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Effect of Different Levels of Yeast on Physico-chemical and Sensory Properties of Guava (*Psidium guajava* L.) Cv Allahabad Safeda Cider during Storage

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

The study was carried out at the Post Harvest Technology, Department of Horticulture, SHUATS, Prayagraj (Uttar Pradesh) during the year 2021 - 2022. The study consisted of 6 different treatments and control comprising the T_0 Guava juice (1L) + yeast (0), T_1 Guava juice (1L) +yeast (0.5gm), T_2 Guava juice (1L) +yeast (1gm), T_3 Guava juice (1L) + yeast (2gm), T_4 Guava juice (1L) + yeast (3gm), T_5 Guava juice (1L) + yeast (4gm), T_6 Guava juice (1L) + yeast (5gm). Guava juice was fermented using *Saccharomyces cerevisiae.* This investigation was laid out in a completely randomized design with three replications. The cider was tested for the physico-chemical changes after preparation, and sensory evaluation was done based on the 9-point hedonic scale tested on a panel of 5 experts. This cider was stored for about 120 days at room temperature. From storage studies, it was revealed that T_1 Guava juice (1L) +yeast (0.5 gm) is most suitable in terms of their physicochemical properties and organoleptic test of cider. The effect of storage on physico-chemical and organoleptic characteristics was also observed.

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1. INTRODUCTION

Guava (*Psidium guajava L*.) is one of the most important commercial fruit crops of India [1]. Guava belongs to the family Myrtaceae and it is native to tropical America (Neotropics), it is cultivated in all tropical and subtropical countries [2].

It possesses a high nutritive value as it is a good source of carbohydrates, minerals, iron, calcium and phosphorous. It is rich in dietary vitamin C with moderate levels of folic acid. Having a generally low-calorie profile of essential nutrients a single common guava fruit contains four times the amount of vitamin C [3].

Fermented guava beverage is the product of anaerobic fermentation by yeast in which the sugars are converted into alcohol and carbon dioxide. Fermented guava beverage production from guava pulp or juice is reported by [4].

The alcoholic fermentation is characterized by the conversion of sugar into ethanol by yeast, especially the *Saccharomyces cerevisiae* strain of fungi is used for alcoholic fermentation. Currently, most of the wine process is done by *Saccharomyces cerevisiae* strain because of reliable and rapid fermentation. The yeast eats all sugar inside the vat of cider and turning it into alcohol and carbon dioxide. Once, the whole sugar inside the cider is converted, the yeast die due to lack of food and fermentation is stopped [5,6].

Cider is considered to be a pleasant, refreshing, thirst-quenching, and hygienic beverage. It is also highly nutritive and health-giving among all the fermented drinks. Besides, it is said to possess remarkable therapeutic properties like the prevention of stone formation in the bladder on account of its diuretic properties [7]. Cider is produced all over the world and consumed throughout the European countries [8].

Cider making process includes various steps such as harvesting fruit, sweating, washing, grinding, pressing, blending, testing, fermentation, racking off, filtering or fining, bottling, and storage [9].

Guava fruits have been used for the preparation of various products and methods have been adopted for processing such as juices, jams, wine, concentrate, preserves, canned products, sweets, jellies, etc. In India, cider production is in its infancy, although there has been considerable research on its various aspects, especially in the context of the Indian scenario as has been documented [9]. Ready-to-serve guava beverage is quite popular in the market. However, unlike apple, its cider is not yet available. Besides apple, there are reports of cider preparation from pear, peach, and raspberry also. However, no such drink has been prepared from guava commercially, which has got low alcohol content and high nutritional value. Since India is one of the major producers of guava, using a part of this product from the development of mild fermented guava cider would be a profitable strategy.

2. MATERIALS AND METHODS

The study was conducted in Completely Randomized Design (CRD) with 6 treatments and control (T_0) replicated thrice. The treatments were T_0 Guava juice (1L) + yeast (0), T_1 Guava juice (1L) +yeast (0.5gm), T_2 Guava juice (1L) +yeast (1gm), T_3 Guava juice (1L) + yeast (2gm), T_4 Guava juice (1L) + yeast (3gm), T_5 Guava juice (1L) + yeast (4gm), T_6 Guava juice (1L) + yeast (5gm).

2.1 Raw Material and Extraction of Juice

Healthy uniform size guava (*Psidium guajava* L.) Cv. Allahabad Safeda free from diseases, pests, and bruises was randomly selected and brought from a local market. After washing, the fruits were cut into small pieces and crushed and the must be obtained was filtered through muslin cloth which was stored in glass bottles after inoculating. The methods of Amerine and Kunkee as used by Robinson were used.

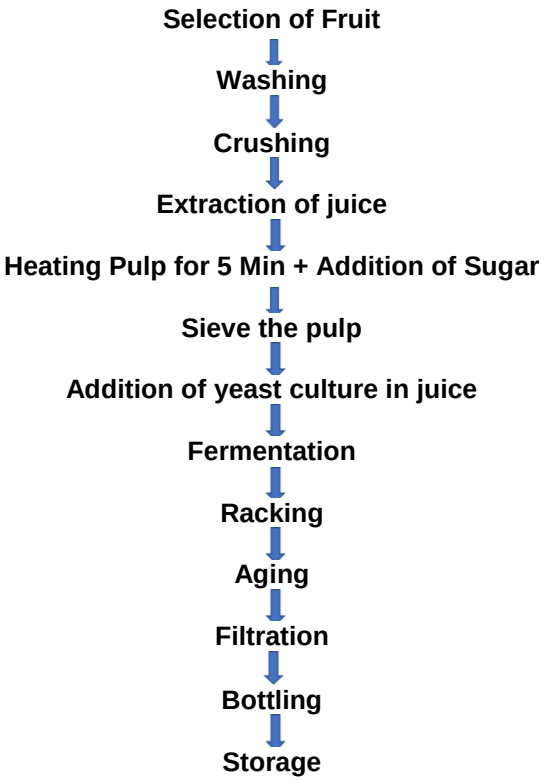
2.2 Yeast and Inoculum Preparation

Saccharomyces cerevisiae was obtained from the market. The inoculum was prepared by inoculating 0.5g, 1g, 2g, 3g, 4g, and 5g brewer's yeast was added to 10ml of lukewarm water in separate beakers according to treatments and stirred gently. The activated *Saccharomyces cerevisiae* was added to the pulp according to the treatments respectively.

2.3 Preparation of Cider

Cider was prepared with different concentrations of *Saccharomyces cerevisiae*. Steps of preparation are given below.

Chart 1: Preparation of Cider



2.4Physico-chemical and Organoleptic Characteristics

The cider was tested for the physico-chemical changes after preparation and during storage room conditions. pH of the product was determined using a digital pH meter, TSS using a hand refractometer, titrable acidity using the titrimetric method, alcohol content and specific gravity by hydrometer, whereas ascorbic acid was determined by titrating the product against 2, 6-dichlorophenol indophenol indicator (A.O.A.C, 1990). Sugars were estimated by Lane and Enyo's method (1923) in terms of sugar. The product was evaluated for colour, flavour, aroma and overall acceptability.

2.5 Statistical Tools

Microsft Excel 2007 was used for statistical analysis at 95% confidence level.

3. RESULTS AND DISCUSSION

3.1 pH

The pH dropped gradually as the fermentation time increases. The variation observed was due to the effect of different concentrations of yeast and the fermentation period. Studies have shown that during the fermentation of fruits, low pH is inhibitory to the growth of spoilage organisms but creates a conducive environment for the growth of desirable organisms. Also, low pH and high acidity are known to give fermentation yeast a comparative advantage in the natural environment Medina et al. (2006). It can be observed from the table 1 that in terms of pH, the lowest score of pH was observed in treatment T_6 (Guava juice+ 5gm yeast) ranging from 4.58 to 3.18 followed by treatment T_5 (Guava juice+ 4gm yeast) with 4.71 to 3.41, whereas the maximum score was observed in treatment T_0 (Guava juice+0 gm) with 5.40 to 4.13 The pH decreased over the duration initial days,30,60,90 and 120 days of storage. Similar results were found in apple cider by Anjali.

3.2 TSS (^{0} Brix)

The rate of utilization of sugar depended upon the amount of yeast added it increased the rate of fermentation. The decrease in the TSS content of wine indicates the utilization of the sugar present in the must during fermentation. The above results are similar to the findings of Shankar et al. [10]. The decrease in TSS was also governed by the level of the inoculum rate (0.5 and 5 gm). From the table 1 it is observable

that Total Soluble Solids, the lowest score of TSS ranging 17.87 to 4.20^0 Brix in T_6 (Guava juice + 5gm yeast), followed by treatment T_5 ranging from 18.27 to 4.73^0 Brix, whereas the maximum score was observed in treatment T_0 (Guava+0gm yeast) with 19.93 to 13.77^0 Brix during Initial day,30,60,90,120 days storage.

3.3 Acidity (%)

During storage yeast produced certain organic acid, was might be the reason for the increasing acidity in guava cider. A similar finding was registered by Beera et al. [11]. In table 2 of Acidity, the lowest score of titratable acidity ranging from 0.34 to 0.67 after storage was observed in treatment T_0 (Guava juice), followed by treatment T_1 (Guava juice + 0.5gm) ranging from 0.35 to 0.69, whereas the maximum score was observed in treatment T_6 (Guava+5gm yeast) ranging 0.42 to 0.91 during the initial day,30,60,90,120 days storage.

3.4 Alcohol Content (%)

There was a slight increase in alcohol level during storage however the difference was not significant statistically Kumar (2006). There was a statistically significant decrease in ethanol production beyond the inoculum level of 9% (v/v) as more sugar was consumed by the biomass production at higher inoculum levels Kaur et al. [12]. Srivastava et al. [13] reported that 10% inoculum size added for guava pulp led to the production of 5.8% (w/v) ethanol by *S. cerevisiae*.

Table 1. Effect of yeast at different concentrations on pH and TSS during storage period

Treatments	pH					TSS				
	Storage period (days)					Storage period (days)				
	0	30	60	90	120	0	30	60	90	120
T_0	5.40	5.24	4.94	4.81	4.13	19.93	16.97	15.1	14.83	13.77
T_1	5.20	4.73	3.79	3.71	3.68	19.73	12.63	9.3	8.47	8.37
T_2	4.64	4.59	3.74	3.71	3.62	19.53	9.57	8.57	7.57	7.67
T_3	4.94	4.55	3.71	3.62	3.55	18.73	8.77	8.13	7.20	6.27
T_4	4.80	4.47	3.62	3.60	3.46	18.43	8.37	7.93	6.87	5.73
T_5	4.71	4.34	3.61	3.51	3.41	18.27	8.17	7.63	6.37	4.73
T_6	4.58	4.18	3.53	3.50	3.18	17.87	7.77	7.37	6.13	4.20
F-test	S	S	S	S	S	S	S	S	S	S
S.Ed(±)	0.182	0.056	0.017	0.007	0.042	0.300	0.806	0.415	0.413	0.303
CD @ 5%	0.394	0.122	0.036	0.015	0.091	0.091	0.084	0.076	0.090	0.657

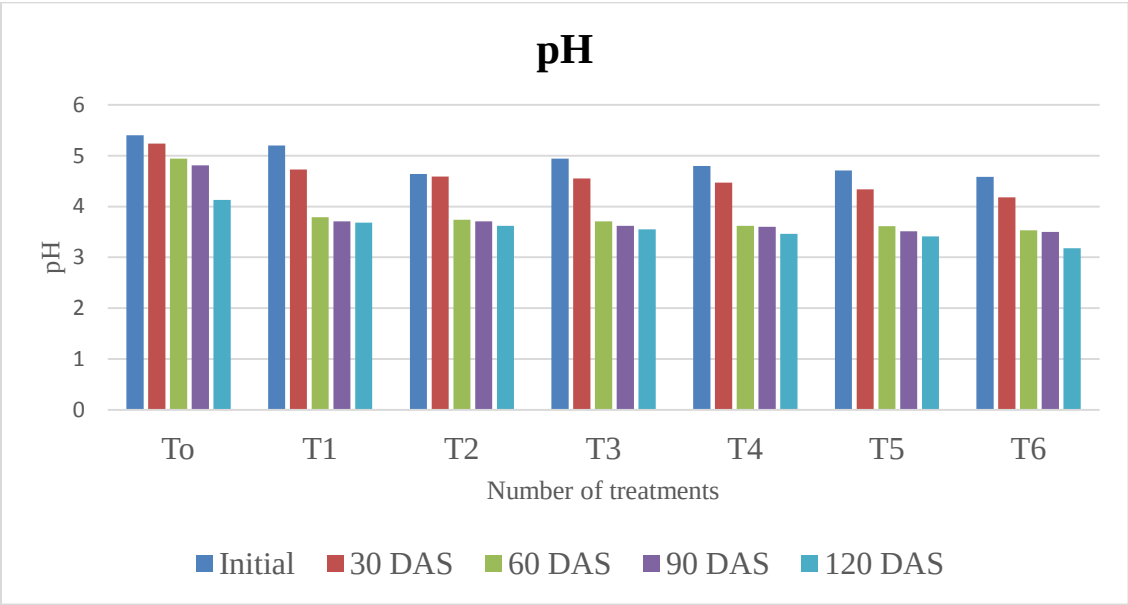


Fig. 1. Effect of different levels of yeast on pH of Guava cider during storage

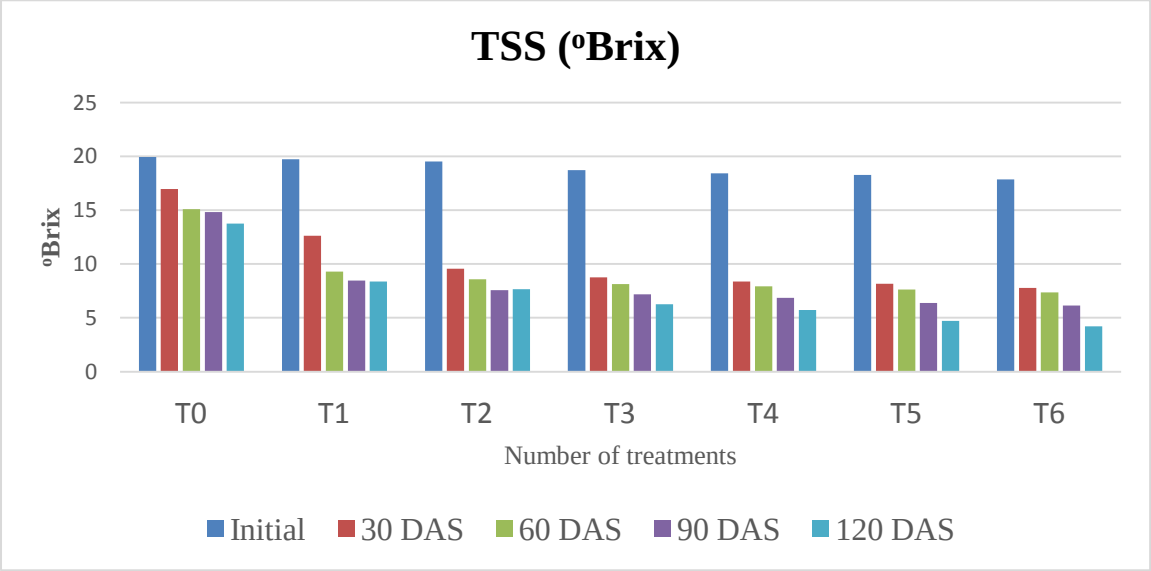


Fig. 2. Effect of different levels of yeast on Total Soluble Solids (TSS) of guava cider

Table 2. Effect of yeast at different concentrations on acidity and alcohol during storage period

Treatments	Acidity					Alcohol Content				
	Storage period (days)					Storage period (days)				
	0	30	60	90	120	0	30	60	90	120
T_0	0.34	0.41	0.59	0.62	0.67	0.03	3.50	4.73	4.83	4.83
T_1	0.35	0.42	0.61	0.66	0.69	0.06	5.70	5.90	6.10	6.07
T_2	0.36	0.43	0.63	0.67	0.71	0.06	6.30	6.37	6.27	6.27
T_3	0.38	0.45	0.64	0.71	0.75	0.20	6.60	6.70	6.73	6.73
T_4	0.38	0.48	0.67	0.75	0.77	0.26	6.17	6.80	6.87	6.90
T_5	0.40	0.52	0.71	0.79	0.85	0.33	7.70	8.43	8.43	8.43
T_6	0.42	0.57	0.74	0.81	0.91	0.43	8.57	9.07	9.13	9.10
F-test	S	S	S	S	S	S	S	S	S	S
S.Ed(±)	0.008	0.009	0.010	0.009	2.93	0.06	0.33	0.09	0.12	0.11
CD @ 5%	0.01	0.02	0.02	0.02	6.43	0.13	0.72	0.20	0.25	0.23

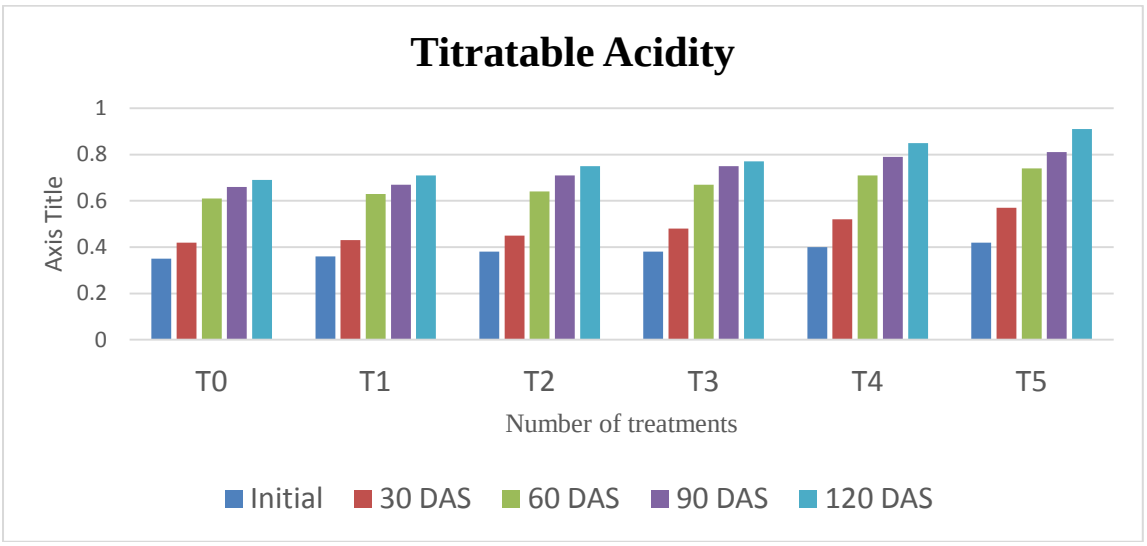


Fig. 3. Effect of different levels of yeast on titratable acidity of guava cider during storage

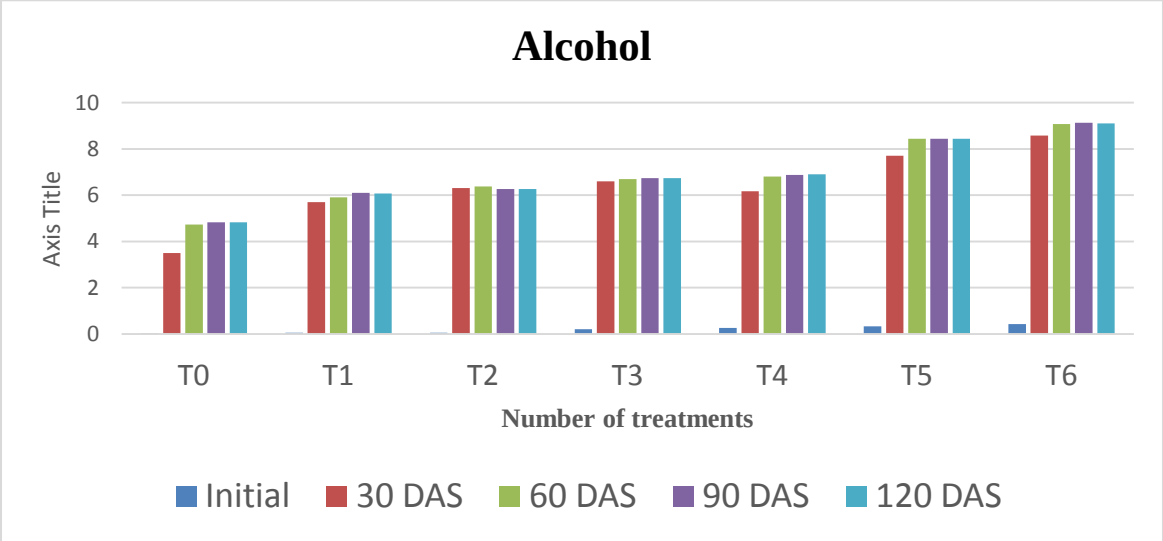


Fig. 4. Effect of different levels of yeast on alcohol content in guava cider during cider

Table 3. Effect of yeast at different concentration on ascorbic acid and overall acceptability during storage period

Treatments	Ascorbic Acid					Overall Acceptability		
	Storage period (days)					Storage period (days)		
	0	30	60	90	120	60	90	120
T_0	117.9	103.1	80.5	72.3	82.2	7.3	7.4	7.5
T_1	166.5	137.1	111.4	100.1	91.9	7.7	8.0	8.2
T_2	150.7	110.7	100.6	97.2	87.6	6.5	7.5	7.5
T_3	72.8	69.4	70.3	66.1	65.6	6.1	6.2	6.9
T_4	59.8	56.2	54.5	54.1	54.2	6.0	5.8	6.3
T_5	67.2	62.9	61.4	50.0	58.1	5.2	5.7	5.7
T_6	57.5	48.6	40.6	43.8	40.4	4.9	4.9	5.3
F-test	S	S	S	S	S	S	S	S
S.Ed(±)	7.35	5.26	5.39	3.55	2.96	0.47	0.35	0.51
CD @ 5%	15.92	11.39	11.68	7.69	6.43	1.03	0.76	1.11

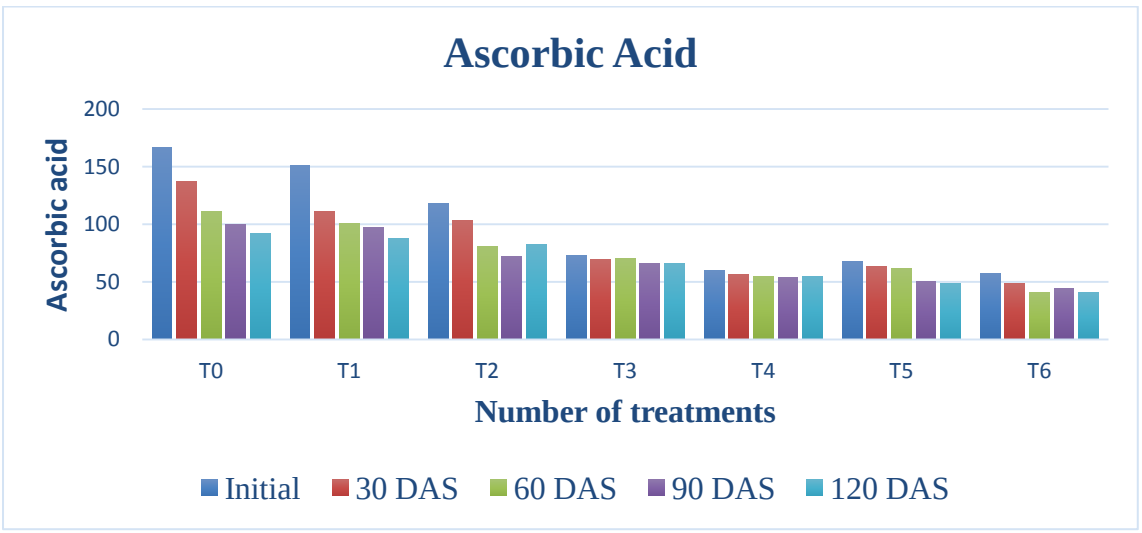


Fig. 5. Effect of different levels of yeast on ascorbic acid content in guava cider

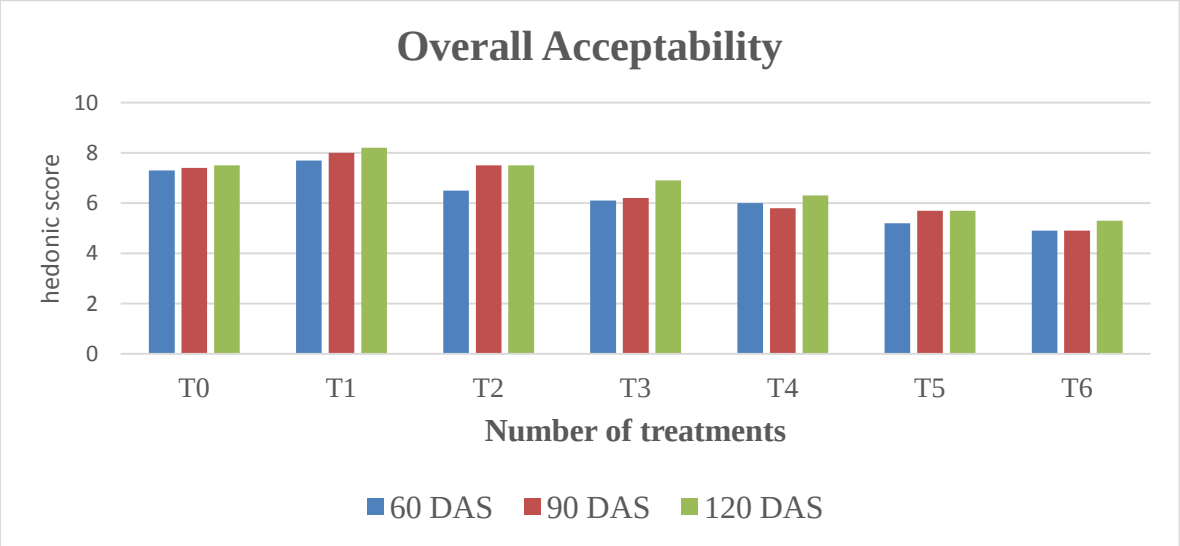


Fig. 6. Effect of different levels of yeast on Overall acceptability of cider during storage

In Table 2 of Alcohol content (%), the highest score of Alcohol content ranging from 8.57 to 9.10 was observed in treatment T_6 (Guava juice + 5gm) followed by treatment T_5 (Guava juice + 4gm) 7.70 to 8.4, whereas the minimum score was observed in treatment T_0 (Guava juice+ 0gm) ranging 3.5 to 4.83 during initial days,30,60,90,120 days storage.

3.5 Ascorbic Acid (mg/100g)

The decrease was significantly higher in all the treatments during storage. Heat destruction and oxidation was might be the reason for ascorbic acid reduction during the storage period. Yadav et al. [14] observed that the ascorbic acid content was decreased from 1.26 mg/100g to 1.19 mg/100g in mahua vermouth during one year of maturation. Loss of ascorbic acid during storage of fruit wines was reported by Patras et al. [15]. In Table 3 of Ascorbic Acid (%) The highest score of ascorbic acid ranging from 166.5 to 91.90 was observed in treatment T_1 (Guava juice + 0 gm) followed by treatment T_2 (Guava juice + 1 gm) ranging from 150.78 to 87.60, whereas the minimum score was observed in treatment T_6 (Guava juice+5gm) with 57.5 to 40.4 during initial,30,60,90,120 days storage.

3.6 Specific Gravity

The specific reduces as the fermentation days of cider increase. The decrease in specific gravity with different yeast levels is due to different concentrations of sugar availability. *Saccharomyces cerevisiae* has been reported to reduce the specific quality of fruit wines during fermentation. The above results are similar to the findings of Amerine et al. (2005). The specific gravity of the cider was recorded, the highest was found in T_0 (1.075) followed by T_1, T_2, T_3, T_4, and T_5 Whereas the lowest score was observed in treatment T_6 (1.035) during storage. This could be observed from Table 3.

3.7 Organoleptic Evaluation

In the organoleptic evaluation such as color and appearance, taste, aroma, and overall acceptability. From the Table 3 the Sensory scores for treatment (T_1 Guava juice (1L) + yeast (0.5gm)) were found to be highest in all parameters of organoleptic attributes. The highest overall acceptability score (8.2) indicated that it was well-received by the judges.

4. CONCLUSION

The above study demonstrated that the strain *Saccharomyces cerevisiae* is capable for guava cider production. It can be concluded that alcohol production increased with increasing in inoculum level. After comparing the overall result in this study, the treatment of T_1 Guava juice (1L) +yeast (0.5gm) was found most suitable treatment in terms of physico-chemical properties i.e., pH (3.68), total soluble solids (8.37), titrable acidity (0.69), alcohol content (6.07) and ascorbic acid (87.60) and organoleptic test overall acceptability (8.2).

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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