

EFFECT OF GRAPE SYRUP AS A REPLACEMENT FOR SUGAR IN VARIOUS BEVERAGES

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Abstract

Objective: The present study was aimed to investigate the possibility of replacing sugar with different concentrations of grape syrup in various beverages. **Methods:** Different types of beverages were mixed with grape syrup. The chemical properties of prepared beverages, such as pH, sugar and Total soluble solids, acidity as well as sensory evaluation; colour, taste and texture were also studied. Sensory analysis of various beverages was performed by using the hedonic scale method. **Results:** It was observed that fruit juice with sugar observed the lowest score 7.14 in terms of appearance, scent, and overall acceptability, while the beverage prepared with grape syrup and addition of pineapple juice offered the best and highest score 8.14 out of 10. The acidity value was observed 0.4, 0.45, 0.50, and 0.75 in GS, OGS, LGS and PGS. The pH was observed 3, 2.4, 2.4, and 3.5 in GS, OGS, LGS and PGS. The total soluble solids of GS (45%), OGS (29%), LGS (37%) and PGS (32%).

Keywords: Beverages, Grape syrup, Acidity, Sensory analysis, Concentrations, Table sugar.

INTRODUCTION

The grape (*Vitis species*) is one of the most frequently cultivated commercial fruit crops in the world, with extensive cultivation in both temperate and tropical zones. The grape plant is classified as a member of the family *Vitaceae* (Mousavivand *et al.*, 2020). Grapes are the berries that grow on the deciduous woody vines of the flowering plant genus *Vitis*. Grapes can be found in a rainbow of colours, from black and blue to yellow and green to orange and violet and even pink and purple (McGovern, 2013). The roughly 60 species that make up the genus *Vitis* which includes most commercial grapes are mostly found in the temperate zones of the Northern Hemisphere, split fairly evenly between the America and Asia. The grape species *Vitis vinifera*, from which seeds most cultivated grapes are derived, was domesticated and disseminated by humans from Eurasia (Dani *et al.*, 2007). The pulp, which makes up around 85% of a grape's total mass, the skin, which makes up about 20%, and the seeds, which make up the remaining 5% (Andersen *et al.*, 2010). Antioxidants and other polyphenols can be found in grapes of every colour. Antioxidants assist stop the oxidation process that damages cells by neutralising damaging free radicals. About 80% of a grape is water, making it a low-calorie fruit. The remaining 20% is made up of flavonoids, responsible for red wine's deep purple hue (Toaldo *et al.*, 2015) observed that many individuals rely on grapes as a key source of healthful ingredients because of their large variety of vitamins, carotenoids, and polyphenolic compounds. Grapes can be ingested as fruits, wine, juice, or raisins. They are quite nutritious. Grapes are an excellent source of vitamin C (3.2mg) and vitamin K (14.6mg). The levels of cholesterol, fat, and sodium in them are rather low (Kumar *et al.*, 2020). The nutritional profile of grapes includes protein (0.72g), carbs (18.1g), dietary fibre (0.9g), vitamins, and minerals;

specifically, grapes are a good source of potassium (191mg), phosphorus (20mg), and calcium (10mg). Grapes are a great source of caffeic acid, a potent cancer fighter (Mehrabi *et al.*, 2017). Grape berries include hydroxyl cinnamic acids largely in the pulp and flavan-3-ols mostly in the seeds. The skin is the primary location for the other phenolic compounds, including hydroxybenzoic acids, stilbenes, flavonols, and anthocyanins. Grape quality is greatly impacted by polyphenols due to their contributions to flavour and colour, as well as their antioxidant activities. Grapes get their vibrant red hue from pigments called anthocyanins (Shahidi and Zhong, 2015).



Figure 1. Green and Red Grapes

Because of the tremendous yield of grapes, grape juice, wine, grape jelly, grape syrup, grape candy, and many more grape-based goods are readily available all over the world. However, wine is the most widely consumed grape-based beverage (Sugiyama *et al.*, 2003). The lack of ethyl alcohol and the presence of a sizable amount of bioactive components in grape juice have made it a popular beverage. Grapes have many uses outside being consumed in their natural form, including in the preparation of beverages and culinary ingredients such as juice, syrup, wine, grape seed extract, raisins, vinegar, and Grape seed oil (Demir, 2014).

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Resveratrol, a compound discovered in grapes, has been associated to a lower risk of colon cancer, according to research headed by Dr. Randall Holcombe. Grapes are so beneficial to human health that they have been linked to a reduction in the risk of developing Alzheimer's, asthma, constipation, heart disease, indigestion, and renal disease, among other health benefits. The risk of cardiovascular disease is lowered by eating grapes (Xia *et al.*, 2010). According to (Pezzuto, 2008), raisins and grapes were used to treat a wide variety of illnesses, including cancer, TB, smallpox, nausea, renal disease, and liver sickness. Probably due to its antioxidant effect, the polyphenol resveratrol found in red wines and grapes has recently been shown to trigger death of human melanoma cells and prevent cancer. These days, grapes are utilised not only as a source for sweetening compounds in a wide variety of dishes, but also as an ingredient in anti-aging and anti-wrinkle cosmetics made from grape seed extracts (Llobera & Canellas, 2007). Grape juice can be utilized as a sweetening agent in various beverages such as other juices, squashes, sharbats etc. as a replacement of table sugar resulting in drinks with less of calories. The purpose of this research was to examine the feasibility of using grape syrup as a sugar substitute in a range of beverages. The chemical and sensory characteristics of these drinks were also analysed as part of this investigation.

MATERIALS AND METHODS

Sample procurement

Fully ripened, fresh, healthy white table grapes and red coloured table grapes were purchased from the Local fruit market of Sirsa, Haryana.

Sample Preparation

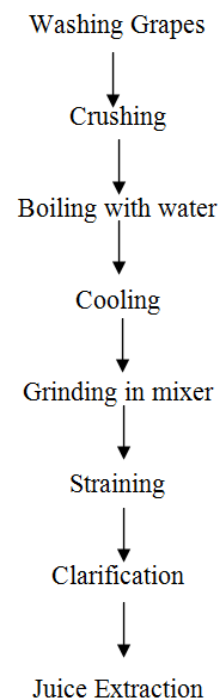
Firstly the mature, fresh and undamaged grapes fruits were selected while unripe or rotten fruits were sorted and removed. All the unnecessary stems and stones or dirt was removed from the fruits. In order to reduce waste, many of the leaves, stems, or other non-fruit components of the grapes were removed before they were washed in clean water. After that, the uncontaminated fruit flesh was exposed to the elements. The equipment was thoroughly cleaned before being put on display. To avoid premature browning and discoloration of the juice, the sliced surfaces were not left exposed to the air for extended periods of time. The browning reactions of the fruit were halted by soaking it in water containing lemon juice (250 ml of lemon juice per litre of water).

Utilization of Grape juice in Beverages

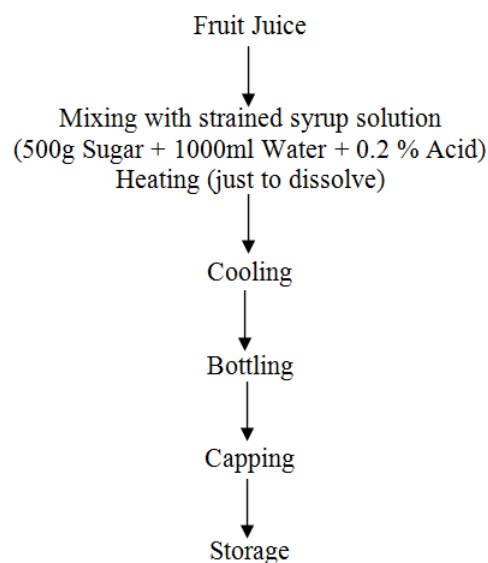
Extraction of Juice: Depending on the fruit, one of numerous ways can be used to obtain the juice. Mixing equipment is used for grapes and other citrus fruits that are inherently juicy.

Preparation of Sugar syrup: According to (Ayed *et al.*, 2017) Sugar syrup was prepared using required amount of sugar and boiling water to get required (SG) specific gravity. At least 25% fruit juice or pulp and 65% total soluble solids are found in the fruit beverage. The acidity of syrup is reduced down to about 1.35 percent before being served. Sugar syrup is prepared by dissolving sugar crystals in boiling water and then letting the mixture cool to syrup consistency. Sugar and water can be mixed at a ratio of 1:1 or 2:1.

Flow chart of juice extraction



Flow chart of syrup preparation



- Fruit- based syrups do not need preservatives but for the longer shelf life 350 ppm sulphur dioxide or 600ppm benzoic acid may be added before bottling.

Ingredients:

Ingredient	Amount
Grapes	1 Kg
Sugar	600g
Citric acid	5g per kg fruit
Pineapple juice	20-30ml

Preparation of pineapple flavoured syrup

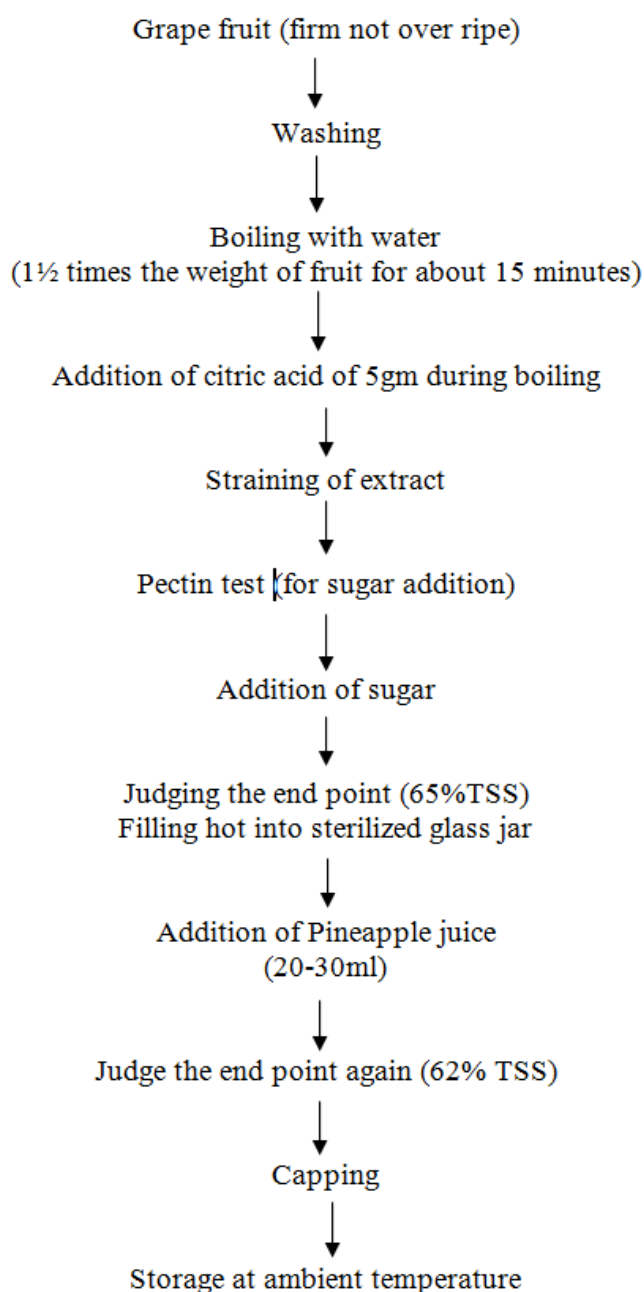
The grapes were washed properly and boiled in water. During boiling 5gm of citric acid per kg of fruit was added. After that,

it was ground up in the grinder and filtered several times. In filtered juice, the sugar syrup was added and cooked for 5 minutes at 75 °C temperature. During heating, juice was frequently stirred and the content became quite dense. The endpoint of 65% TSS is then evaluated using the sheet test method. The product was then poured into clean, disinfected bottles or glass jars before being stored at room temperature. In the end, when the grape syrup was prepared, 20 to 30 ml of pineapple juice was added to provide pineapple flavour and aroma. After pineapple juice is added, the TSS lowers somewhat, reaching 63- 62% TSS in grape syrup flavoured with pineapple. The grape syrup is divided into two glass jars, one containing pineapple-flavoured grape syrup and the other containing grape syrup to which pineapple chunks have been added. This unique flavour and aroma of pineapple was used into the preparation of syrup made from white and red table grapes.



Figure 2. Pineapple flavoured Grape syrup

Flow Chart of Pineapple flavoured Syrup



RESULTS AND DISCUSSION

The hedonic scale approach was used for sensory analysis, with the help of a panel of both trained and untrained individuals. The judges were instructed to rate the performances on a scale from 0 (extremely weak) to 9 (very intense). Products were presented and tasted 1 hour after removal from the refrigerator in white translucent, neat, and well-cleaned glass miniature containers. There were some differences in flavour, hardness, juiciness, crispness, and intensity of taste among the red grapes, and in flavour, juiciness, hardness, crispness, and intensity of taste among the white grapes. The judges ranked it as the least sweet of the white grapes, whereas the greatest and lowest ratings for sweetness were given to the red grape varieties.

Table 1. Sensory evaluation of Grapes

Sensory attributes	Desirable score in green grapes	Desirable score in grapes
Color	Greenish color	Purplish color
Texture	Soft	Liquid (light thick)
Taste	Sweet	Sweet

Sensory evaluation of grape syrup with beverages

pH and acidity of grape syrup: The concentration of organic acids is easily evaluated to establish maturation standards, and they play a crucial influence in how foods are perceived in terms of flavour (Jayasena & Cameron, 2008). Grape juice pH was measured to be 3.01-3.84, with a mean value of 3.50. The acidity of the grapes was titrable, and it varied from 0.27% to 0.83%, averaging 0.44%. Total acidity content of the products was estimated in terms of citric acid. A few drops of one percent phenolphthalein were used as an indicator. The grape juices exhibited a moderate inverse connection between pH and titrable acidity ($r = 0.425$). Green grapes, on average, have a higher acidity than red grapes. This is likely connected to the climate in which the grapes were grown and matured. The build-up of nutrients and phenolic compounds in grape berries might benefit from drier seasons between veraison and maturation. Tested cultivars showed seasonal variation in pH and acidity levels.

Total soluble solids of grape syrup: The total soluble solids content present in grapes varieties was determined by the hand refractometer.

Table 2. Sensory evaluation of grape syrup with beverages

Contents	Sensory Attributes	Color	Texture	Flavor	Evaluation Scale	Overall Acceptability
Orange juice with Sugar	Color Orange, liquid, sweet	8.01±0.11	7.31±0.21	9.01±0.31	Very good	8.11±0.21
Orange juice with Grape syrup	Color Orange, liquid, little-bit sour	9.03±0.44	7.02±0.12	9.01±0.22	Excellent	8.35±0.26

Table 3. Sensory evaluation of grape syrup with beverages

Contents	Sensory Attributes	Color	Texture	Flavour	Evaluation scale	Overall Acceptability
Lemon juice with Sugar	White, liquid and sour	7.12±0.52	8.20±0.61	9.41±1.20	Very good	8.24±0.77
Lemon juice with Grape syrup	White, thick liquid, little sweet	8.14±0.21	7.11±1.01	9.31±0.21	Good	8.18±0.47

Table 4. Sensory evaluation of grape syrup with beverages

Contents	Sensory Attributes	Color	Texture	Flavor	Evaluation Scale	Overall Acceptability
Pineapple juice with Sugar	Yellow, liquid and sweet	7.31±0.31	8.11±0.21	6.01±0.22	Good	7.14±0.24
Pineapple juice with Grapes syrup	Yellow, thick liquid and little sour	8.21±0.11	7.22±1.0	9.11±0.01	Very good	8.18±0.37

There was also a large disparity in the soluble solids concentration (SSC), measured in Brix value, amongst muscadine grape cultivars. Values, for instance, varied from 10.92% to 23.91. The examined cultivars had a mean soluble solids concentration of 15.31% and a median of 14.80% at Brix. Grapes' Brix to acid ratio varied widely, from 14.02% to 57.06%, with an average of 34.46%. The total soluble solids content was determined with the help of refractometer in the grapes product of grape syrup after preparation was 35%. Orange juice having sugar; it gives the sensory attributes as orange in colour, sweet in taste and normal and liquid in texture. Whereas the grape syrup is sweeter and when grape syrup is added in squash it brings some changes in taste as sour and converts the texture from thick to normal liquid. The overall acceptability score was given by the supervisor and panellists for grape syrup as 8 out of 10 and evaluation scale was observed as good while in case of grape syrup and squash it was 8.5 and evaluation scale was very good. But in case of orange juice having sugar, evaluation scale was good and overall acceptability was 8 given by the panellists. The lemon juice having sugar it gives the sensory attributes as no effect in colour but changes as sour and texture remains same as normal liquid. Whereas the grape syrup is more sweet thick liquid and when grape syrup is added in lemon juice it brings some changes in taste as sour and converts the texture from thick to normal liquid and golden yellowish in colour. The overall acceptability score was given by the supervisor and panellists for grape syrup as 8 score out of 10 and evaluation scale was observed as good while in case of grape syrup and lemon juice having sugar it was 8.5 and evaluation scale observed as very good. But in case of grape syrup and lemon juice, evaluation scale is brilliant and overall acceptability score was 9 out of 10 given by the panellists.

Sensory evaluation of grape syrup with pineapple juice: The sensory evaluation results of prepared grape syrup are given in Table 3. In addition, GS, OGS, LGS, and PGS concentrations all received high marks for all sensory values. The results showed that the fruit juice with sugar observed the lowest score in terms of appearance, scent, and overall acceptability, while the made grape syrup with the addition of pineapple juice offered the best and highest score. In contrast, the samples made with grape syrup and pineapple juice fared best in terms of colour. A higher concentration of fruit juice led to lower ratings in the sensory evaluation. In parallel with the preparation of grape syrup with the addition of pineapple juice decrease the total soluble solids content. In order to understand the analysis of variance's findings, a thorough physical, chemical, and sensory examination of each sample is performed.

The criteria for the modifications tested were derived from the descriptions of screen panellists' sensory rating criteria. The sugar having fruit juice it gives the sensory attributes as normal colour, sweet in taste and normal liquid in texture. Whereas the grape syrup is sweeter and when grape syrup added in pineapple juice it brings some changes in taste as sour due to pineapple and converts the texture from thick to normal liquid. The overall acceptability score obtained by the supervisor and other panellists for grape syrup as 8 out of 10 and evaluation scale was observed as excellent while in case of grape syrup and it was very good. But in case of fruit juice having sugar, evaluation scale good and overall acceptability score was 8 given by the panellists.

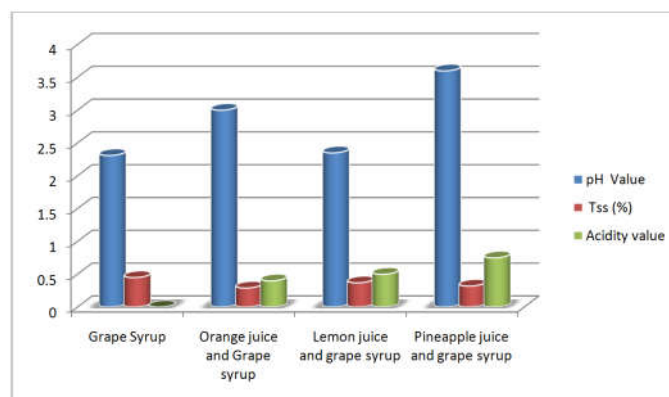


Figure 3: Graphical representation of comparison in various prepared beverages

The graphical data presents that the pH value, TSS value (%) and acidity value are the characters responsible for acceptance and rejection of any beverages. So, it is clear that the pineapple juice with grape syrup has high pH content as 3.5 as compared to other beverages and total soluble solids of grape syrup are 45% and acidity value is very less as compared to the other juices and beverages. The acidity value was observed 0.4, 0.45, 0.50, and 0.75 in GS, OGS, LGS and PGS. The pH was observed 3, 2.4, 2.4, 3.5 in GS, OGS, LGS and PGS. The total soluble solids of GS (45%), OGS (29%), LGS (37%) and PGS (32%).

Conclusion

This research set out to find out if varying quantities of a natural sweetener (grape syrup) could be used to replace sugar in popular beverages. For this purpose, different types of beverages were mixed with grape syrup. The chemical properties of prepared beverages, such as pH, sugar and Total

soluble solids, acidity as well as sensory evaluation; colour, taste and texture were also studied. Using a sensory rating scale, this study found that the formulation made with grape syrup was more generally accepted. In addition, grape syrup-sweetened beverages provide a low-sugar alternative to traditional sugar-sweetened beverages. The products prepared of using grape syrup showed the high pH value as well as the high level of sugar. When comparing treatments on day seven, the control group had the highest mean L* (lightness) whereas the grape syrup group had the lowest mean L* (lightness). It was determined that, among beverages containing grape syrup, pineapple juice scored the highest in terms of quality, colour, soft texture, flavour, and aroma.

Conflicts of Interest: We declare that we have no conflicts of interest.

Declarations: This manuscript is original work of the mentioned authors that has not been submitted anywhere else and follows the research ethics.

Abbreviations

TSS – Total Soluble Solids

SSC – Soluble Solids Concentration

GS – Grape Syrup

OJS – Orange juice having Grape Syrup

LJS – Lemon juice having Grape Syrup

PJS – Pineapple juice having Grape Syrup

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