

Original Research Article

Effect of different levels of cider, baker yeast (*Saccharomyces cerevisiae*) and Hamei ((Bacteria (*Bacillus sp.*), fungi (*Aspergillus niger van Tiegh.*) and the yeast (*Saccharomyces cerevisiae*)) on pineapple cider.

Abstract

The experiment was laid out in CRD (Complete Randomized Design) with 8 treatments replicated thrice. The pineapples were fermented by using two different kinds of yeast, baker yeast (*Saccharomyces cerevisiae*) and Hamei (Bacteria (*Bacillus sp.*), fungi (*Aspergillus niger van Tiegh.*) and the yeast (*Saccharomyces cerevisiae*) for 30 days. Longer fermentation times resulted in higher levels of alcohol, acidity, and sensory characteristics, but lower levels of total soluble solids, pH, and specific gravity were observed. Cider is a fermented product, produced from fruit juices, which increases juice's shelf life. In this experiment, Hamei and baker yeast were used to make pineapple cider. Treatment T₅ (Pineapple pieces (700 g) + Sugar (300g) + Hamei (0.5g) + Water (1L) produced the best cider among all the treatments in terms of alcohol content (7.00), pH (3.90) and total soluble solids (4.90 Brix).

Keywords: Pineapple, Cider, *Saccharomyces cerevisiae*, Hamei (Bacteria (*Bacillus sp.*), fungi (*Aspergillus niger van Tiegh.*) and the yeast (*Saccharomyces cerevisiae*), Fermentation, Alcohol Content.

INTRODUCTION

The pineapple (*Ananas Comosus*), a prominent member of the Bromeliaceae family, has around 2,000 species, most of which are epiphytic and many and stunningly attractive and its colour ranges from virtually white to yellow (**Morton, 1987**). Pineapples contain good sugar proportion which makes it suitable for wine making (**Adaikan and Ganesan, 2004**).

A brief account of my study, the variety of pineapple was used in my project is given below: -

Queen: Its fruits are rich yellow in colour, weighing 0.9- 1.3 kg each. The flesh is deep golden yellow, less juicy than Kew, crisp textured with a pleasant aroma and flavour. Eyes are small and deep, requiring a thicker cut when removing the skin. The leaves are brownish-red, shorter and very spiny.

Originally, Cider used to be prepared from apple juice only that is consumed after a minimum 3-month fermentation period. There are two main types of cider, sparkling and natural, depending on the addition of sugars and CO₂ (**Picinelli et al., 2000**). As a refreshing and versatile drink, cider has emerged as a popular choice among consumers seeking an alternative to traditional alcoholic beverages.

In recent years, the global cider industry has witnessed remarkable growth and variations, both in terms of production volume and market demand. This surge in popularity has sparked an increasing interest in understanding the intricacies of cider production, its cultural significance, and the factors driving its consumption patterns.

Fermentation is a viable technique in the development of new products with modified physio-chemical and sensory qualities especially flavour and nutritional components. Alcohol, acetic and lactic acid fermentations are important for quality in production. Out of these, alcoholic fermentation is widely employed for the preparation of beverages in which alcohol is major constituent. Fermented beverages have been known to mankind from time immemorial. An alcoholic beverage is a drink that contains ethanol.

Fruit wines and ciders are undistilled alcoholic beverages usually made from apples, grapes or other fruits such as pear, pineapple, Bael etc. which are nutritive, more tasty and mild stimulants. These fruits undergo a period of fermentation and ageing. They usually have an alcohol content ranging between 5 to 13 percent. Wines and ciders made from fruits are often named after the fruits. No other drinks, except water and milk have earned such universal acceptance and esteem throughout the ages as has wine and ciders. Both wine and ciders are a food with a flavour like fresh fruit which could be stored and transported under the existing conditions.

Being fruit based fermented and undistilled product, wine contains most of the nutrients present in the original fruit juice. The nutritive value of cider is increased due to release of amino acids and other nutrients from yeast during fermentation. Cider contains 4 to 12 per cent alcohol and 2 to 3 per cent sugar with energy value 208 kcal per 100 mL.

Wine and cider making involves mainly three categories of operations, viz: pre-fermentation, fermentation and post fermentation operations (**Iland *et al.*, 2000; Jackson, 2000; Ribéreau-Gayon *et al.*, 2000**). In the case pre-fermentation involves crushing the fruit and releasing juice. Fermentation involves a reaction that converts the sugars in the juice into alcohol and carbon dioxide. Yeasts utilise the sugars during the fermentation period. A stuck fermentation occurs when yeasts do not completely utilise the available sugar and the rate of fermentation slows down and/or ceases.

Clarification may be achieved by racking, filtration and/or centrifugation. Post fermentation practices are done after fermentation has reached the desired stage or when fermentation is complete. Here, wine is racked off the yeast lees, usually in stainless steel vessels or in oak barrels. Wine and ciders undergo continued changes during maturation and at an appropriate stage; the wine is filtered and bottled (**Swami *et al.*, 2014**).

For fermentation, commercial yeast *Saccharomyces cerevisiae* **Instant Dry Yeast (Four Season)** (from Kothari Fermented and Biochem Ltd, Community centre Saket, New Delhi-110017) and Hamei ((Bacteria (*Bacillus sp.*), fungi (*Aspergillus niger van Tiegh.*) and the yeast (*Saccharomyces cerevisiae*)) from Sekmai, Manipur) was used. (**Walker GM and Stewart GG (2016); P K Singh and K I Singh (2006)**)

This study aimed to study the effect of different levels of cider, baker yeast (*Saccharomyces cerevisiae*) and Hamei ((Bacteria (*Bacillus sp.*), fungi (*Aspergillus niger van Tiegh.*) and the yeast (*Saccharomyces cerevisiae*)) on pineapple cider. And to estimate the economics of various treatments.

MATERIALS AND METHODS

The experimental entitled “**Effect of different levels of cider, baker yeast and Hamei on pineapple cider**” was conducted Post- Harvest Laboratory, Department of Horticulture, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj, Uttar Pradesh.

The completely randomised block design (CRBD) by **Panase and Sukhtme (1984)** was statistically analysed using the analysis of variance (ANOVA) method. Using the critical difference (C. D. at 5%) threshold of significance, the overall significance of differences

between the treatments was examined. A window-based computing tool called OPSTAT was used to statistically analyse the results (Sheoran, 2004).

Table 1: Treatment details.

SL.	TREATMENT SYMBOL	DETAILS OF TREATMENT COMBINATION
1.	T ₁	Pineapple pieces (700g) + Sugar (300g) + Baker yeast (0.5g) + Water (1L)
2.	T ₂	Pineapple pieces (700g) + Sugar (300g) + Baker yeast (1g) + Water (1L)
3.	T ₃	Pineapple pieces (700 g) + Sugar (300g) + Baker yeast (1.5g) + Water (1L)
4.	T ₄	Pineapple pieces (700 g) + Sugar (300g) + Baker yeast (2g) + Water (1L)
5.	T ₅	Pineapple pieces (700 g) + Sugar (300g) + Hamei (0.5g) + Water (1L)
6.	T ₆	Pineapple pieces (700 g) + Sugar (300g) + Hamei (1g) + Water (1L)
7.	T ₇	Pineapple pieces (700 g) + Sugar (300g) + Hamei (1.5g) + Water (1L)
8.	T ₈	Pineapple pieces (700 g) + Sugar (300g) + Hamei (2g) + Water (1L)

***Water was sterilised before adding.**

****Baker yeast contains (*Saccharomyces cerevisiae*)**

*****Hamei contains Bacteria (*Bacillus sp.*), fungi (*Aspergillus niger van Tiegh.*) and the yeast (*Saccharomyces cerevisiae*).**

Raw material preparation:

Fruits were cleaned, cut, weighed, and processed as must when they were at their healthiest and best stage for wine production. Commercial cider yeast *Saccharomyces cerevisiae* **Instant Dry Yeast (Four Season)** (from Kothari Fermented and Biochem Ltd, Community centre Saket, New Delhi-110017) and Hamei ((Bacteria (*Bacillus sp.*), fungi (*Aspergillus niger van Tiegh.*) and the yeast (*Saccharomyces cerevisiae*)) from Sekmai, Manipur) was used in fermentation.

Activation of yeast:

The baker yeast and local yeast were activated by putting yeast into Luke warm water. After some minute it show bubble like structure and make little sound, and that's the point where the yeast is ready to inoculate.

Fermentation:

With the addition of the starting culture, the main fermentation was started. Every day, following a one-day break, the must was stirred. A tube was introduced into a clean bottle containing clean water to perform the secondary fermentation in an airtight container. The most important thing was to keep an eye on the fermenting process. This was permitted until the fermentation process was complete, which was indicated by the absence of bubbles in the container, which often happened after weeks. The fermentation process lasted 30 days. When fermentation was complete, the cider was quickly racked off the lees to ensure minimal oxygen exposure. The upper liquid was then transferred to a different, clean container to filter out any contaminants. At the completion of the secondary fermentation, the cider's microbial analysis, alcohol, sugar content, specific gravity, titratable acidity, and pH were all measured.

Clarification of cider:

After fermentation was finished, the cider was extracted, filtered through a clean, sterile muslin cloth, Whatman No. 1 filter paper, sieve, and syphon tubes sterilised with 70% alcohol, and then stored in sterile glass jars. For three weeks, the cider was racked in order to clarify it. Before doing further chemical analysis, the residues were eliminated and the filtrates were given time to develop. Due to the presence of sediments in fermented cider, clarification is a crucial step in the manufacture of cider

Packaging and preservation:

For storage and marketing, the mature cider should be packaged in hygienic containers. Glass bottles are excellent for packaging since they are simple to maintain. To significantly lower the microbe burden, the bottles that the cider will be put in should be sterilised.

RESULT AND DISCUSSION**Total Soluble Solid:**

In accordance to the TSS, all of the storage treatments differed significantly from one another. At various times, the TSS content decreased. The lowest score of TSS (18.50 and 4.90 °Brix) at Initial and 30 days after storage was observed in treatment T₅ (Pineapple pieces (700 g) + Sugar (300g) + Hamei (0.5g) + Water (1L)), whereas the maximum score was observed in treatment T₃ (Pineapple pieces (700 g) + Sugar (300g) + Baker yeast (1.5g) + Water (1L)) with (19.13 and 5.30 °Brix) at initial and 30 days after storage. **Given in table no. 2.**

During storage, the total soluble solids concentration of pineapple cider decreased. With increasing cider levels, the total soluble solids content of pineapple cider decreases. The presence of yeast and sugar in storage may be owing to the fermentation of sugars into alcohol by the activity of yeast. TSS decreased as time passed, which was clearly due to yeast fermentation of sugar. This is common fermentation behaviour in any alcoholic fermentation of fruit juice into cider. The higher alcohol production inhibits the activity of yeast in the medium thus exerting inhibitory effect on the fermentation ability (**Nishino *et al.*, 1985; Joshi *et al.*, 1999**). The TSS levels in cider are declining, which shows that the sugar used for fermentation was used.

Acidity:

Acidity is important in assessing cider quality since it aids in fermentation and improves the overall qualities and balance of the cider. Due to its direct and indirect effects on cider quality, acidity is a further essential factor (**Clarke and Bakker, 2004**). According to **Berry (2000)**, a lack of acidity will result in a poor fermentation. The Acidity (%) proved that there were substantial variations between all treatments during storage. Afterward, the acidity increased throughout various storage times. The lowest score of Acidity (0.39 and 0.44) at initial and 30 days after storage was observed in treatment T₃ (Pineapple pieces (700 g) + Sugar (300g) + Baker yeast (1.5g) + Water (1L)), whereas the maximum score was observed in treatment T₄ (Pineapple pieces (700 g) + Sugar (300g) + Baker yeast (2g) + Water (1L)) with (0.38 and 0.82) during initial and 30 days storage. Given in **table no. 2**.

During storage, all pineapple ciders' acidity showed an increasing trend. A reduction in pH occurred along with a rise in titratable acidity. The rise in acidity of pineapple cider with varied amounts of cider yeast during storage might be due to the action of different yeast strains and fermentation periods. According to **Attri (2009)**, the increase in alcohol production brought on by the high initial sugar content may be the cause of the rise in acidity. According to (**Samah *et al.*, 1992**), *S. cerevisiae* produced organic acids such citric, malic, lactic, tartaric, oxalic, and succinic acids when fermenting cocoa beans. Due to the fact that too much acidity can result in tartness and too little can result in stale and insipid cider, acid prevents the formation of spoilage bacteria and promotes the growth and activity of ciders. Contrary to what **Pratima *et al.* (2006)** observed, they found that the amount of inoculum had no impact on the TA of fermenting juice.

pH:

During storage, the pH revealed substantial changes across all treatments. At various storage times, the pH subsequently decreased. The lowest score of pH (4.79 and 3.61) at initial

and 30 days after storage was observed in treatment T₁ (Pineapple pieces (700g) + Sugar (300g) + Baker yeast (0.5g) + Water (1L)), whereas the maximum score was observed in treatment T₃ (Pineapple pieces (700 g) + Sugar (300g) + Baker yeast (1.5g) + Water (1L)) with (4.72 and 3.92) during 30 days storage.

Table no. 2 displays the cider's pH measurement results. As the fermentation period increased, the pH steadily fell. The influence of the varied yeast strain and fermentation time served as the reason for the variation that was found. According to studies, low pH during fruit fermentation inhibits the development of microbes that cause spoiling while fostering the growth of beneficial organisms. In addition, it is known that fermentation yeast has a competitive advantage in natural conditions when the pH is low and the acidity is high (**Macrae et al., 1993**). It is possible that the dissociation of parental acids and the production of hydrogen ions is what causes a decrease in pH with rise in acidity of cider. The cider's pH is influenced by the must's composition, the quantity of organic acids and sugars contained in the cider, and other factors.

Specific Gravity:

The specific gravity revealed that during storage all of the treatments were differed significantly from one another. At various storage times, the specific gravity subsequently decreased. The lowest score of Specific gravity (1.06 and 1.010) at initial and 30 days after storage was observed in treatment T₅ (Pineapple pieces (700 g) + Sugar (300g) + Hamei (0.5g) + Water (1L)), whereas the maximum score was observed in treatment T₆ (Pineapple pieces (700 g) + Sugar (300g) + Hamei (1g) + Water (1L)) with (1.07 and 1.062) at initial and 30 days storage. Given in table no. 2.

All pineapple ciders' specific gravities under storage exhibited a trend towards decline. Table no. 2 displays the outcomes of the fermentation process. As the cider's fermentation days increase, its specific gravity decreases in the study's pineapple cider. The type of yeast used to make the cider may be the cause of the drop in specific gravity of pineapple cider with various levels of cider yeast throughout storage. During the fermentation process, *Saccharomyces cerevisiae* has been observed to decrease a certain quality of fruit ciders. The findings of (**Amerine et al., 2005**), (**Robinson 2006**), (**Anon 2008**), (**Okafor 2007**), (**Idise and Ofiyai 2011**), and (**Noah et al.,2013**) are comparable.

Alcohol:

The alcohol content of fruit wine depends directly on the sugar content of the fruit, with a poor must in terms of sugar content resulting in cider with a low alcohol content. The primary

alcoholic component of cider and an index of its quality is ethanol. Due to its preservation capabilities, capacity to dissolve volatile compounds, and influence on the growth of aromatic compounds, its concentration is essential to the stability, ageing, and sensory qualities of the cider. According to the alcohol concentration, all of the storage procedures differed significantly from one another. The data given in **table no 2.** reveal that as fermentation time rose, the concentration of alcohol increased. The highest score of Alcohol content (7.00) at 30 days after storage was observed in treatment T₅ (Pineapple pieces (700 g) + Sugar (300g) + Hamei (0.5g) + Water (1L)), whereas the minimum score was observed in treatment T₄ (Pineapple pieces (700 g) + Sugar (300g) + Baker yeast (2g) + Water (1L)) with (2.181) during 30 days storage.

Throughout the storage period, the alcohol percentage of pineapple cider increased. According to **Joshi and Sharma (1995)**, the fermentation behaviour of every fruit that made wine followed a similar trend of alcohol growth or TSS decline. The rise in alcohol content of pineapple wine with various levels of wine yeast and sugar throughout storage may perhaps be caused by the variability in the yeast's capacity to use the fermentable sugars, which affects the fermentability and results in the variable alcohol production (**Amerine et al., 1980**).

Table 2: Physio-chemical parameters of pineapple cider.

Treatment Symbol	Treatment details	Total Soluble Solids (°Brix)		pH		Acidity (%)		Specific Gravity		Alcohol Content
		Initial	Final	Initial	Final	Initial	Final	Initial	Final	Final
T ₁	Pineapple pieces (700gm) + Sugar (300g) + Baker yeast (0.5g) + Water (1L)	19.30	5.03	0.41	0.61	4.79	3.61	1.07	1.03	5.25
T ₂	Pineapple pieces (700gm) + Sugar (300g) + Baker yeast (1g) + Water (1L)	19.16	5.20	0.39	0.53	4.68	3.79	1.06	1.03	4.37
T ₃	Pineapple pieces (700 gm) + Sugar (300g) + Baker yeast (1.5g) + Water (1L)	19.13	5.30	0.39	0.44	4.72	3.92	1.06	1.04	3.50
T ₄	Pineapple pieces (700 gm) + Sugar (300g) + Baker yeast (2g) + Water (1L)	19.33	5.16	0.38	0.82	4.79	3.85	1.07	1.06	2.18
T ₅	Pineapple pieces (700 gm) + Sugar (300g) + Hamei (0.5g) + Water (1L)	18.50	4.90	0.35	0.80	4.62	3.90	1.06	1.01	7.00
T ₆	Pineapple pieces (700 gm) + Sugar (300g) + Hamei (1g) + Water (1L)	18.83	5.24	0.40	0.75	4.75	3.84	1.07	1.06	2.18
T ₇	Pineapple pieces (700 gm) + Sugar (300g) + Hamei (1.5g) + Water (1L)	19.33	4.96	0.38	0.51	4.80	3.91	1.06	1.02	4.81
T ₈	Pineapple pieces (700 gm) + Sugar (300g) + Hamei (2g) + Water (1L)	19.20	5.00	0.38	0.77	4.83	3.78	1.07	1.04	3.93
F-test		S	S	S	S	S	S	S	S	S
CD		0.274	0.151	0.020	0.059	0.066	0.092	0.011	0.024	2.921
SE.(d)		0.128	0.071	0.009	0.028	0.031	0.043	0.005	0.011	1.366
CV		0.821	1.699	2.892	5.154	0.791	1.380	0.573	1.302	40.255

ORGANOLEPTIC SCORE:

Colour and Appearance:

The colour revealed that there were considerable changes between all of the treatments throughout storage. The colouring gradually improved with time. The maximum score of colour (7.940) at 30 days respectively was observed in treatment T₅ (Pineapple pieces (700 g) + Sugar (300g) + Hamei (0.5g) + Water (1L)), whereas the minimum score was observed in treatment T₆ (Pineapple pieces (700 g) + Sugar (300g) + Hamei (1g) + Water (1L)) with (4.939) during 30 days storage. Given in **table no.3**.

Taste:

The taste confirmed that every single of the treatment during storage differed significantly from one another. Taste subsequently improved during various storage times. The maximum score of Taste (8.353) at 30 days respectively was observed in treatment T₅ (Pineapple pieces (700 g) + Sugar (300g) + Hamei (0.5g) + Water (1L)), whereas the minimum score was observed in treatment T₆ (Pineapple pieces (700 g) + Sugar (300g) + Hamei (1g) + Water (1L)) with (4.240) during 30 days storage. Given in **table no.3**.

All pineapple wines throughout storage showed an increasing tendency in the flavour. A smooth, mellow flavour and a clean aroma are developed when the wine matures properly, replacing the harsh taste and yeasty odour (**Amerine *et al.*, 1980**).

Since pineapples contain significant amounts of citric acid, malic acid, and ascorbic acid, pineapple wine has a higher pH than grape wine. These acids make it less likely for wines to get contaminated, and they help improve wine's flavour. The high overall quality score seen in pineapple wine may be attributable to the juice's initial good sensory characteristics, as well as the juice's appreciable fermentation by yeast, as shown by the high alcohol concentration. Wine underwent several changes throughout maturation, some of which are beneficial to the sensory properties. White wine's body and astringency decreased as phenolic components were reduced (**Gallego *et al.*, 2013**). According to the kind and concentration, alcohol and esters, the main category of aroma compounds that account for more than 90% of the free volatiles, contribute significantly to the flavour of wine. (**Valero *et al.*, 2002**). Higher levels of ethyl alcohol, lower levels of acidity, and a smaller quantity of volatile acidity are desirable qualities from a quality standpoint, and researchers have already discovered these effects on grape fermentation (**Amerine *et al.*, 1980; Carroll, 1986**).

Aroma:

The Aroma revealed that all of the treatments differed significantly during storage. At various storage times, there was a subsequent rise in Aroma. The maximum score of Aroma (8.763) at 30 days respectively was observed in treatment T₅ (Pineapple pieces (700 g) + Sugar (300g) + Hamei (0.5g) + Water (1L)), whereas the minimum score was observed in treatment T₆ (Pineapple pieces (700 g) + Sugar (300g) + Hamei (1g) + Water (1L)) with (5.577) during 30 days storage. Given in **table no.3**.

During storage, every pineapple cider had an increasing tendency in the aroma. According to reports, the kind and scent of the cider generated during the fermentation process depends on the yeast, the environment, and the physio-chemical properties of the "musts". The harsh and yeasty aroma of the wine fades as it matures correctly, replacing it with a smooth, mellow taste and a clean aroma (**Amerine et al., 1980**). The pineapple wine's high overall quality score might be attributed to the juice's initial good sensory qualities and the juice's notable yeast fermentation, which is indicated by the juice's high alcohol level. Wine underwent several changes throughout maturation, some of which are advantageous to the sensory properties. White wine's body and astringency decreased as a result of the phenolic component reduction (**Gallego et al., 2013**). According to type and concentration, alcohol and esters—the main category of aroma compounds and accounting for more than 90% of the free volatiles—play a major role in wine flavour (**Valero et al., 2002**). Higher levels of ethyl alcohol, lower levels of acidity, and a smaller quantity of volatile acidity are desirable qualities from a quality standpoint, and researchers have already discovered these effects on grape fermentation (**Amerine et al., 1980; Carroll, 1986**).

Overall Acceptability:

All of the treatments during storage, had noticeable changes, according to the overall acceptance. At various storage times, there was a subsequent rise in overall approval. The maximum score of Overall acceptability (7.79) at 30 days respectively was observed in treatment T₅ (Pineapple pieces (700 g) + Sugar (300g) + Hamei (0.5g) + Water (1L) g), whereas the minimum score was observed in treatment T₆ (Pineapple pieces (700 g) + Sugar (300g) + Hamei (1g) + Water (1L)) with (4.413) during 30 days storage. Given in **table no.3**.

Overall, the acceptability of pineapple cider increased over storage. The pineapple wine's high overall quality score might be attributed to the juice's initial good sensory qualities and the juice's notable yeast fermentation, which is indicated by the juice's high alcohol level. Wine underwent several changes throughout maturation, some of which are advantageous to

the sensory properties. White wine's body and astringency decreased as a result of the phenolic component reduction (Gallego *et al.*, 2013). According to type and concentration, alcohol and esters—the main category of aroma compounds and accounting for more than 90% of the free volatiles—play a major role in wine flavour (Valero *et al.*, 2002). Higher levels of ethyl alcohol, lower levels of acidity, and a smaller quantity of volatile acidity are desirable qualities from a quality standpoint, and researchers have already discovered these effects on grape fermentation (Amerine *et al.*, 1980; Carroll, 1986).

Table No.3: Organoleptic score on effect of different levels of cider yeas

Treatment	Treatments combination	Final Reading			
		COLOUR AND APPEARANCE	TASTE	AROMA	OVERALL ACCEPTABILITY
T ₁	Pineapple pieces (700g) + Sugar (300g) + Baker yeast (0.5g) + Water (1L)	7.00	7.557	8.03	7.66
T ₂	Pineapple pieces (700g) + Sugar (300g) + Baker yeast (1g) + Water (1L)	5.74	6.277	7.71	6.55
T ₃	Pineapple pieces (700g) + Sugar (300g) + Baker yeast (1.5g) + Water (1L)	5.36	5.363	6.38	5.53
T ₄	Pineapple pieces (700g) + Sugar (300g) + Baker yeast (2g) + Water (1L)	5.33	5.333	6.44	5.63
T ₅	Pineapple pieces (700g) + Sugar (300g) + Hamei (0.5g) + Water (1L)	7.94	8.353	8.76	7.79
T ₆	Pineapple pieces (700g) + Sugar (300g) + Hamei (1g) + Water (1L)	4.39	4.240	5.57	4.41
T ₇	Pineapple pieces (700g) + Sugar (300g) + Hamei (1.5g) + Water (1L)	5.21	5.500	6.51	5.56
T ₈	Pineapple pieces (700g) + Sugar (300g) + Hamei (2g) + Water (1L)	4.72	5.173	5.92	6.28
F-Test		S	S	S	S
C.D.		0.426	0.307	0.415	0.332
SE(d)		0.199	0.143	0.194	0.155
C.V.		4.266	2.940	3.434	3.079

BENEFIT-COST RATIO:

The data on effect of different levels of cider, baker yeast and Hamei on pineapple cider, on benefit cost ratio are shown in **table no. 4**.

The Cost Benefit Ratio revealed that there were considerable variations between all treatments in terms of cost net return, gross return, and cost benefit ratio.

The highest Gross return of Rs.2100 is recorded in T₅ and highest Net Return of Rs.1203.15 and Cost Benefit Ratio 2.34 was recorded in treatment T₅ (Pineapple pieces (700 g) + Sugar (300g) + Hamei (0.5g) + Water (1L)), whereas lowest Gross Return Rs.960, Net Return Rs. 62.85 and Cost Benefit Ratio 1.07 was recorded in treatment T₆ (Pineapple pieces (700 g) + Sugar (300g) + Hamei (1g) + Water (1L)).

Table no. 4: Economics of different treatments and benefit cost ratio.

Treatments	Treatment details	Total cost (Rs)	Pineapple cider output	Selling rate (Rs)	Gross return (Rs)	Net return	B:C ratio
			(1ltr)	/1ltr bottle		(Rs.)	
T ₁	Pineapple pieces (700g) + Sugar (300g) + Baker yeast (0.5g) + Water (1L)	301.10	3	660	1980	1076.70	2.19
T ₂	Pineapple pieces (700g) + Sugar (300g) + Baker yeast (1g) + Water (1L)	303.35	3	550	1650	739.95	1.81
T ₃	Pineapple pieces (700 g) + Sugar (300g) + Baker yeast (1.5g) + Water (1L)	305.60	3	440	1320	403.20	1.43
T ₄	Pineapple pieces (700 g) + Sugar (300g) + Baker yeast (2g) + Water (1L)	307.85	3	440	1320	396.45	1.42
T ₅	Pineapple pieces (700 g) + Sugar (300g) + Hamei (0.5g) + Water (1L)	298.95	3	700	2100	1203.15	2.34
T ₆	Pineapple pieces (700 g) + Sugar (300g) + Hamei (1g) + Water (1L)	299.05	3	320	960	62.85	1.07
T ₇	Pineapple pieces (700 g) + Sugar (300g) + Hamei (1.5g) + Water (1L)	299.15	3	550	1650	752.55	1.83
T ₈	Pineapple pieces (700 g) + Sugar (300g) + Hamei (2g) + Water (1L)	299.25	3	440	1320	422.25	1.47

CONCLUSION

From the present investigation, it is concluded that treatment T₅ (Pineapple pieces (700 g) + Sugar (300g) + Hamei (0.5g) + Water (1L)) was found superior in terms of total soluble solids (4.90 °Brix), acidity percentage (0.80), pH (3.90), and specific gravity (1.01) and alcohol content (7.00). The highest B:C ratio was found in the treatment (T₅) with 2.34 .

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