Studies on effect of different levels of yeast and sugar on quality cider production from pomegranate (*Punica granatum* L.)

ABSTRACT

The present research work entitled **"Studies on effect of different levels of yeast and sugar on quality cider production from pomegranate (*Punica granatum* L.)".** The study was conducted in Completely Randomized Design (CRD) with 8 treatments replicated thrice for a period of 90 days. The treatments were T1 (Pomegranate Juice 500 ml + Sugar 100 g + Yeast 1 g), T2 (Pomegranate Juice 500 ml + Sugar 100 g + Yeast 2 g), T3 (Pomegranate Juice 500 ml + Sugar 150 g + Yeast 1 g), T4 (Pomegranate Juice 500 ml + Sugar 150 g + Yeast 2 g), T5 (Pomegranate Juice 500 ml + Sugar 200 g + Yeast 1 g), T6 (Pomegranate Juice 500 ml + Sugar 200 g + Yeast 2 g), T7(Pomegranate Juice 500 ml + Sugar 250 g + Yeast 1 g), T8 (Pomegranate Juice 500 ml + Sugar 250 + Yeast 2 g). A significant decreasing trend was observed in Total Soluble Solids, pH and Specific Gravity while the Alcohol content, Acidity and the Sensory Qualities increased with increasing length of fermentation. From the statistical analysis of the above treatments, it was concluded that treatment T6 was found superior in respect of the parameters like Total Soluble Solids, Acidity, pH, Alcohol content and Specific gravity. When evaluating both chemical parameters and organoleptic properties treatment T6 consistently outperformed other treatments and emerged as the most favorable option.

Keywords: Cider, Pomegranate; Fermentation; Yeast; Sugar.

INTRODUCTION

Pomegranate (*Punica granatum* **L.**) belongs to the family Punicaceae. It is a small tree with potential human health benefits and is a native of Iran to Iranian Plateau and has been cultivated in the Caucasus since ancient times. It is extensively grown in Iran, Spain, India and USA as well as in most East countries (Schubert *et al.,* 1999). The cultural and geographical diversity of its growth is a testament to its widespread popularity.

When we delve into the unique characteristics of the pomegranate, we discover its allure lies in its multiple fruit structure. The dark red to red-colored arils it bears hold numerous nutritional benefits for humanity. For thousands of years, pomegranate has been employed as a traditional remedy, thanks to its abundance of potentially healthy bioactive compounds. India, known for its rich agricultural heritage, cultivates different varieties of pomegranate, including Ganesh, Bhagwa, Ruby, Arakta, and Mridula. The states of Maharashtra, Karnataka, Gujarat, Andhra Pradesh, Tamil Nadu, and Himachal Pradesh are the main commercial cultivators of this remarkable fruit in India.

The richness of pomegranate lies in its arils, which are particularly abundant in polyphenols such as ellagic acid and punicalagins. These compounds act as potent antioxidants, providing a host of health benefits. Interestingly, ellagic acid can not only be found in pomegranate but also in other red-colored berries. The rind of the fruit and the tree's bark have long been used as traditional remedies against ailments such as diarrhea, dysentery, and intestinal parasites. The seeds and juice, on the other hand, have gained a reputation as a tonic for the heart and throat. They are classified as bitter and astringent, offering a healthful counterbalance to diets rich in sweet-fatty components.

Pomegranate is a multiple fruit and the brilliantly coloured arils have nutritional value, 100 grams of edible portion contains (3.5 oz) energy 285 kJ (68 kcal), carbohydrates 17.17 g, sugars 16.57 g, dietary fiber 0.6 g, fat 0.3 g, protein 0.95 g, thiamine (Vit. B1) 0.030 mg (2%), riboflavin (Vit. B2) 0.063 mg (4%), niacin (Vit. B3) 0.300 mg (2%), pantothenic acid (B5) 0.596 mg (12%), vitamin B6 0.105 mg (8%), folate (Vit. B9) 6 mg (2%), vitamin C 6.1 mg (10%), calcium 3 mg (2.5%), iron 0.30 mg (2%), magnesium 3 mg (1%), phosphorus 8 mg (1%), potassium 259 mg (6%) and zinc 0.12 mg (1%) LaRue and James (1980). The succulent, juicy arils not only provide liquid refreshment but also supply sugars, vitamins, and minerals necessary for sustaining human life. The chemical composition of the edible portion of pomegranate includes 78% moisture, 1.6% protein, 0.10% fat, 5.10% fiber, 14.60□ brix TSS, 0.87% pectin, 1.58 % acidity, 16.0 % ascorbic acid (mg/100 gm), 133.0% potassium, and 65.0 Kcal of food energy (Berry, 2005).

The post-harvest processing of pomegranates plays a crucial role in ensuring effective utilization of the produce and the quality of end products which influences the consumption and acceptance of the final product. Pomegranate concentrate and juice have gained popularity as health drinks in the international market. Despite the immense potential for pomegranate-derived products, industrial processing remains limited due to a lack of technological development (Artes and Barberan, 2000).

The production of cider, a beloved alcoholic beverage derived from fermented fruit juice, has been extensively explored with various fruits. Cider is not only considered safe and healthy but also acts as an important dietary adjunct. In recent years, pomegranate juice or pulp has emerged as a fascinating ingredient for cider production. However, there is limited information available about utilizing pomegranate for cider preparation. The content of alcohol in cider serves as a macro nutrient, providing energy for essential biological activities within human cells. It consists of water, alcohol, pigments, esters, vitamins, carbohydrates, minerals, acids, and tannins, all

of which possess medicinal and therapeutic value (Patil *et al.,* 2005). Fruit cider is widely produced and consumed in advanced countries around the world. Although a few industries in India produce cider from fruit, its production remains insignificant despite the tremendous increase in fruit production (Joshi *et al.,* 1995).

Cider represents an intriguing alcoholic beverage obtained through the fermentation of fruit juice by yeast, primarily belonging to the *Saccharomyces* species. Fruit cider production flourishes in advanced countries due to its delectable taste, nutritional value, and delicate stimulant properties. Moreover, cider is often named after the fruits used in its creation. Interestingly, the abundance of spoiled, cracked, and nonmarketable pomegranate fruits poses a significant challenge on farms and in market yards. Finding ways to utilize such fruits by processing them into value-added products presents an excellent opportunity to minimize post-harvest losses. Cider, therefore, emerges as a viable solution for managing nonmarketable pomegranate fruits, transforming them into an alcoholic beverage through yeast fermentation and proper processing with sugar supplementation.

Cider holds immense value as both a food aid and a flavor enhancer. It complements meals and serves as a regular dietary component, providing valuable nutrients that can act as a tonic. Moderate consumption of cider also holds medicinal utility and health benefits. It aids in inducing sleep, increasing appetite, stimulating gastric secretions, and producing mild diuresis. Since fermentation is an energy-efficient process for value addition, the present study focuses on optimizing the fermentation conditions required for producing high-quality pomegranate cider as part of product diversification. While apple cider and cider from other fruits have been extensively studied and developed, limited information are available on pomegranate cider production. Hence, the current study aims to investigate the fermentation parameters specific to pomegranate cider. By fermenting pomegranate arils juice with different concentrations of the yeast *Saccharomyces cerevisiae* and varying levels of sugar, we can unlock the full potential of pomegranate as a unique cider source and optimize the production of pomegranate cider as part of product diversification.

Materials and Methods

The study was conducted using a Completely Randomized Design (CRD) with 8 different treatments, each replicated thrice. The study lasted for a period of 90 days. The treatments involved variations in the quantities of pomegranate juice, sugar, and yeast used in the preparation of the cider. The treatments were as follows:

T1: Pomegranate Juice 500 ml + Sugar 100 g + Yeast 1 g

T2: Pomegranate Juice 500 ml + Sugar 100 g + Yeast 2 g

T3: Pomegranate Juice 500 ml + Sugar 150 g + Yeast 1 g

T4: Pomegranate Juice 500 ml + Sugar 150 g + Yeast 2 g

T5: Pomegranate Juice 500 ml + Sugar 200 g + Yeast 1 g

T6: Pomegranate Juice 500 ml + Sugar 200 g + Yeast 2 g

T7: Pomegranate Juice 500 ml + Sugar 250 g + Yeast 1 g

T8: Pomegranate Juice 500 ml + Sugar 250 g + Yeast 2 g

Source of Raw Materials

Fresh, ripe, and mature pomegranates were purchased from a local market in Prayagraj. The fruits were stored at room temperature until they reached their optimum and wholesome stage for cider production. The pomegranates were washed, weighed, and their seeds were ground to extract the juice. The juice was then sieved through muslin cloth. Commercial yeast strain *Saccharomyces cerevisiae* var. ellipsoideus (USD 552) was obtained from the Indian Institute of Science, Bangalore, and stored in a refrigerator at 0-5 □C until used.

Preparation of Yeast Starter Culture

A yeast starter culture was prepared using a known quantity of the pomegranate must (juice) with approximate amount of sugar, yeast, and water. Approximately 200 ml of water was boiled and allowed to reach 37 □C. Then, 200 ml of the pomegranate must mixed with sugar was added to the water. Approximately 1g and 2 g of yeast (*S. cerevisiae*) were added to the mixture, representing approximately 108cfu/ml (measured using McFarland standard) after centrifugation. The mixture was stirred properly and allowed to stand for 24 hours before use. The following parameters were monitored before and during the fermentation process: TSS (Total Soluble Solids), alcohol content, pH, titratable acidity, and specific gravity.

Fermentation of Must

The primary fermentation was initiated by adding the yeast starter culture to the must. The must was stirred every 12 hours with a wooden spoon, and the TSS, alcohol content, acidity, pH and specific gravity were measured for 8 days. After 8 days, the cider was transferred to a secondary fermentation container. The secondary fermentation was conducted in an airtight container with a tube passing into a clean bottle containing water. This setup allowed monitoring of the fermentation process, which was considered

complete when no more bubbles appeared in the container, typically within 3 weeks. The secondary fermentation lasted for 21 days at 21 □C. Once fermentation stopped, the cider was carefully separated from the sediments and transferred to another clean container to remove impurities. The cider continued to ferment at 20 □C for additional days and was then subjected to storage conditions at 20 □C for a total aging period of 90 days. The TSS, alcohol content, titratable acidity, pH and specific gravity of the cider were monitored at the end of the secondary fermentation.

Clarification of Cider

After fermentation, the cider samples were clarified to remove any remaining suspended insoluble matter. Bentonite clay (0.1 %) was used to clarify the cider, which was then allowed to settle for 24-48 hours. Once the fermentation was complete, the clarified cider was siphoned off and filtered through sterilized muslin cloth, Whatman No.1 filter paper, sieves, and sterilized syphon tubes. The filtrates were collected in sterile glass jars, and the cider was further racked for 3 weeks to clear it. Residues were removed, and the filtrates were allowed to mature before further chemical analysis. Clarification is an essential step in cider production to remove sediments present in the fermented cider.

Aging of Cider

Aging of cider is an important step that potentially improves its quality for consumption. After maturation, the clear liquid (supernatant) was transferred into fresh sterile bottles, corked, and subjected to pasteurization at 82 ºC for 20 minutes. After cooling, the cider was aged in long-necked 500 ml bottles for 17 days at 22-25 ºC before analysis. The physio-chemical properties of the cider were analyzed at 30-day intervals (i.e., at 30, 60, and 90 days) from the start of fermentation. Additionally, sensory evaluation of the cider was conducted using a panel of judges to assess its colour and appearance, flavor, clarity, aroma, taste, and overall acceptability. The mean scores of various products were evaluated to determine their acceptability.

Storage:

Storage conditions play a crucial role in cider quality over time. Fresh cider should be aged until it becomes drinkable and marketable. Cider can improve with age but it can also rapidly deteriorate if stored in unfavorable conditions. Cider bottles should

be airtight to prevent the effects of humidity, and they can be stored at temperatures between 10 □C to 25 □C. Dry places are preferred for longer storage periods and bottles can be stored for more than six months under these conditions.

Sensory Evaluation

The pomegranate cider was subjected to sensory evaluation by a panel of judges using the Hedonic scale rating test as defined by (Ranganna 1997). The judges assessed the colour and appearance, taste, aroma and clarity of the cider. Acceptability was determined based on mean scores of 6.5 or more on a 9-point hedonic scale. The overall acceptability of the cider was based on the mean scores obtained from the various sensory attributes evaluated.

RESULT AND DISCUSSION

The result of the experiment entitled **Studies on effect of different levels of yeast and sugar on quality cider production from pomegranate (*Punica granatum* L.)** was undertaken in the Post- Harvest Laboratory, Department of Horticulture, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj during the year 2022-2023. The results of the investigation regarding production of cider from pomegranate influence by different levels of yeast and sugar have been presented in Table.1 and Table.2 along with Fig 1- Fig 10 for references.

Total Soluble Solids (TSS)

During various storage periods, all treatments exhibited a decline in the content of Total Soluble Solids (TSS). In terms of TSS, Treatment T1 (Pomegranate Juice (500 ml) + Sugar (100 g) + Yeast 1 g) recorded the lowest TSS scores (11.52, 8.43, 6.13, 5.72 □Brix) at the initial, 30, 60, and 90 days of storage, while Treatment T6 (Pomegranate Juice (500 ml) + Sugar (200 g) + Yeast 2 g) displayed the highest scores (14.54, 13.32, 11.57, 10.01 □Brix) during the same storage periods. The decrease in total soluble solids content of pomegranate cider, influenced by the levels of yeast and sugar, can be attributed to the yeast's fermentation of sugars into alcohol. The reduction in TSS values was consistently observed over time and can be attributed to yeast-mediated sugar fermentation. These findings align with the results reported by Joshi *et al.* (1991**)** Akubor *et al.* (2001), Deta *et al.* (2004**)** and Jadhav *et al.,* (2016).

Alcohol content

In terms of Alcohol content, the highest score for alcohol content (10.12 %, 10.87 %, 11.22 %) at 30, 60 and 90 days after storage was observed in treatment T6 (Pomegranate Juice (500 ml) + Sugar (200 g) + Yeast 2 g) followed by treatment T5 (Pomegranate Juice (500 ml) + Sugar (200 g) + Yeast 1g) with (9.16 %, 9.87 %, 10.06 %) at 30, 60 and 90 days after storage, whereas the minimum score was observed in treatment T2 (Pomegranate Juice (500 ml) + Sugar (100 g) + Yeast 2 g) with (5.68 %, 5.74 %, 5.78 %) during 30, 60 and 90 days of storage. The trend of alcohol increase and TSS decrease during fermentation was similar to the fermentation process observed in fruit cider production. The variation in yeast performance in utilizing fermentable sugars is likely responsible for the differences in fermentability and alcohol production in pomegranate cider with different levels of yeast and sugar during storage. These findings support the results reported by Adusule *et al.* (1992), Sapna *et al.* (2002) and Lakshmana *et al.,* (2006).

Titratable acidity (TA)

In terms of acidity, the lowest acidity content of (0.35 %, 0.39 %, 0.42 %) at 30, 60 and 90 days after storage was observed in treatment T8 (Pomegranate Juice (500 ml) + Sugar (250 g) + Yeast 2 g), followed by treatment T7 (Pomegranate Juice (500 ml) + Sugar (250 g) + Yeast 1 g) with (0.42 % , 0.44 %, 0.48 %) at 30, 60 and 90 days after storage, whereas the maximum score was observed in treatment T1 (Pomegranate Juice (500 ml) + Sugar (100 g) + Yeast 1 g) with (0.74 %, 0.78 %, 0.83 %) during 30, 60 and 90 days of storage. The increase in acidity of the pomegranate cider across various yeast and sugar levels during storage can be attributed to the impact of different yeast strains and fermentation durations, which lead to elevated alcohol production from the initially high sugar concentration. These findings align with the research conducted by Sapna *et al.* (2002), Olasupo and Obayori (2003) and Kumar *et al.,* (2009).

pH

From the result obtained from table.1, the lowest pH of (3.52, 3.44, 3.22, 2.87) at initial, 30, 60 and 90 days after storage was observed in treatment T1 (Pomegranate Juice (500 ml) + Sugar (100 g) + Yeast 1 g) followed by treatment T2 (Pomegranate Juice (500 ml) + Sugar (100 g) + Yeast 2 g) with (3.02, 3.22, 3.15, 3.07) at initial, 30, 60 and 90 days of storage, whereas the maximum score was observed in treatment T8 (Pomegranate Juice (500 ml) + Sugar (250 g) + Yeast 2 g) with (3.76, 3.71, 3.66, 3.61) during initial, 30, 60 and 90 days of storage. The pH gradually decreased as the fermentation time progressed, with variations observed due to the use of different strains of yeast and the duration of fermentation. This phenomenon of pH progressively decreasing following

fermentation during aging has also been observed in studies on strawberry wine conducted by Saravana *et al.* (2001), Joshi and Sandhu (2000) and Olasupo and Obayori (2003).

Specific gravity

In terms of Specific gravity, the lowest specific gravity (1.59, 1.33, 1.21and 1.02) at initial, 30, 60 and 90 days of storage was observed in treatment T6 (Pomegranate Juice (500 ml) + Sugar (200 g) + Yeast 2 g) which was followed by treatment T5 (Pomegranate Juice (500 ml) + Sugar (200 g) + Yeast 1g) with (1.51, 1.36, 1.21 and 1.07) at initial 30, 60 and 90 days respectively after storage, whereas the maximum score was observed in treatment T2 (Pomegranate Juice (500 ml) + Sugar (100 g) + Yeast 2 g) with (1.57, 1.51, 1.46 and 1.32) during initial 30, 60 and 90 days of storage. The specific gravity of the pomegranate cider produced in this study decreased as the fermentation duration increased. This decline in specific gravity could be attributed to the specific type of yeast employed in the cider production, as *Saccharomyces cerevisiae* has been known to affect the specific quality of fruit ciders during fermentation. These findings align with previous studies conducted by Shankar et al. (2014) and Jadhav *et al.*, (2016).

Colour and appearance

In terms of organoleptic analysis for colour and appearance, the maximum score of colour (7.75, 7.88, 8.05) at 30 60 and 90 days was observed in treatment T6 (Pomegranate Juice (500 ml) + Sugar (200 g) + Yeast 2 g), followed by treatment T5 (Pomegranate Juice (500 ml) + Sugar (200 g) + Yeast 1 g) with (7.72, 7.84, 7.91), whereas the minimum score was observed in treatment T1 (Pomegranate Juice (500 ml) + Sugar (100 g) + Yeast 1 g) with (6.05, 6.24, 6.38) during 30, 60 and 90 days of storage.

Taste

In terms of Taste, the maximum organoleptic score of taste (7.63, 7.83 and 8.11) at 30 60 and 90 days respectively was observed in treatment T6 (Pomegranate Juice (500 ml) + Sugar (200 g) + Yeast 2 g) followed by treatment T5 (Pomegranate Juice (500 ml) + Sugar (200 g) + Yeast 1 g) with (7.48, 7.63 and 7.87) whereas the minimum score was observed in treatment T1 (Pomegranate Juice (500 ml) + Sugar (100 g) + Yeast 1 g) with (5.10, 5.46 and 5.65) during 30, 60 and 90 days of storage.

Aroma

In terms of Aroma, the maximum organoleptic score of aroma (7.54, 7.79 and 8.05) at 30 60 and 90 days respectively was observed in treatment T8 (Pomegranate Juice (500 ml) + Sugar (250 g) + Yeast 2 g) which was followed by treatment T6 (Pomegranate Juice (500 ml) + Sugar (200 g) + Yeast 2 g) with (7.33, 7.55 and 7.77) whereas the minimum score was observed in treatment T1 (

Pomegranate Juice (500 ml) + Sugar (100 g) + Yeast 1 g) with (5.15, 5.47 and 5.64) respectively during 30, 60 and 90 days of storage.

Clarity

In terms of organoleptic analysis for clarity, the maximum score of clarity (7.18, 7.43 and 7.76) at 30 60 and 90 days respectively was observed in T5 (Pomegranate Juice (500 ml) + Sugar (200 g) + Yeast 1 g), followed by treatment with T6 (Pomegranate Juice (500 ml) + Sugar (200 g) + Yeast 2 g) with (7.08, 7.37 and 7.64) whereas the minimum score was observed in treatment T1 (Pomegranate Juice (500 ml) + Sugar (100 g) + Yeast 1 g) with (6.02, 6.21 and 6.34) respectively during 30, 60 and 90 days of storage.

Overall acceptability

In terms of organoleptic analysis for overall acceptability, the maximum score of overall acceptability (7.45, 7.66 and 7.89) at 30 60 and 90 days respectively was observed in treatment T6 (Pomegranate Juice (500 ml) + Sugar (200 g) + Yeast 2 g), followed by treatment T5 (Pomegranate Juice (500 ml) + Sugar (200 g) + Yeast 1 g) with (7.39, 7.55 and 7.76) whereas, the minimum score was observed in treatment T1 (Pomegranate Juice (500 ml) + Sugar (100 g) + Yeast 1 g) with (5.60, 5.85 and 6.00) respectively during 30, 60 and 90 days of storage.

CONCLUSION.

Based on the results obtained from the present experiment, it is concluded that Treatment T6, which consisted of a combination of Pomegranate Juice (500 ml) + Sugar (200 g) + Yeast (2 g), exhibited superiority across various parameters such as Total Soluble Solids (TSS), Alcohol content, Acidity, pH, and Specific gravity. When evaluating both chemical parameters and organoleptic properties, Treatment T6 Pomegranate Juice (500 ml) + Sugar (200 g) + Yeast (2 g) consistently outperformed other treatments and emerged as the most favorable option. Therefore, for commercial production, it is recommended to utilize treatment T6 for the production of cider from pomegranate.

Table.1. Physio-chemical parameters on effect of different levels of yeast and sugar on cider production from pomegranate

Treatment symbols	Treatment combination	TSS				Alcohol			ph				Acidity			Specific gravity			
		Initial	30 Days	60 Days	90 Days	30 Days	60 Days	90 Days	Initial	30 Days	60 Days	90 Days	30 Days	60 Days	90 Days	Initial	30 Days	60 Days	90 Days
T1	Pomegranate Juice (500 ml) + Sugar (100g) + Yeast (1g)	11.52	8.43	6.13	5.72	6.15	6.2	6.24	3.52	3.44	3.22	2.87	0.74	0.78	0.83	1.45	1.44	1.33	1.28
T2	Pomegranate Juice (500 ml) + Sugar (100g) + Yeast (2g)	14.31	9.12	8.76	7.74	5.68	5.74	5.78	3.02	3.22	3.15	3.07	0.64	0.68	0.71	1.57	1.51	1.46	1.32
T3	Pomegranate Juice (500 ml) + Sugar (150g) + Yeast (1g)	13.83	10.51	8.22	7.8	6.03	6.22	6.56	3.45	3.33	3.24	3.12	0.61	0.64	0.67	1.56	1.46	1.31	1.21
T4	Pomegranate Juice (500 ml) + Sugar (150g) + Yeast (2g)	12.44	11.5	10.64	9.11	6.34	6.97	7.25	3.51	3.41	3.37	3.27	0.53	0.57	0.61	1.52	1.43	1.33	1.24
T5	Pomegranate Juice (500 ml) + Sugar (200g) + Yeast (1g)	12.51	11.1	10.76	9.55	9.16	9.87	10.06	3.54	3.47	3.43	3.38	0.49	0.51	0.54	1.51	1.36	1.21	1.07
T6	Pomegranate Juice (500 ml) + Sugar (200g) + Yeast (2g)	14.54	13.32	11.57	10.01	10.12	10.87	11.22	3.64	3.52	3.47	3.42	0.47	0.5	0.52	1.59	1.33	1.21	1.02
T7	Pomegranate Juice (500 ml) + Sugar (250g) + Yeast (1g)	13.24	10.71	9.15	8.82	7.78	8.22	8.47	3.67	3.62	3.59	3.54	0.42	0.44	0.48	1.53	1.42	1.25	1.11
T8	Pomegranate Juice (500 ml) + Sugar (250g) + Yeast (2g)	11.47	10.32	9.21	8.52	6.84	7.28	7.49	3.76	3.71	3.66	3.61	0.35	0.39	0.42	1.48	1.28	1.36	1.13
	F-Test	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S
	C.V	0.426	0.194	0.22	0.299	0.093	0.075	0.064	5.746	0.166	0.171	0.164	1.262	0.95	1.122	0.954	5.44	1.437	3.338
	SE(d)	0.045	0.017	0.017	0.021	0.006	0.005	0.004	0.165	0.005	0.005	0.004	0.006	0.004	0.006	0.012	0.062	0.015	0.032
	C.D @ 5%	0.097	0.036	0.036	0.044	0.012	0.01	0.009	0.353	0.01	0.01	0.009	0.012	0.009	0.012	0.025	0.134	0.033	0.069

Table.2. Organoleptic score on effect of different levels of yeast and sugar for cider production from pomegranate

Treatment symbols	Treatment combination	Colour and Appearannce			Taste			Aroma			Clarity			Overall Acceptability		
		30 Days	60 Days	90 Days	30 Days	60 Days	90 Days	30 Days	60 Days	90 Days	30 Days	60 Days	90 Days	30 Days	60 Days	90 Days
T1	Pomegranate Juice (500 ml) + Sugar (100g) + Yeast (1g)	6.05	6.24	6.38	5.1	5.46	5.65	5.15	5.47	5.64	6.02	6.21	6.34	5.6	5.85	6
T2	Pomegranate Juice (500 ml) + Sugar (100g) + Yeast (2g)	6.17	6.28	6.44	5.24	5.58	5.71	5.33	5.61	5.85	6.63	6.86	7.07	5.84	6.08	6.27
T3	Pomegranate Juice (500 ml) + Sugar (150g) + Yeast (1g)	6.87	7.01	7.18	6.81	7.08	7.24	6.55	6.68	6.87	6.96	7.18	7.31	6.8	6.99	7.15
T4	Pomegranate Juice (500 ml) + Sugar (150g) + Yeast (2g)	7.12	7.26	7.4	7.21	7.35	6.91	6.32	6.56	6.71	7.02	7.21	7.48	6.92	7.09	7.13
T5	Pomegranate Juice (500 ml) + Sugar (200g) + Yeast (1g)	7.72	7.84	7.91	7.48	7.63	7.87	7.18	7.32	7.48	7.18	7.43	7.76	7.39	7.55	7.76
T6	Pomegranate Juice (500 ml) + Sugar (200g) + Yeast (2g)	7.75	7.88	8.05	7.63	7.83	8.11	7.33	7.55	7.77	7.08	7.37	7.64	7.45	7.66	7.89
T7	Pomegranate Juice (500 ml) + Sugar (250g) + Yeast (1g)	6.26	6.43	6.67	6.31	6.48	6.75	6.77	6.95	7.17	6.83	7.11	7.23	6.54	6.74	6.95
T8	Pomegranate Juice (500 ml) + Sugar (250g) + Yeast (2g)	6.44	6.42	6.73	6.48	6.63	6.97	7.54	7.79	8.05	6.06	6.28	6.44	6.63	6.78	7.05
F-Test		S	S	S	S	S	S	S	S	S	S	S	S	S	S	S
C.V		0.097	0.078	0.078	0.09	0.084	5.927	0.09	0.084	0.086	0.087	0.082	0.078	6.614	6.191	5.95
SE(d)		0.005	0.004	0.005	0.005	0.005	0.334	0.005	0.005	0.005	0.005	0.005	0.005	0.311	0.3	0.296
C.D @ 5%		0.012	0.009	0.01	0.01	0.01	0.715	0.01	0.01	0.01	0.01	0.01	0.01	0.646	0.622	0.614

Fig 1. Change in T.S.S of pomegranate cider during storage storage

Fig 2. Change in alcohol content of pomegranate cider during

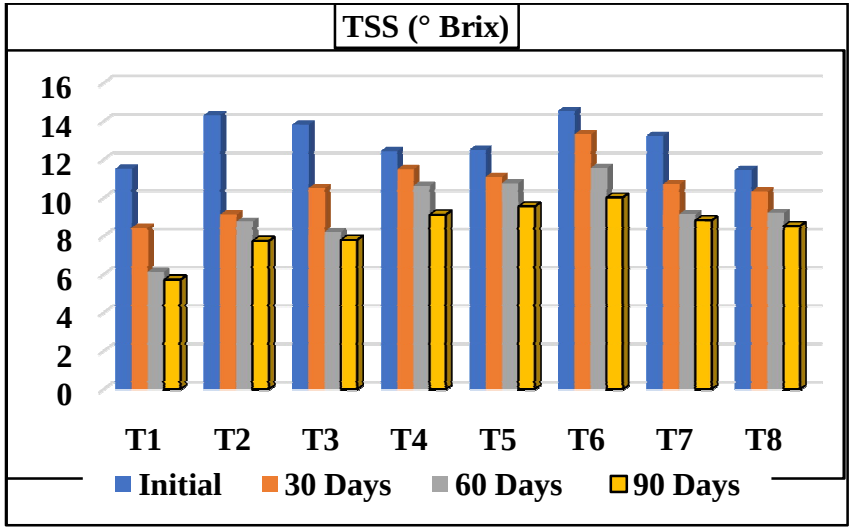


Fig 3. Change in acidity content of pomegranate cider during storage

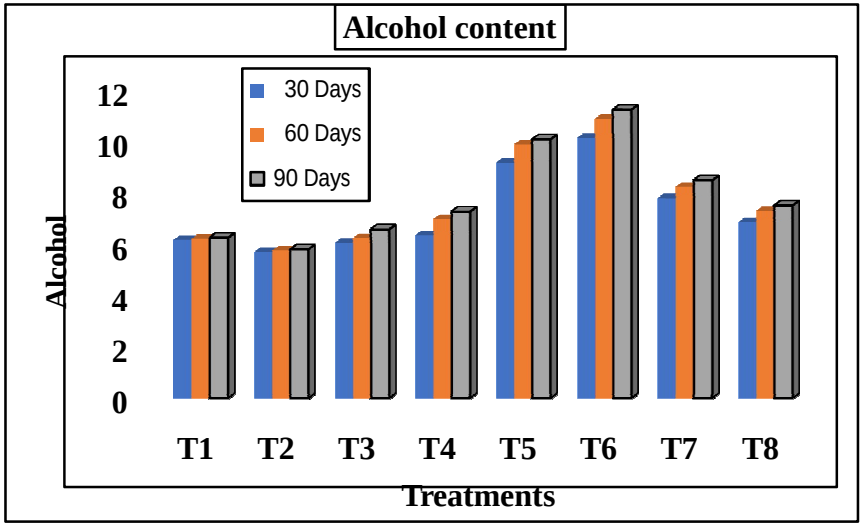


Fig. 4. Change in pH of pomegranate cider during storage

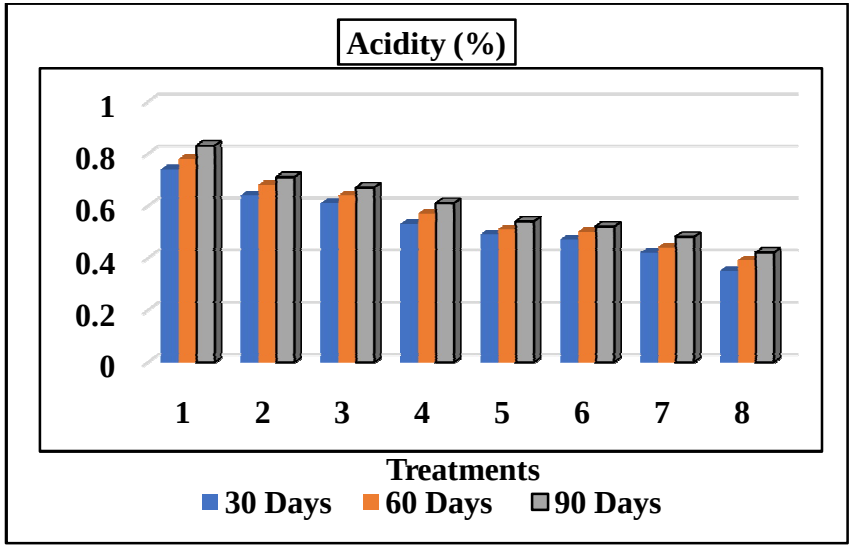


Fig 5. Change in specific gravity of pomegranate cider during storage

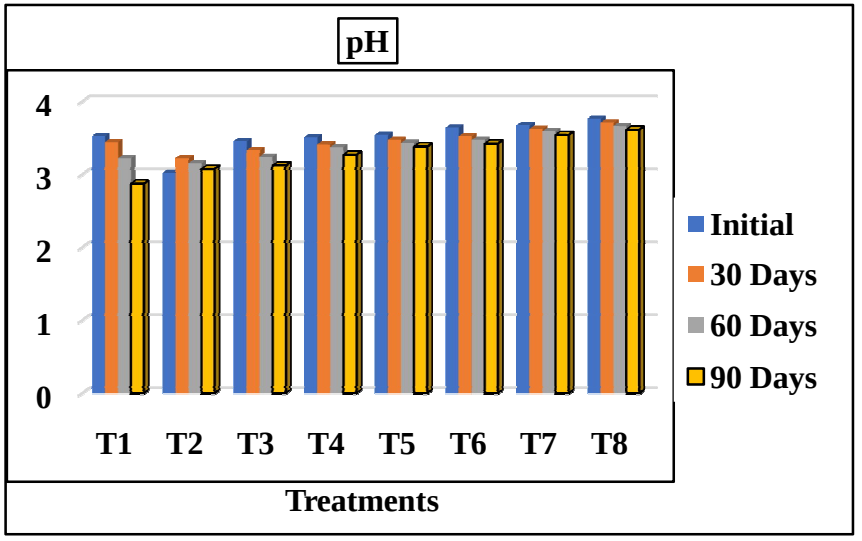


Fig 6. Organoleptic Score for Colour and Appearance

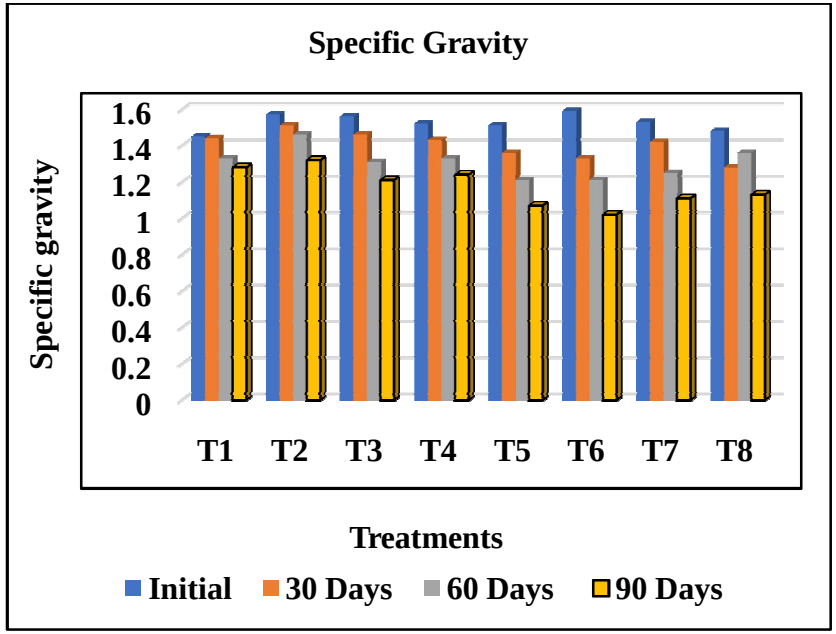


Fig 7. Organoleptic Score for taste

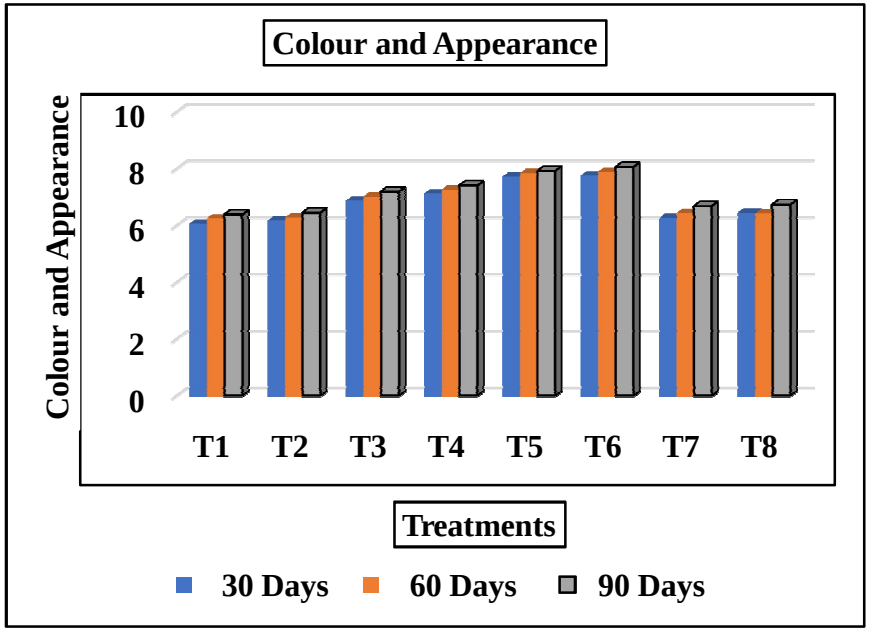


Fig 8. Organoleptic Score for aroma

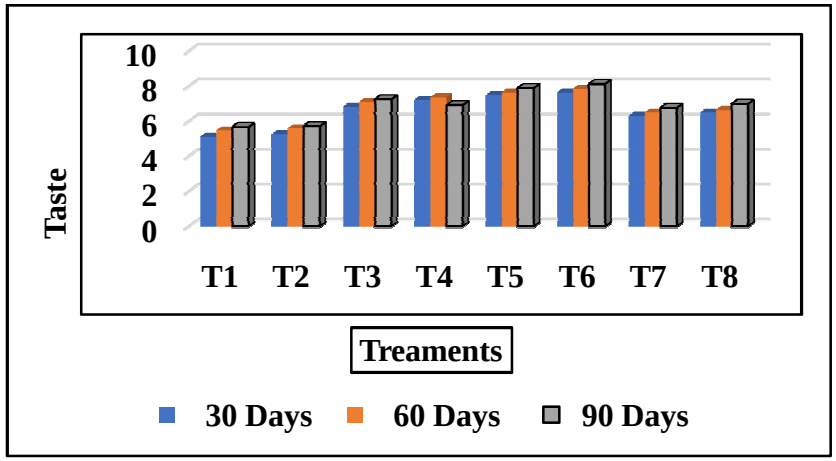


Fig 9. Organoleptic Score for clarity

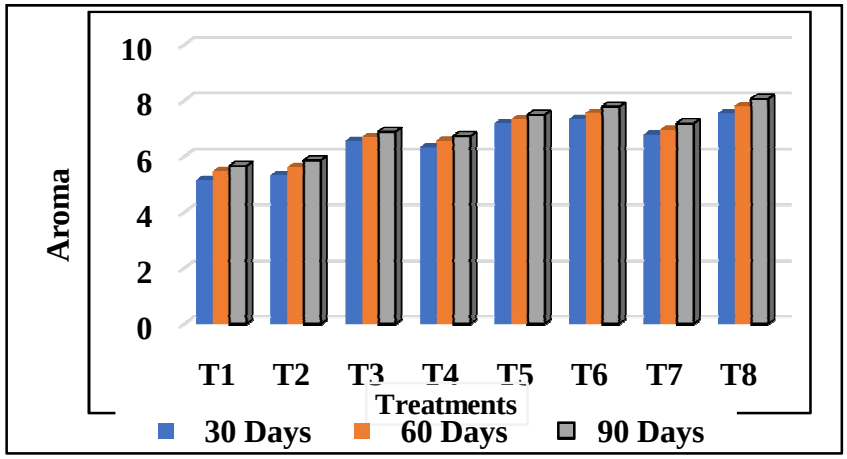
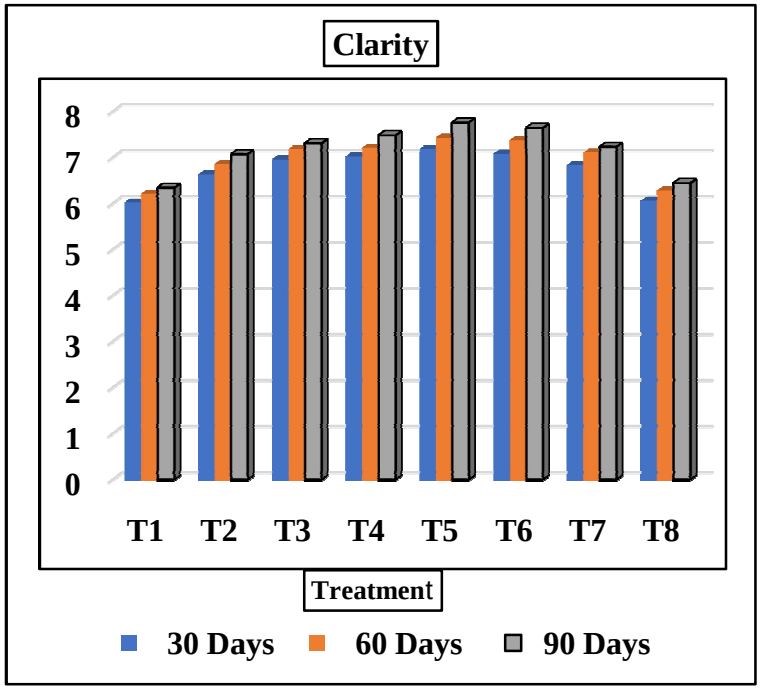
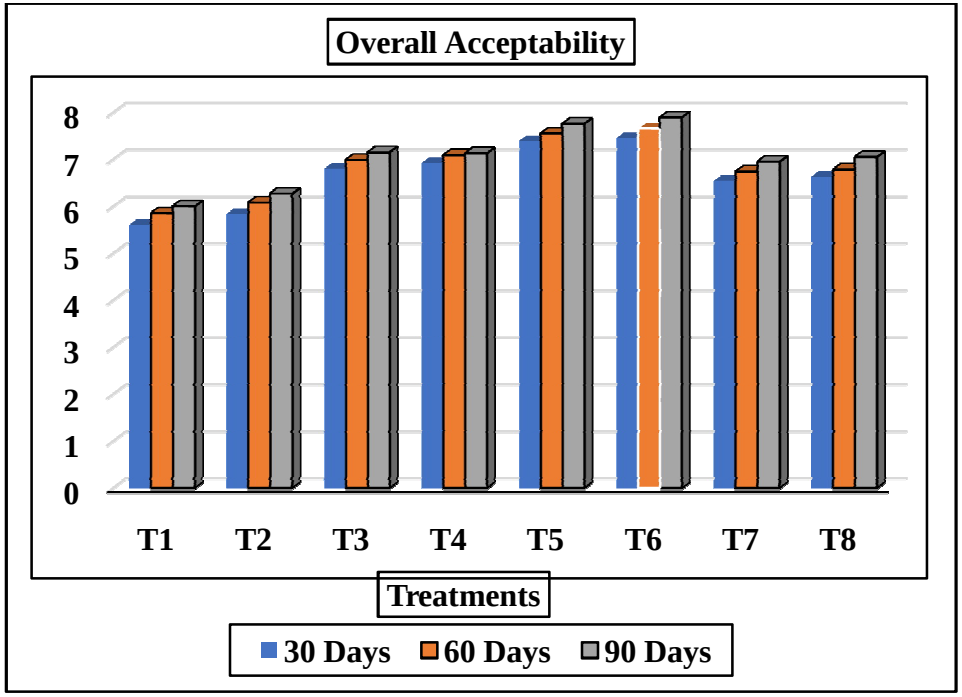


Fig 10. Organoleptic Score for Overall Acceptability of pomegranate cider


Clarity
8
7
6
5
4
3
2
1
0
T1
T2
T3
T4
T5
T6
T7
T8
Treatment
30 Days
60 Days
90 Days


Overall Acceptability
8
7
6
5
4
3
2
1
0
T1
T2
T3
T4
T5
T6
T7
T8
Treatments
30 Days
60 Days
90 Days

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