi, V., Reddy, S. A., & Rao, B. S. (2022). Physico-Chemical Properties of Juice in Different Wine Varieties of Grape (*Vitis vinifera* L.). *International Journal of Plant & Soil Science*, 34 (23), 64-75.
  7. Ngoc, T. B., Thinh, P. V., Mui, D. T., Uyen, L. H., Ngan, N. N., Tran, N. T., Khang, P. H., Huy, L. Q., Minh, T. N., & Trung, N. Q. (2024). Influences of Fermentation Conditions on the Chemical Composition of Red Dragon Fruit (*Hylocereus polyrhizus*) Wine. *Beverages*, 10(3), 61. <https://doi.org/10.3390/beverages10030061>
  8. Nwachukwu, I. N., Ibekwe, V. I., Nwabueze, R.N. and Anyanwu, B. N. 2006. Characterization of palm wine yeast isolates for industrial utilization. *African J. Biotechnol.*, 5(19): 1725-1728.
  9. Ohoke, F. O. & Nwokonkwo, D. C. (2019). Production, Chemical Properties and Sensory evaluation of Wine from blends of Gaper (*Vitis vinifera*) fruit, Pawpaw (*Carica papaya*) fruit and Tiger nut (*Cyperus esculentus*) tuber. *International Journal of ChemTech Research*, 12(6), 17-27. <https://doi.org/10.20902/ijctr.2019.120603>
  10. Okoro, C.E. 2007. Production of red wine from roselle (*Hibiscus sabdariffa*) and pawpaw (*Carica papaya*) using palm-wine yeast (*Saccharomyces cerevisiae*). *Nigerian Food J.*, 25(2): 158-164.
  11. Pathak, A., Regmi, A., Gautam, K., & Wagle, M. N. (2023). Study on quality parameters of wine at opening and deterioration with time. *Scientific World*, 16(16), 71-76.
  12. R.P.Srivastava and Sanjeev Kumar 2017. Fruit & Vegetable Preservation: Principles and Practices, Publisher: CBS PUBLISHERS AND DISTRIBUTORS PVT LTD; Third Edition.
  13. Rios-Corripio, G., & Guerrero-Beltrán, J. Á. (2019). Antioxidant and physicochemical characteristics of unfermented and fermented pomegranate (*Punica granatum* L.) beverages. *Journal of food science and technology*, 56(1), 132-139.
  14. Tsegay, Z. T. (2020). Total titratable acidity and organic acids of wines produced from cactus pear (*Opuntia-ficus-indica*) fruit and Lantana camara (*L. Camara*) fruit blended fermentation process employed response surface optimization. *Food science & nutrition*, 8(8), 4449-4462.
  15. Ukuru, M.U. and Awah J.I. 2013. Properties of palm wine yeasts and its performance in wine making. *African J. Biotechnol.*, 12(19): 2670-2677.
  16. Yadav, D. K., Chand, K., & Kumari, P. (2022). Effect of fermentation parameters on physicochemical and sensory properties of Burans wine. *Systems Microbiology and Biomanufacturing*, 2(2), 380-392.
  17. Zhu, Y., Su, Q., Jiao, J., Kelanne, N., Kortensniemi, M., Xu, X., Zhu, B., & Laaksonen, O. (2023). Exploring the Sensory Properties and Preferences of Fruit Wines Based on an Online Survey and Partial Projective Mapping. *Foods*, 12(9), 1844.