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Development of Pineapple Juice and Observation of Shelf Stability Using Various Degrees of Preservative in Several Storage Condition

Anonnya Kundu[1], Rehnova Mostofa[1], Alamgir Hassain[1], Pratima Roy Dina[1], Mohammad Esrafil[1], Mohammad Akhter Uzzaman[2], Mohammad Abu Zubair[1, *]

[1]Department of Food Technology and Nutritional Science, Faculty of Life Science, Mawlana Bhashani Science and Technology University, Santosh, Tangail, Bangladesh

[2]Planning and Development Division, Bangladesh Atomic Energy Commission, Dhaka, Bangladesh

Email address:

kunduanonya@gmail.com (A. Kundu), nitu13nitu@gmail.com (R. Mostofa), alamgirhossain10006@gmail.com (A. Hassain), pratima074@gmail.com (P. R. Dina), esrafilmbstu@gmail.com (M. Esrafil), akhter_uzzaman@yahoo.com (M. A. Uzzaman)

[*]Corresponding author

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Abstract: Fresh pineapple juices rich in health and nutritional benefits are valued for their fresh flavor, taste, and aroma. These juices' quality however is affected by factors like temperature, and microbiological contamination significantly changing physicochemical parameters and storage stability. Pineapple processing plays an important role in juice preservation. This study was conducted to developed products from pineapple and evaluates the quality of preserved pineapple juice. Three different samples of pasteurized pineapple juices termed as without preservative (PJ-1), with preservative (sodium benzoate) 5 mg (PJ-2) and with preservative (sodium benzoate) 20 mg (PJ-3), were made which were stored in two conditions at room and refrigeration temperature up to 45 days. Results revealed that the content of moisture, ash, TSS, P^H and vitamin C of fresh pineapple juice were 87.5%, 0.31%, 11.5%, 3.49 and 3.06 mg respectively. After 21 days, the TSS of PJ-1, PJ-2, PJ-3 was decreased to 9%, 10%, 11% at room temperature and 10%, 10.5% and 11% at refrigeration temperature respectively. On the other hand, the P^H of PJ-1, PJ-2, PJ-3 was decreased to 3.47, 3.47, 3.45 at room temperature and 3.46, 3.47, 3.49 at refrigeration temperature respectively. In case of total viable bacteria, the minimum microbial load was observed in PJ-3 ($0.3x10^5$) and maximum in PJ-1 ($0.5x10^5$) at room temperature. Whereas, minimum in PJ-2, PJ-3, i.e. ($0x10^5$) and maximum in PJ-1 ($0.1x10^5$) at refrigeration temperature, after 21 days. Again, minimum microbial load was observed in PJ-3 ($0.6x10^5$) and maximum in PJ-1 ($1.0x10^5$) at room temperature. Whereas, minimum in PJ-3 ($0.1 x10^5$) and maximum in PJ-1 ($0.2x10^5$) at refrigeration temperature, after 45 days. The shelf life of preserved juice at room temperature was 21 days and in refrigeration temperature was 45 days. Among three treated juice samples PJ-2 and PJ-3 at refrigeration temperature was most effective in maintaining the sensory properties and acceptable for consumption. Pineapple bar was kept in room temperature and good for consume up to 30 days. Finally, it can be concluded that, the shelf life of preserved juice at room temperature was 21 days and in refrigeration temperature was 45 days.

Keywords: Pineapple Juice, Pineapple Bar, Sodium Benzoate, Antioxidant Properties

1. Introduction

Pineapple (*Ananas comosus*) is one of the world's preferred tropical fruits [1]. First called "anana", a Caribbean word for "excellent fruit", the name "pineapple" came from European explorers who believed the fruit looked like a "pinecone" with flesh like an apple [2]. The pineapple is the top edible member of *Bromeliaceae* which embraces about

2,000 species, mostly epiphytic and several strikingly ornamental. Christopher Columbus was the first person to host pineapples to Europe [3]. There are many cultivars of Ananas, but the prime one is 'Smooth Cayenne' [4]. Whole pineapple production global is around 16 to 18 million tons [5]. The pineapple shares the dissimilarity accorded to all major food plants of the world of having been designated, developed, and domesticated by peoples of prehistoric times and agreed on to us through earlier civilizations [6]. Pineapples are expended or served fresh, cooked, juiced and can be preserved [7]. This fruit is highly perishable and seasonal. Mature fruit holds 14% of sugar; a protein digesting enzyme, bromelain, and good magnitude of citric acid, malic acid, vitamin A and B [7]. The U.S. National Library of Medicine leans bromelain as a proteolytic digestive enzyme [8]. When unavailable with meals, bromelain reliefs in the digestion of proteins, working to break proteins down into amino acids [9]. Pineapple ranks after bananas, donating to over 20% of the world manufacture of tropical fruits [10]. It has been advised) that ideal growth temperature deceits between 20 to 30°C, and new definitely at 23 - 24°C [11]. Pineapple plants requisite sandy soils and good drainage to proscribe water logging and thus purpose-built higher beds on slopes are utilized [12]. Well drained loamy soil with great organic matter and a pH of 4.5-6.5 is best for pineapple agriculture [13]. When ambient temperature drops to 10-16 C, fruit growth is inhibited [14]. Plants may standpoint sub-freezing temperatures for very short periods [15]. Conversely, exposure to temperatures well over 30 °C heat damage may occur due to improved respiration rate and metabolism and reduced nutrient absorption [16]. Pineapple can be cast-off as additional nutritional fruit for good personal health [3]. Pineapple fruits are an excellent source of vitamin and minerals [7]. Pineapple also progresses digestion, regulates stomach acidity, aids in detoxification processes, the neutralization of free radicals and blood clots, as relief in the treatment of rheumatoid arthritis, drop of sciatica symptoms, collagen production, weight control and in the supervision of albuminuria [17]. The gums and tooth enamel are at particular risk and eating too copious pineapple may pay to gingivitis and cavities [7]. Sensory analysis showed that color, flavor, taste and appearance of preserved pineapple juice persisted outstanding up to 30 days [18]. However, pineapple production in Bangladesh is very truncated compared to that of other pineapple producing countries of the world. It also covered a very few areas of land under pineapple cultivation. There is abundant space of growing its production in the country by both increasing area as well as yield. But late and irregular flowering and dumpy harvesting season are the tricky of pineapple production and its year-round availability in Bangladesh.

2. Materials and Methods

Fresh pineapple was collected from Tangail region and were cleaned with laboratory quality water. Then it prepared by washing, pilling and sizing for juice extraction and pineapple bar.

2.1. Preparation of Pineapple Juice

For juice extraction we washed crusher machine and receive fresh pineapple juice. We firstly filtered the received pineapple juice by muslin cloth and measure the p^H value by a p^H meter. The p^H value of juice was 3.49. Then we collected the fresh juice into 200ml sealed sterilized transparent glass bottles. As a sample we added sodium benzoate as a preservative in average amount (5mg) and maximum amount (20mg) and we also collected some fresh juice without preservative. After then we pasteurized all juices with a laboratory scale pasteurizer. The juice bottles were pasteurized at 72°C for 15 minutes. After finished the pasteurization, we cooled all samples for further processing. Finally, Juice bottles were separated into two categories and one group was kept in room temperature (25°C) and another group was placed in the refrigerator (5°C). Then we analyzed various physical, chemical and microbial tests. This preservation duration was 21 days. We repeated all test after 7 days, 14 days and 21 days.

Table 1. *Specification of Pineapple Juice Samples.*

Juice Sample	Scientific Name	Sample code	Sample groups categories
Pineapple Juice	*Ananas comosus*	PJ-1	Pineapple juice without preservative
		PJ-2	Pineapple juice with preservative 5 mg
		PJ-3	Pineapple juice with preservative 20 mg

2.2. Physico-Chemical Properties

All Pineapple juice samples were analyzed of moisture, ash, TSS, P^H and Vitamin-C.

2.2.1. Estimation of Moisture

Moisture percentages of pineapple juice were determined by oven drying method [19]. A crucible first washed and dried up. The weight of the crucible was taken. Then nine ml of sample was taken in the crucible and weighted. Crucible plus sample is then placed in an oven heated at 105°C for 4 hours. The sample plus crucible was placed in a desiccator and weighted. Repeated this process until final weight reached to constant weight.

2.2.2. Estimation of Ash

Ash percentages of pineapple juice were determined by incineration of samples in a muffle furnace. Nine ml of sample was taken in a crucible. The sample was heated at 105°C for 3 to 4 hours. Sample was then heated in a muffle

furnace at 600°C for 3 to 4 hours [20]. Sample was then cooled and ash content of the supplied sample was measured.

2.2.3. Estimation of Total Soluble Solids (TSS)

Total solid is determined by weighing pineapple juice. Test portion is dried 4 hours in 100-105°C forced air oven. Total solids content of sugarcane juice is weight of dried juice residue expressed as % of original pineapple juice test portion weight.

2.2.4. Estimation of P^H

A Sension TM+ P^H31, P^H meter are used for determination of P^H [21]. After checking the P^H meter and make sure the P^H meter has worked well, P^H meter set in a dry place. Then calibrate the meter containing a buffer solution of P^H 4, P^H 7 and P^H 10. Whenever readings are taken correctly, ensure that the meter is work correct. After rinsing in distilled water - place in the sample solution to be tested, then take the reading correctly.

2.2.5. Estimation of Vitamin C

2, 6 Dichlorophenol indophenols is reduced to a colorless form by ascorbic acid. The reaction is specific for ascorbic acid at p^H 1 to 3.5. The dye is blue in alkaline solution and red in acid.

2.2.6. Determination of Total Viable Count

For total viable count of the pineapple juice, we used Nutrient agar media. Estimation of bacterial load was performed by standard method [22].

2.3. Sensory Evaluation

The panel members were teachers and students of Food Technology & Nutritional Science department evaluated the product fortnightly for Appearance, color, flavor, aroma, texture consistency and overall acceptability by Hedonic scale term used in tasting panels where the judges indicate the extent of their like or dislike for the food [23]. A nine-point Hedonic scale used for sensory evaluation of pineapple juice samples stored at different storage condition.

2.4. Statistical Analysis

The data obtained were statistically analyzed for analysis of variance (ANOVA) and consequently Duncan's Multiple Range Test (DMRT) was used to determine significant difference. Data were analyzed using the software, IBM SPSS Statistics, version 22 at the 5% level of significance ($P<0.05$).

3. Results and Discussion

Physico-Chemical Analysis

The fresh pineapple juices were analyzed for physico-chemical properties. The Table 2 represents the compositional analysis of Moisture, Ash, $P^{H,}$ TSS and vitamin C of fresh pineapple juice which were 87.5%, 0.31%, 11.5%, 3.49 and 3.06 mg respectively.

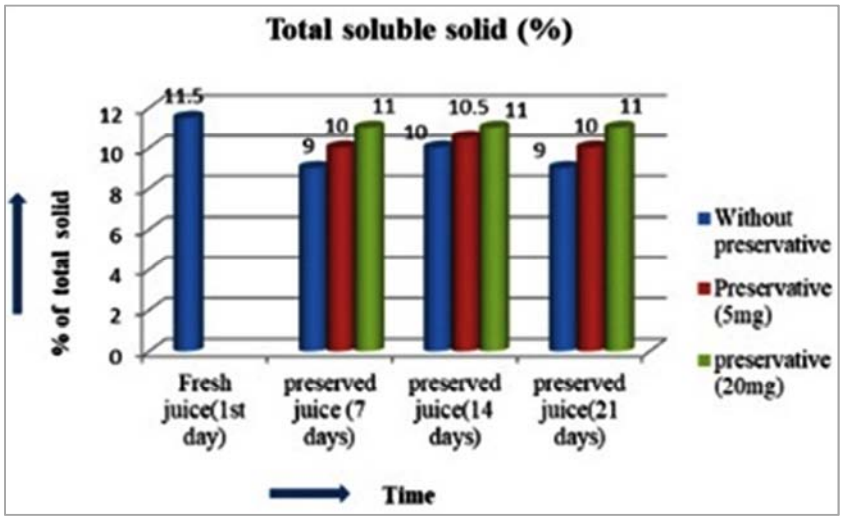

Figure 1. *TSS at room temperature.*

Table 2. *Compositional analysis of fresh pineapple juice.*

Components	Amount
Moisture	87.5%
Ash	0.31%
PH	3.49
Total Soluble Solid (TSS)	11.5%
Vitamin C	3.06 mg/100ml

Above figure 1 represents the percentage of Total soluble Solids of preserved pineapple juice from day 1 to day 21. Total solid of pineapple juice represents all nutrients without moisture. The amount of total soluble solid in processed pineapple juice (1st day) was 11.5%. After 7 days at room temperature the total solid percentage of pineapple juices was 9, 10, and 11 of samples without preservative, with

preservative (5mg), with preservative (20mg) respectively. After 14 days the amount of total soluble solid was 10, 10.5, 11 of samples without preservative, with preservative (5mg), with preservative (20mg) respectively. Finally, we observed after 21 days and the amount of total soluble solid was 9, 10, and 11 of samples without preservative, with preservative (5mg), with preservative (20mg) respectively.

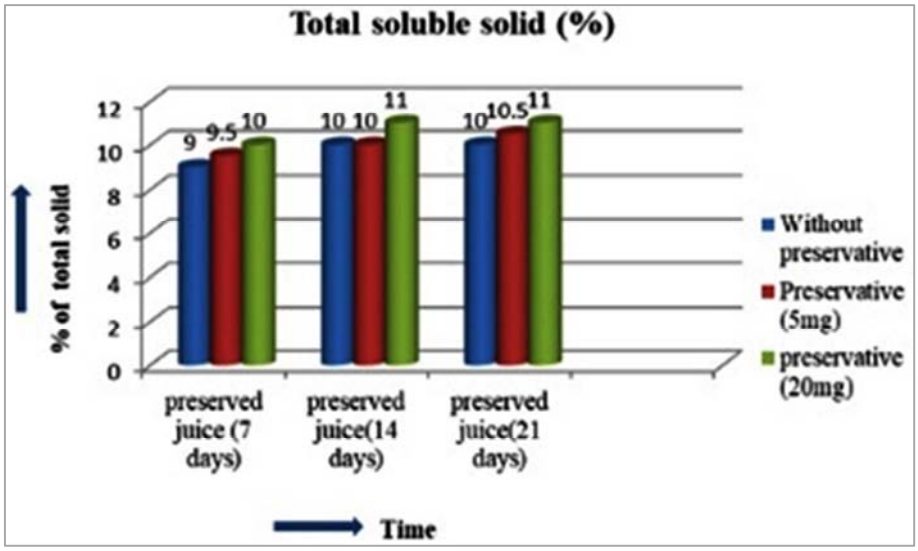

Figure 2. *TSS at refrigeration temperature.*

Above figure 2 represents the percentage of Total soluble Solids of preserved pineapple juice from day 7 to day 21. After 7 days at refrigeration temperature, the total solid percentage of pineapple juices was 9, 9.5, and 10, of samples without preservative, with preservative (5mg), with preservative (20mg) respectively. After 14 days the amount of total soluble solid was 10, 10, and 11 of samples without preservative, with preservative (5mg), with preservative (20mg) respectively. Finally, we observed after 21 days and the amount of total soluble solid was 10, 10.5, and 11 of samples without preservative, with preservative (5mg), with preservative (20mg) respectively.

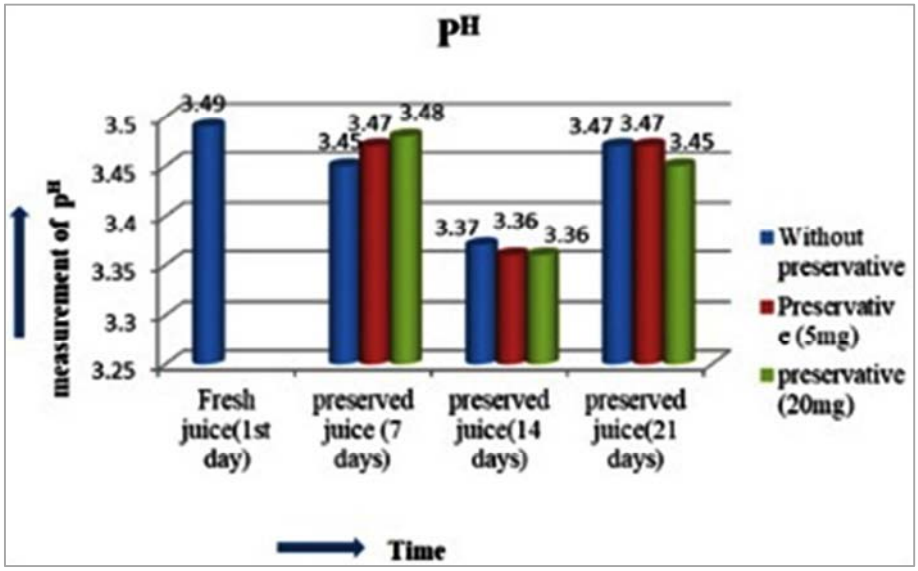

Figure 3. *P^H of pineapple juice at room temperature.*

Above figure 3 represents the P^H of preserved pineapple juice from day 1 to day 21. After 7 days at room temperature the P^H of pineapple juices was 3.45, 3.47, and 3.48 of samples without preservative, with preservative (5mg), with preservative (20mg) respectively. After 14 days the amount of P^H was 3.37, 3.36, and 3.36 of samples without preservative, with preservative (5mg), with preservative (20mg) respectively. Finally, we observed after 21 days and the amount of P^H was 3.47, 3.47, and 3.45 of samples without preservative, with preservative (5mg), with preservative (20mg) respectively. (Fresh pineapple juice contains P^H 3.71) [24].

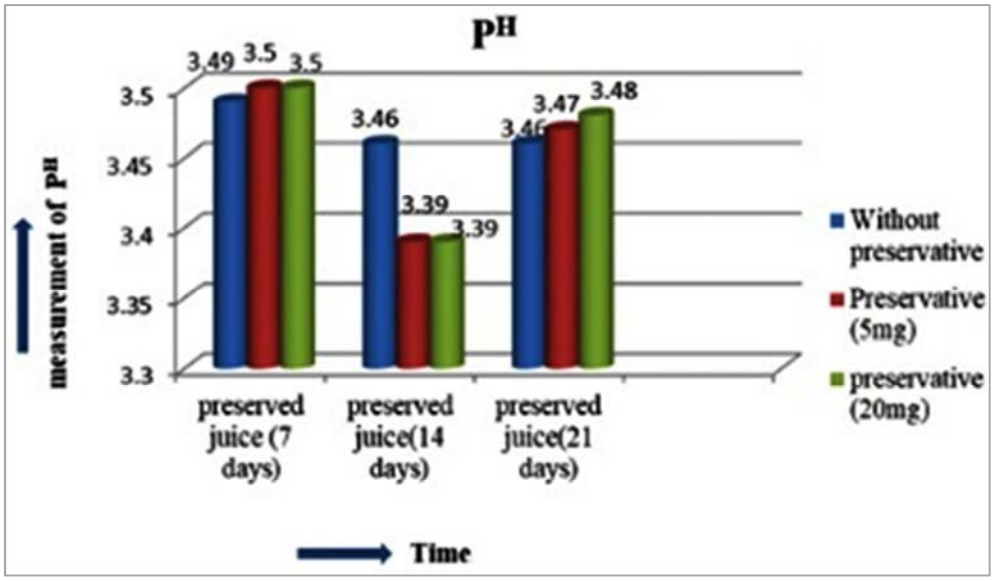

Figure 4. *P^H of pineapple juice at refrigeration temperature.*

Above figure 4 represents the P^H of preserved pineapple juice from day 7 to day 21. After 7 days at refrigeration temperature the P^H of pineapple juices was 3.49, 3.5, and 3.5 of samples without preservative, with preservative (5mg), with preservative (20mg) respectively. After 14 days the amount of P^H was 3.46, 3.39, and 3.39 of samples without preservative, with preservative (5mg), with preservative (20mg) respectively. Finally, we observed after 21 days and the amount of P^H was 3.46, 3.47, and 3.48 of samples without preservative, with preservative (5mg), with preservative (20mg) respectively.

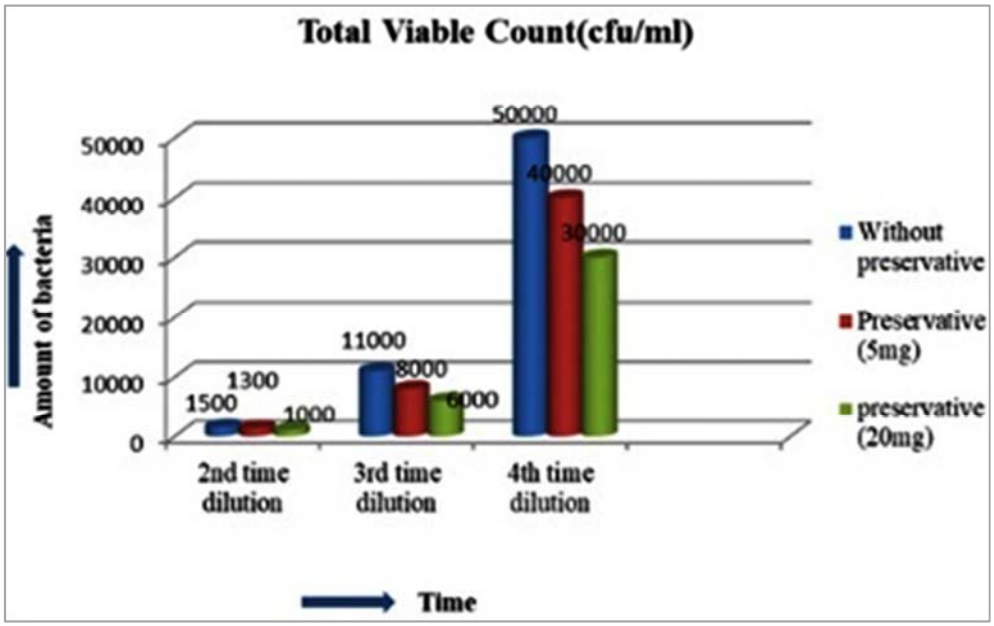

Figure 5. *TVC of pineapple juice at room temperature (21 days).*

Above figure 5 represents the Total viable count of preserved pineapple juice after 21 days. Microbiological analysis of pineapple juice was done under present study as microbial contamination is a great concern. The total bacterial count of a sample gives an indication of the total number of bacterial present in the pineapple juice. As shown, at room temperature of the without preservative juice, total bacteria recorded in 2nd, 3rd and 4th time diluted samples were 1500, 11000, 50000 respectively. Whereas preservative (5mg) juice has the number of total bacteria 1300, 8000, 40000 respectively. And finally preservative (20mg) juice has the number of total bacteria in 2nd, 3rd and 4th time diluted samples were recorded 1000, 6000, 30000 respectively.

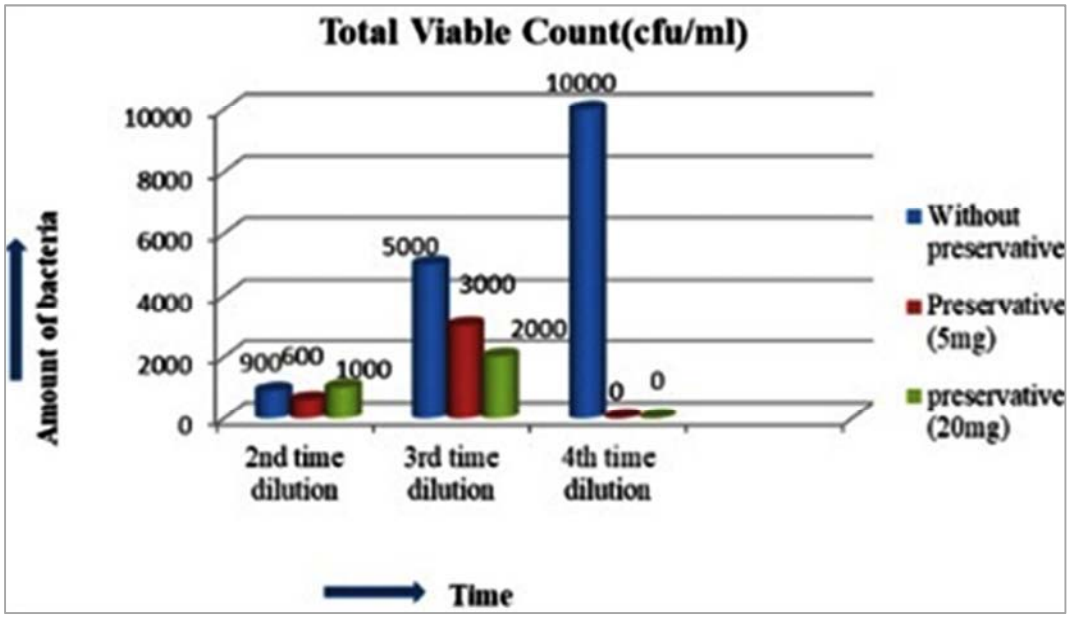

Figure 6. *TVC of pineapple juice at refrigeration temperature (21 days).*

Above figure 6 represents the Total viable count of preserved pineapple juice after 21 days. In testing refrigeration stored juice samples, it depicts that total bacterium present in without preservative juice recorded in 2nd, 3rd and 4th time diluted samples were 900, 5000, 10000 respectively. Whereas preservative (5mg) juice has the number of total bacteria 600, 3000, 0 respectively. And finally preservative (20mg) juice has the number of total bacteria in 2nd, 3rd and 4th time diluted samples were recorded 1000, 2000, 0 respectively.

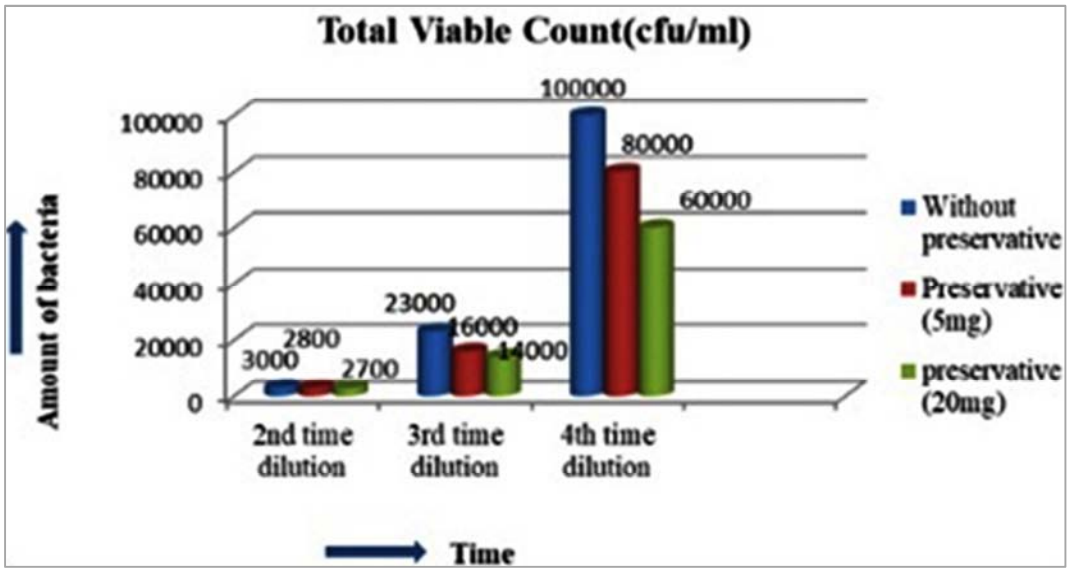

Figure 7. *TVC of pineapple juice at room temperature (45 days).*

Above figure 7 represents the Total viable count of preserved pineapple juice after 45 days. Microbiological analysis of pineapple juice was done under present study as microbial contamination is a great concern. The total bacterial count of a sample gives an indication of the total number of bacterial present in the pineapple juice. As shown, at room temperature of the without preservative juice, total bacteria recorded in 2nd, 3rd and 4th time diluted samples were 3000, 23000, 100000 respectively. Whereas preservative (5mg) juice has the number of total bacteria 2800, 16000, 80000 respectively. And finally preservative (20mg) juice has the number of total bacteria in 2nd, 3rd and 4th time diluted samples were recorded 2700, 14000, 60000 respectively. Different values of bacterial counts of both treated and control pineapple juices were obtained during the period of monitoring but the total viable bacterial count ranged from 3.8×10^4 to 4.4×10^8 cfu/ml [25].

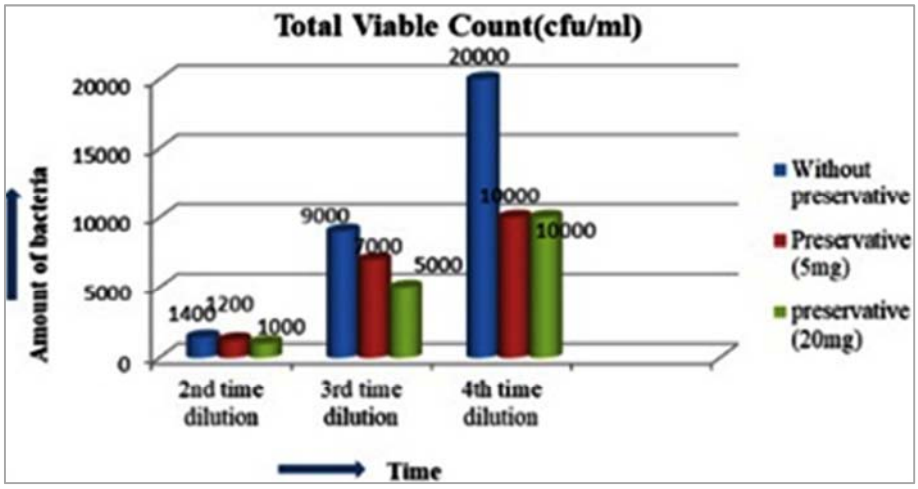

Figure 8. *TVC of pineapple juice at refrigeration temperature (45 days).*

Above figure 8 represents the Total viable count of preserved pineapple juice after 45 days. In testing refrigeration stored juice samples, it depicts that total bacterium present in without preservative juice recorded in 2nd, 3rd and 4th time diluted samples were 1400, 9000, 20000 respectively. Whereas preservative (5mg) juice has the number of total bacteria 1200, 7000, 10000 respectively. And finally preservative (20mg) juice has the number of total bacteria in 2nd, 3rd and 4th time diluted samples were recorded 1000, 5000, 10000 respectively.

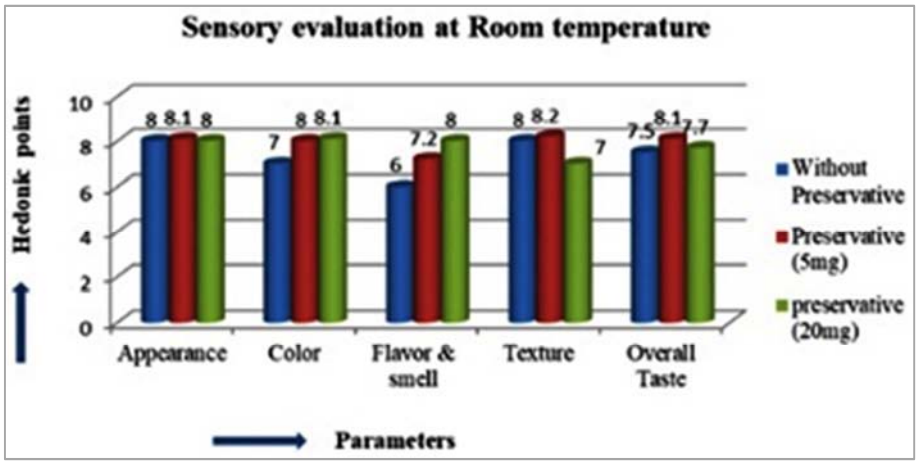

Figure 9. *Sensory evaluation of pineapple juice in room temperature (7 days).*

From figure 9 in without preservative juice, with preservative (5mg) juice and with preservative (20mg) juice the acceptability of appearance was liked very much by panelists.

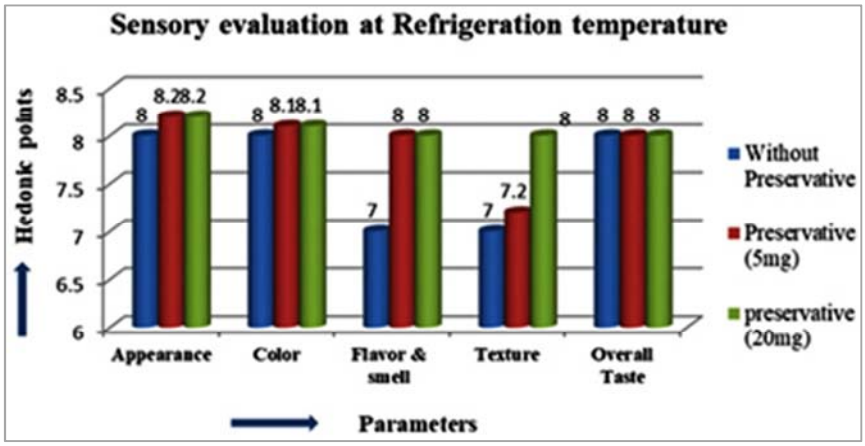

Figure 10. *Sensory evaluation of pineapple juice in refrigeration temperature (7 days).*

From figure 10 in without preservative juice the acceptability was like slightly. With preservative (5mg) juice and with preservative (20mg) juice acceptance was disliked slightly by panelists.

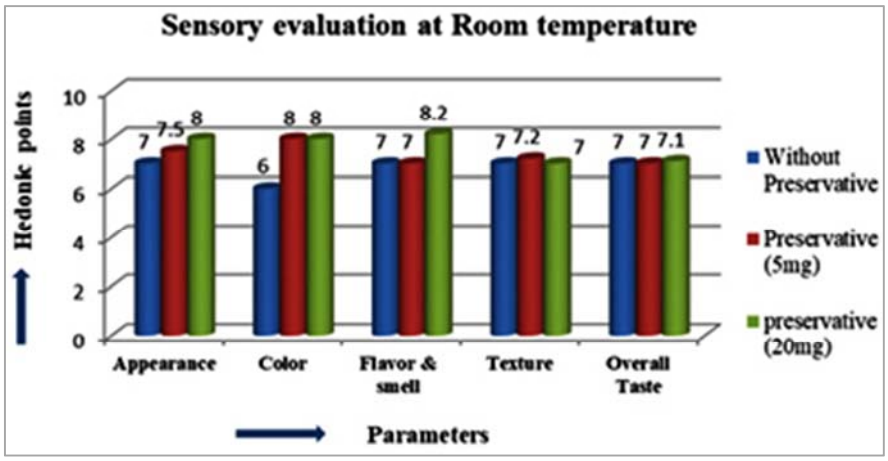

Figure 11. *Sensory evaluation of pineapple juice in room temperature (14 days).*

From figure 11 in without preservative juice and with preservative (5mg) juice the acceptability of appearance was liked moderately. But with preservative (20mg) juice acceptance was liked very much by panelists.

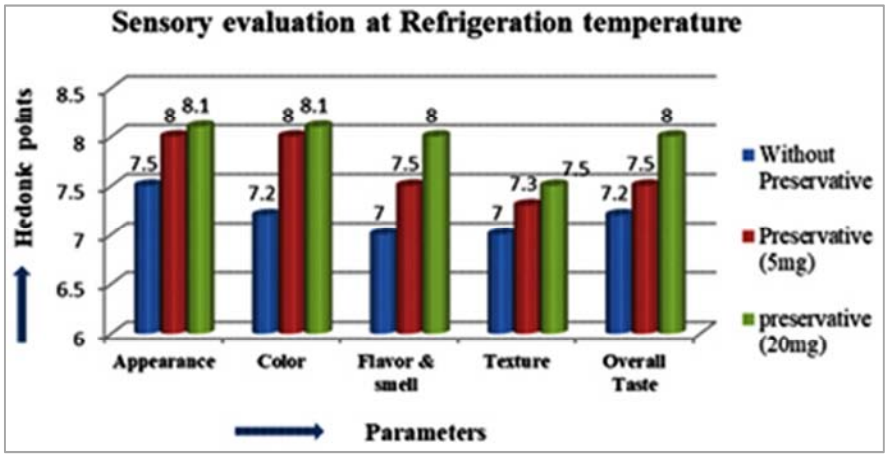

Figure 12. *Sensory evaluation of pineapple juice in refrigeration temperature (14 days).*

From figure 12 in without preservative juice the acceptability of appearance was like moderately. With preservative (5mg) juice and with preservative (20mg) juice acceptance was liked very much by panelists.

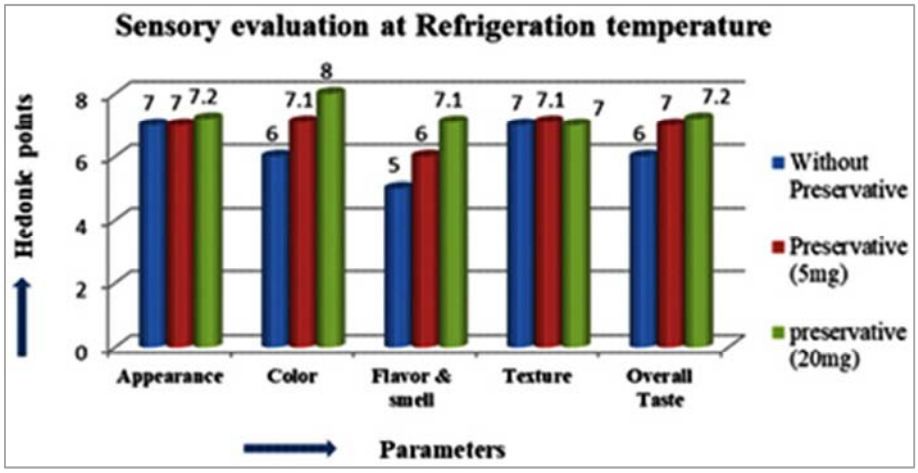

Figure 13. *Sensory evaluation of pineapple juice in room temperature (21 days).*

From figure 13 in without preservative juice the acceptability of appearance was like moderately. With preservative (5mg) juice and with preservative (20mg) juice acceptance was liked very much by panelists.

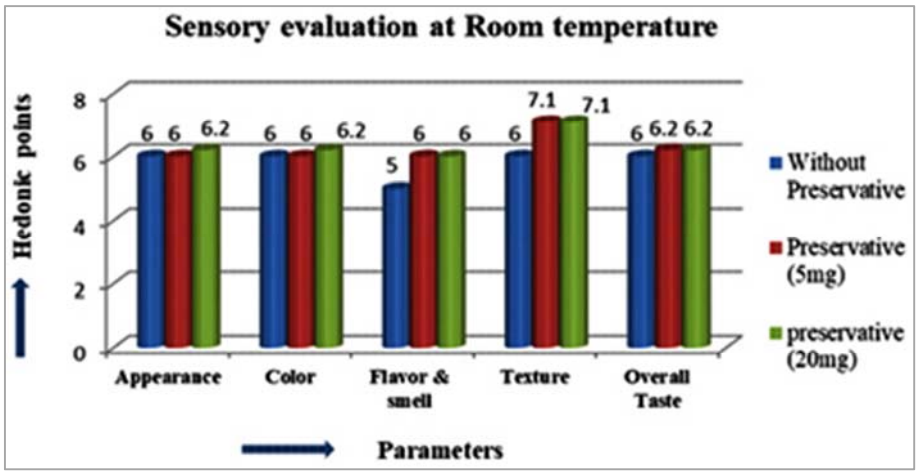

Figure 14. *Sensory evaluation of pineapple juice in refrigeration temperature (21 days).*

From figure 14 in without preservative juice the acceptability of appearance was like moderately. With preservative (5mg) juice and with preservative (20mg) juice acceptance was liked very much by panelists.

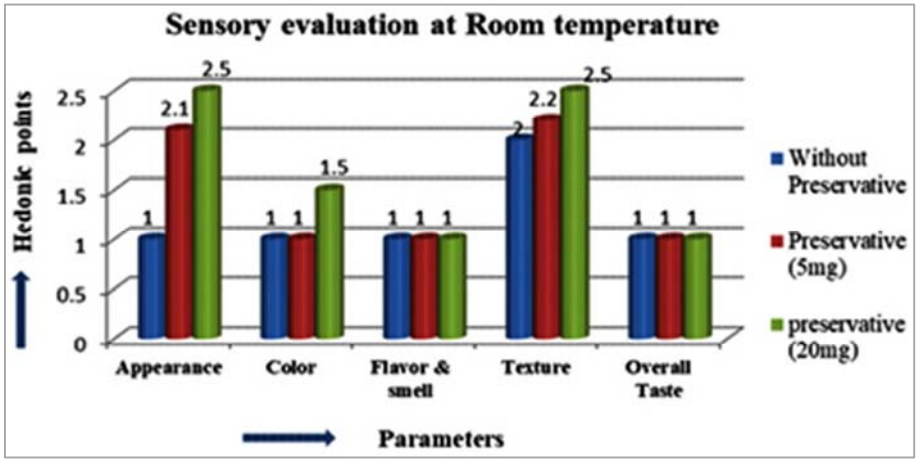

Figure 15. *Sensory evaluation of pineapple juice in room temperature (45 days).*

From figure 15 in without preservative juice the acceptability of appearance was like moderately. With preservative (5mg) juice and with preservative (20mg) juice acceptance was liked very much by panelists.

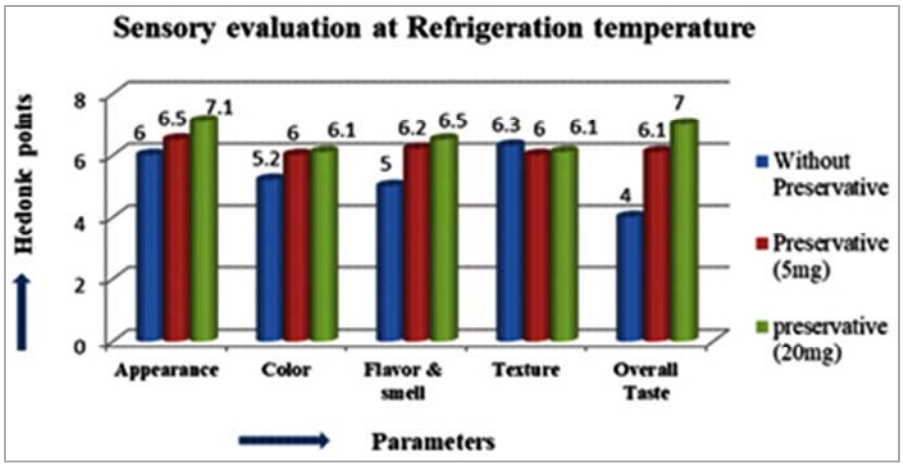

Figure 16. *Sensory evaluation of pineapple juice in refrigeration temperature (45 days).*

From figure 16 in without preservative juice the acceptability of appearance was like moderately. With preservative (5mg) juice and with preservative (20mg) juice acceptance was liked very much by panelists.

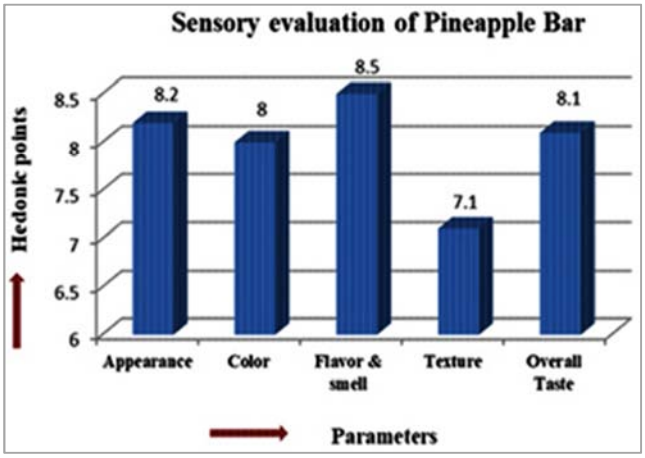

Figure 17. *Sensory evaluation of pineapple bar.*

Above figure 17 represents the sensory evaluation of pineapple Bar. The acceptability of appearance, color, flavor and smell of the bar was liked very much. The bar was liked moderately for its texture. But the acceptability of overall taste of the bar was liked very much by panelists.

4. Limitations of the Study

The effective time allowed to complete this study was not enough due to some uncontrollable variables which have squeezed our total effective time period. Sophisticated laboratory equipment and proper packaging materials is mandatory for any secure output of study. There were lacking in the laboratory supports and it was one of the limitations that handicaps us to carryout extensive experiments. Costs with this type of work are significant. So, without any financial assistance it would be very difficult to carry forward these types of empirical project in practice.

5. Conclusion

In our study we tried to develop pineapple product for pineapple preservation. For pineapple product development we made pineapple juice and pineapple bar. Results indicated that at room temperature maximum changes occurred in all physico-chemical parameters such as moisture content, ash content, TSS, P^H which was negligible. In case of sensory evaluation, a significant change in flavor and color was noticed in preserved juice than fresh pineapple juice. We also noticed that the flavor and color of juice preserved in refrigeration temperature was better than juice preserved in room temperature. From the microbial analysis we found that juice preserved in refrigeration temperature was minimal microbial content than juice preserved in room temperature. In room temperature the juice preserved with preservative was low microbial content than the juice preserved without preservative. We also made pineapple bar which was a significant color, flavor and appearance. The taste of the bar was so delicious. We keep it in room temperature and it was good for consume for 30 days. Finally, it can be concluded that, the shelf life of preserved juice at room temperature was 21 days and in refrigeration temperature was 45 days.

6. Recommendation

Pineapple juice production has increased significantly in recent years. These days, pineapple juice is largely consumed around the world as canning industry by-product in the form of single-strength or concentrated juice. To improve consumer preference, it must be reconstituted in blended composition to Obtain new flavors in beverages and other products. The novel formulations of pineapple juice include aseptic pineapple juice concentrates, natural pineapple pulp formulations, frozen pineapple concentrates, sulfated pineapple pulps and purees, and ready-to-serve pineapple drinks. All of these formulations have numerous applications in dairy and food industries.

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Conflict of Interest

The authors declare that they have no competing interests.

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