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Research Article

Different factors affecting production of fermented Jackfruit beverage

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Abstract

Through the process of jackfruit juice fermentation, the following conclusion has been drawn: after crushing jackfruit pulp, sterilization should be conducted to prevent oxidation and infection by adding $NaHSO_3$ as quickly as possible to avoid juice darkness owing to oxidative products and to destroy any harmful microorganisms. Jackfruit was diluted at the rate of fruit/water = 1/3 to retain the flavour and aroma of the product. Soluble dry matter content suitable for fermentation was found to be 20% and the yeast ratio used is 0.05%. After pouring the bottle capping for preservation, the fermented jackfruit beverage should be pasteurized at 70^{o}C within 10 minutes. During storage time (28 days), the soluble dry matter and acidity do not change significantly; the density of the total aerobic bacteria is lower than the limit allowed in fermented beverages.

Keywords: yeast, soluble dry matter, acidity, *Artocarpus heterophyllus*, alcohol, Vietnam.

1. INTRODUCTION

Jackfruit tree (*Artocarpus heterophyllus)* is familiar to the people of Vietnam because it is easily cultivated. Jackfruit and banana are grown all across Vietnam, mostly in rural areas. In Southeast Asia, jackfruit trees are either grown as house plants or are considered to be crops usually cultivated by poorer people. Being a large and heavy fruit it is not easily handled or transported. Jackfruit is not normally popular with Westerners due to the texture and the overwhelming smell. In addition, very few products are made from jackfruit and it is mostly eaten fresh. That limits the market for products and the income of fruit growers is very low. As a result, the cultivation of jackfruit is declining. The under-utilization of jackfruit and post-harvest losses has been a grave problem for cultivators. This particular fruit is not exploited fully despite the fact that it has a very good sugar content and antioxidant activity. In an effort to improve the value of the fruit, researchers have been examining various methods of adding value to the product through further processing, such as drying, making glace and chips.

Fermented fruit juice is one possible avenue for adding value to jackfruit by fermenting the pulp in combination with a suitable yeast. The product retains the characteristic aroma and the sweetness of the fruit. Also, a small amount of ethanol is produced in the fermentation process. The final beverage has a very low alcohol content, which also helps in digestion and enhancing its potential popularity with all walks of people.

Compared to other types of beverages that are currently sold on the market,fermented beverages are delicious and have much more cooling effect. They are more delicious because CO_2 escapes due to the fermentation reaction and will dissolve into the beverage then react with other substances to create simple and complex esters, giving a more subdued taste and aroma. Cooling is also better because when carbonated CO_2 will evaporate and endothermics contribute to cooling.

Several notable studies on producing jackfruit beverages have been undertaken. S.M.R. Rahman *et al*. (2001) utilized jackfruit juice in the manufacture of yogurt. Yogurt samples were prepared by adding 5, 10 and 15% jackfruit juice with milk. The quality of prepared yogurt was measured by some organoleptic, chemical and microbiological tests. Smell and taste; body and consistency; colour and texture score of yogurt improved due to the addition of jackfruit juice. The addition of jackfruit juice also increased the total solids content but decreased the protein, fat and ash content. Yeast cells were higher in jackfruit yogurt (JFY) than plain yogurt. From this study it was suggested that yogurt could be prepared successfully by adding different proportions of jackfruit juice with milk and among of them 5% jackfruit juice yogurt showed the better performance. Rosnah Shamsudin *et al*. (2009) examined the chemical composition of jackfruit juice during storage. Chemical properties such as pH, total acidity, total soluble solids (TSS) and sugar content changes during ripening of jackfruit were evaluated at ambient temperature (±27°C; 70-80% RH). There are significant changes in pH, total soluble solids, total acidity and sugar content at different ripening days. In this study, data obtained suggests that the ripening process of jackfruit was at its optimum at day 9 after harvest at ambient temperature. The results will help to make the best use of jackfruit for different purposes and applications.

D.K. Dushyantha *et al.* (2011) studied the fermentation of jackfruit juice by beneficial lactic acid bacteria. Lactic acid bacteria were isolated from the jackfruit phyllosphere, perianth lobes and juice. They were characterized and compared with standard lactic acid bacterial strain *Lactobacillus acidophilus* for different characteristics. Among the isolated strains, lactic acid bacterial strain JFL1 was found superior to other isolates in fermenting the jackfruit juice. Hence, this strain was further screened for beverage making. Casein and soy protein were supplemented as a nitrogen source for enhancing the fermentation efficiency of strains. Beverage produced by supplementation of a nitrogen source was found superior to beverage produced without.

Andri Cahyo Kumoro *et al.* (2012) prepared wine from jackfruit juice using Baker's yeast and studied the effect of yeast and initial sugar concentrations. This research investigated the effect of yeast and initial sugar concentrations on jackfruit juice fermentation. Clarified jackfruit juice of 14 % w/w sugar concentration was fermented using 0.5 to 2.0% w/v Baker's yeast (*Saccharomyces cerevisiae*) under anaerobic conditions at 30°C for 14 days. Samples were collected daily for ethanol and sugar contents analysis. The profile of sugar and ethanol concentration as a function of fermentation time showed that a higher yeast inoculum rate and initial sugar concentration inhibited growth of yeast. The fermentation of original jackfruit juice of 14 %w/w sugar concentration using 0.5% w/v yeast for 9 days was found to be the best to produce a good quality beverage with 12.13% v/v of ethanol and specific jackfruit aroma.

C. Mondal *et al*. (2013) investigated product development from jackfruit and analyzed the nutritional quality of the processed products. They developed products by processing different parts of the fruit and the highest total soluble solids were observed from jelly (65.00%). The highest pH was also found in jelly (5.047). Green pickle contain the highest amount of vitamin C (3.4433 mg/100 g) and carotenoids (22.78 mg/100 g). Sweet pickle contained the highest amount of moisture (50.95%). After six months of storage, quality of the processed products regarding colour, taste, flavour and texture were similar to that of freshly processed products. However, after 8-9 months of storage the quality of jam, jelly and squash started to deteriorate and the quality of pickles (i.e., green pickle and sweet-pickle) remained unchanged even after 12 months of storage.

Nirmal Sharma *et al.* (2013) examined the process optimization for fermentation of wine from jackfruit. Because of the sugar content present, jackfruit juice is a very good substrate for fermentation. In order to minimize post-harvest losses, jackfruit juice can be used for wine production. Their work was conducted to study the conditions that affect the fermentation of wine from jackfruit. Jackfruit juice was divided into 3 parts and the pH was adjusted to 4, 5 and 6. The juices with the adjusted pH were added to different bottles and maintained at a temperature of 27°C, 32°C, and 37°C. 9 bottles were used for each temperature condition, which contained an inoculum concentration of 5%, 10% and 15% for each pH. Samples were collected on a weekly basis and were tested for sugar content, alcohol content, polyphenol content, antioxidant activity and pH. Jackfruit wine underwent an acidic fermentation and in most cases, fermentation was completed on the 14th day, with a maximum alcohol content of 18%.

The purpose of this research is to create new products of good quality from fermented juice, with long storage time. The influence of dilution ratio and product quality was examined, as well as the influence of the ratio of yeast used and the dissolved dry matter content to fermentation time and product quality and the effect of sterilization temperature on product quality.

Materials and Methods

Materials

Ripe jackfruit, refine sugar and yeast *Saccharomyces cerevisiae* were used during this study.

Research method

Experiment 1: Effect of dilution to product quality

Purpose: determine initial water content before adding to ensure good sensory characteristics as well economics reasons.

Preparation: ripe jackfruit is washed, crushed and water added.

Arrangement: random layout experiments repeated with 1 multiplication factor.

A factor: the ratio of additional water; A1: water/jackfruit = 2/1; A2: water/jackfruit = 2.5/1; A3: water/jackfruit = 3/1; A4: water/jackfruit = 3.5/1.

Monitoring parameter: sensory, colour, aroma.

Experiment 2: Effect of yeast ratio and soluble dry matter to fermentation time and product quality

Purpose: determine yeast ratio and soluble dry matter suitable for fermentation and product quality.

Preparation: mixed jackfruit juice to be fermented with three levels of yeast ratio and three levels of soluble dry matter ready for fermentation.

Arrangement: random layout repeat with 2 factors.

B factor: yeast ratio; B1= 0.01%; B2 = 0.05%; B3 = 0.1%

C factor: soluble dry matter (Brix); C1 = 16%; C2 = 20%; C3 = 24%

Monitoring parameter: sensory (status, colour, aroma, taste); Brix (Brix meter) and ethanol (ethanol meter) by fermentation time.

Experiment 3: Effect of temperature and pasteurization time on product quality
Purpose: determine temperature and pasteurization time effects on product quality in minimum.
Preparation: after clearing, proceed to bottle pouring and pasteurization at three temperature levels and three time levels intended.
Arrangement: random layout repeat with 2 factors.

T factor: pasteurization temperature; T1 = 60^oC; T2 = 70^oC; T3 = 80^oC
M factor: pasteurization time; M1 = 5 minutes; M2 =10 minutes; M3 = 15 minutes

Monitoring parameter: sensory(status, colour, aroma, taste); residue soluble dry matter; microorganisms (TPC)

Results and Discussion

Nutrient composition of jackfruit

Figure 1. Jackfruit *Artocarpus heterophyllus* L.

Table 1. Nutrient composition of ripe jackfruit.

Description	Value (*)
Total sugar, %	16
Soluble dry matter, %	20
Moisture, %	70
pH	5,8

(*) Data are average from triplicates

Jackfruit as raw material with dry substances dissolved to 20% is good conditions for fermentation, but due to economic problems it must be diluted, thus reducing the dry matter content. To achieve the soluble dry matter suitable for fermentation it is necessary to adjust by adding sugar.

pH in jackfruit of about 5.8 is very conducive to bacterial growth but not suitable for active yeast and thus the product will easily be damaged. pH is suitable for active yeast at about pH = 4.0-4.5, so this was adjusted to pH = 4.3 and the fermentation process takes place smoothly by adding citric acid.

Effect of dilution on product quality

Table 2. Effect of dilution on sensory characteristics.

Dilution	Brix	Colour	Aroma
1 jackfruit/2 water	6.50	4.05^a	4.15^a
1 jackfruit /2,5 water	5.25	3.75^a	3.95^a
1 jackfruit /3 water	4.70	3.70^a	3.80^a
1 jackfruit /3,5 water	3.75	3.10^b	3.10^b
		F = 9.01	F = 8.23
		P = 0.000	P = 0.001

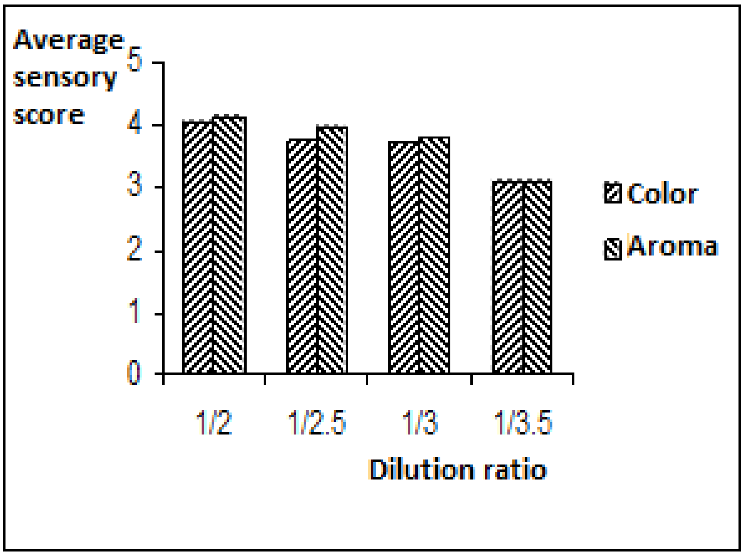

Figure 2. Effect of dilution on sensory characteristics.

From Figure 2 it can be seen that degrees brix at the dilution ratio 1/2 has the highest average score and is different from the rest. Degree brix in the dilution ratio 1/2.5 and 1/3 shows no statistically significant difference with one another, having a relatively high average score; also model 1/3.5 has the lowest average score and clear difference compared with the remaining samples.

The statistical results in Table 2 show the colours and flavours of fermented jackfruit juice were affected by water dilution. The sample dilution ratio is 1/2, 1/3 and 1/2.5. Colour and flavour have no differences with one another in terms of statistical significance, separate from form 1/3.5, there are clear differences in comparison with the other samples. Because of this, dilution rate directly influences the natural flavour, an important indicator of the product by adding water to reduce the dry ingredients that in turn reduces the value perception of the product.

As can be seen from Figure 2, when the ratio of dilution water is rising, the colour is reduced accordingly. Poor taste, odor and colour reduction from product nature are clearly noticed. Form 1/3.5 has the lowest average score, for the lower sensory 3 remaining samples, and adding that there are clear differences in comparison with the 3 remaining samples should not be selected. Form 1/2 has the highest average score, for the best sensory values; form 1/2.5 and 1/3 are the average scores equal high sensory, sensory value well and there is no difference in terms of statistical significance compared to the model 1. So in the dilution ratio 1/3, we get medium quality in terms of perception, moderate economic performance.

Effect of yeast inoculation and soluble dry matter to fermentation time and product quality

Table 3. Soluble dry matter change by fermentation time, %.

Soluble dry matter, %	Yeast ratio, %	Fermentation time, days						
		0	2	3	4	5	7	9
16	0.01	16	8	5	4	4.2	4.3	4.5
	0.05	16	7	4.8	4.8	4.6	4.6	4.5
	0.10	16	7	4.5	4.2	4.6	4.2	4.5
20	0.01	20	14	9	6	6	6	6
	0.05	20	12	7.4	6	5.4	5.5	6
	0.10	20	11.2	6.8	5.5	5.2	6	6
24	0.01	24	19.4	14	10	7	6.5	6.5
	0.05	24	17.5	11.6	9.8	8	6.5	6.5
	0.10	24	18	12	9.4	7,5	6.5	6.5

Table 4. Ethanol formation by fermentation time, % volume.

Soluble dry matter, %	Yeast ratio, %	Fermentation time, days						
		0	2	3	4	5	7	9
16	0.01	0	5.5	9.0	9	9	9	9
	0.05	0	6.5	8.5	9	9	9	9
	0.10	0	6.5	9.0	9	9	9	9
20	0.01	0	3.0	9.0	11	11.5	11.5	11.5
	0.05	0	6.0	10.0	11	12	12	12
	0.10	0	6.5	11.0	12	11.5	12	12
24	0.01	0	4.0	7.5	10	12	12	12
	0.05	0	5.0	9.5	11	12	13	13
	0.10	0	5.0	9.5	11	12	13	13

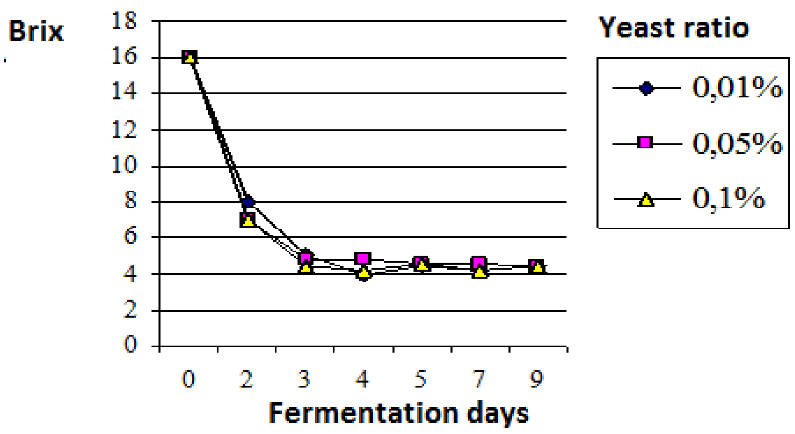

Figure 3. Effect of yeast ratio to soluble dry matter by fermentation time at initial Brix 16.

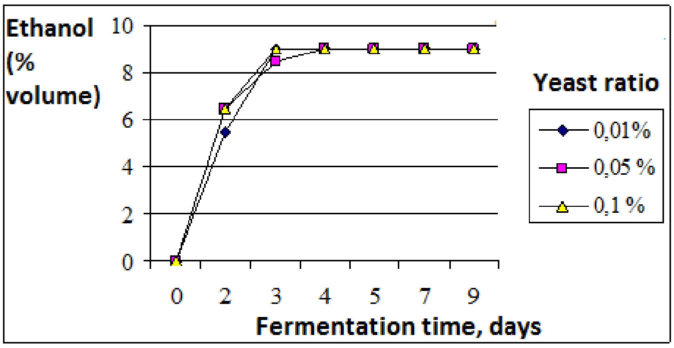

Figure 4. Effect of yeast ratio to ethanol formation by fermentation time at initial Brix 16.

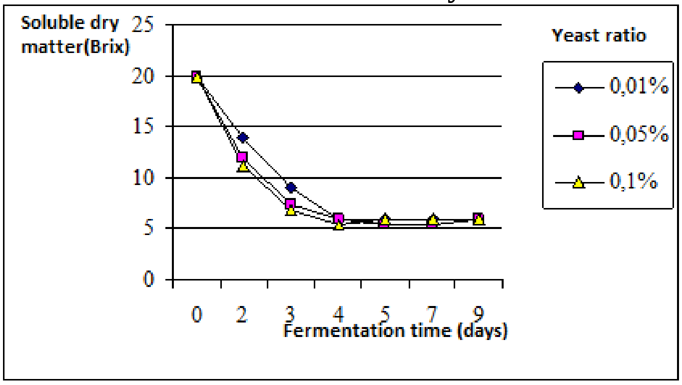

Figure 5. Effect of yeast ratio to soluble dry matter by fermentation time at initial Brix 20.

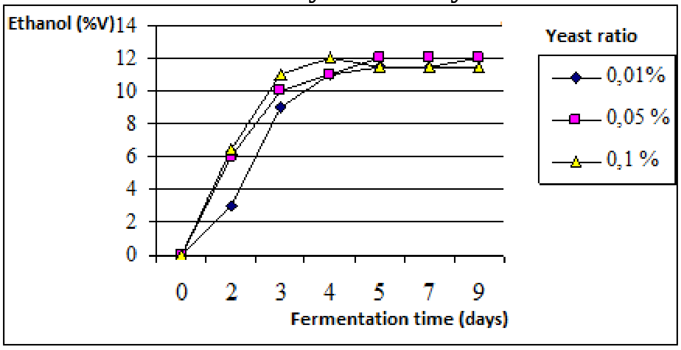

Figure 6. Effect of yeast ratio to ethanol formation by fermentation time at initial Brix 20.

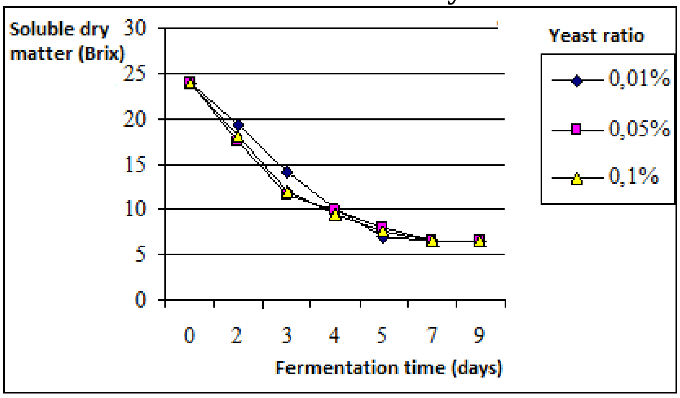

Figure 7. Effect of yeast ratio to soluble dry matter by fermentation time at initial Brix 24.

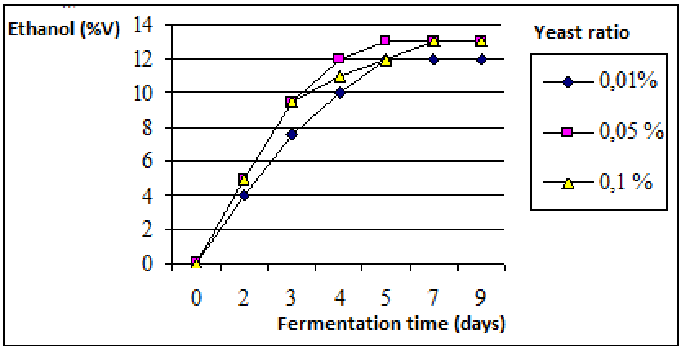

Figure 8. Effect of yeast ratio on ethanol formation by fermentation time at initial Brix 24.

Table 5. Effect of initial Brix to soluble dry matter.

Initial Brix	Soluble dry matter, %
16	4.97[a]
20	7.27[b]
24	9.62[c]
	F = 79.36
	P = 0.0000

Table 6. Effect of fermentation time on soluble dry matter.

Fermentation time, days	Soluble dry matter, %
0	20.00[d]
2	11.57[a]
3	8.34[b]
4	6.63[c]
5	5.94[c]
7	5.56[c]
9	5.67[c]
	F = 39.96
	P = 0.0000

Table 7. Effect of yeast ratio on soluble dry matter, %.

Yeast ratio, %	Soluble dry matter, %
0.01	7.25[a]
0.05	7.36[a]
0.10	7.24[a]
	F = 0.06
	P= 0.9386

Table 8. Effect of initial Brix on ethanol formation.

Initial Brix	Ethanol formation, % volume
16	8.50[a]
20	10.30[b]
24	10.36[b]
	F = 39.05
	P = 0.0000

Table 9. Effect of fermentation time on ethanol formation.

Fermentation time, days	Ethanol formation, % volume
0	0.00[d]
2	5.33[a]
3	9.22[b]
4	10.44[c]
5	11.00[c]
7	11.17[c]
9	11.17[c]
	F = 90.01
	P = 0.0000

Table 10. Effect of yeast ratio on ethanol formation.

Yeast ratio, %	Ethanol formation, % volume
0.01	9.69[a]
0.05	9.88[a]
0.10	9.69[a]
	F = 6.56
	P= 0.021

Table 5 shows the dry substance content of solubles descending in the form of the original 16 brix, 20 and 24 have a difference. Table 6 shows the dissolved content of dry substances decrease with fermentation time. In the early days, the dry matter content of soluble falling fast due to yeasts used to increase biomass. At this time the most powerful yeast's activity should use the metabolized alcohol is highest. So in day 2, 3, 4 degrees brix diminished and there were differences over the next days. In the days following fermentation the yeast's activity was much weaker should use sugar to metabolize the alcohol also slows and there is no difference in terms of statistical significance. Table 7 shows at the rate of 0.01% yeast, 0.05%, 0.1% of the dry matter content of the soluble reduction are not identical, but there is no difference in terms of statistical significance. Table 8 shows the samples were originally 16 brix content wineries produce high and there are differences compared to the rest. The samples were originally 20 brix and 24 with high-born alcohol and there is no difference in terms of statistical significance. This demonstrates the brix 16 is too low and not enough for fermentation. The template has a brix 20, 24 suitable for fermentation, but in terms of economics model 20 degrees brix is more effective. So the model with 20 brix was chosen. Table 9 shows the time fermenting in the early days (from the first day to the fourth day) of alcohol was born very different, from day 4 onwards, the alcohol content of birth there is no difference in terms of statistical significance. This can be interpreted as the initial of active yeast should powerful force, capable of high fermentation alcohol content, more, and there's a clear difference. From Wednesday onwards alcohol concentrations in the room is high fermentation (> 10% by volume) inhibit the activity of the yeast, the yeast metabolizes sugar into alcohol diminishes, so alcohol content generated no statistically significant differences in the next days. Table 10 shows the proportion of different yeast alcohol amounts produced no difference in terms of statistical significance. Sample rate of 0.05% yeast give the highest beverage quality.

Table 11 shows the target colour and then the samples 5, 6, 8 points higher sensory patterns of rest, of characteristic yellow jackfruit is very beautiful, uniform product with no residue to the bottom of the bottle. This sample demonstrates a brix and ratio of yeast used for fermentation. The yeast works well to inhibit microorganism contamination issue that causes instability products.

Table 11. Effect of yeast ratio and soluble dry matter on product sensory quality.

Soluble dry matter, %	Yeast ratio, %	Parameter		
		Colour and status	Aroma	Taste
16	0.01	2.00	2.50	3.05
	0.05	2.05	2.70	2.95
	0.10	3.00	2.90	2.90
20	0.01	3.45	3.10	3.35
	0.05	4.25	3.95	4.10
	0.10	3.95	3.50	3.50
24	0.01	3.55	3.15	3.45
	0.05	4.05	3.65	3.80
	0.10	3.75	3.30	3.10

Table 12. Effect of soluble dry matter on product sensory quality.

Soluble dry matter, %	Parameter		
	Colour and status	Aroma	Taste
16	2.35[a]	2.7[a]	2.97[a]
20	3.88[b]	3.52[b]	3.65[b]
24	3.78[b]	3.77[b]	3.45[b]
	F = 82.85	**F** = 26.33	**F** = 20.28
	P = 0.0000	**P** = 0.0000	**P** = 0.0000

Table 13. Effect of yeast ratio on product sensory quality.

Yeast ratio, %	Parameter		
	Colour and status	Aroma	Taste
0.01	3.00[a]	2.92[a]	3.28[a]
0.05	3.45[b]	3.43[b]	3.62[a]
0.10	3.57[b]	3.23[b]	3.17[b]
	F = 10.08	**F** = 9.45	**F** = 8.96
	P = 0.0001	**P** = 0.0001	**P** = 0.002

In addition, the samples 1, 2, 3 have low sensory scores for this sample shows a low brix enough nutrients for good fermentation. In the first stage the yeast uses the nutrients in the environment to increase biomass, making nutrients decreased significantly. So after a few days of fermentation, the nutrient sources in the environment is exhausted, the yeast will die. When that occurs, junk microorganisms infection will develop active and changing the pH environment, clearly diminished product colour (lighter in colour).

With regard to the aroma of fermented fruit juice, Table 11 shows the samples 5, 6, 8 have high sensory points. Scented products are featured; there is the appearance of strange smell (rancid, rotten, etc.). Also the samples 1, 2, 3 are still characteristic fragrance of water or the strange smell (rancid, rotten). This can be explained by this model has a low brix is insufficient for good fermentation yeast; yeast activity is weak enough not to inhibit the growth of odor- causing microorganism contamination of impurities in the product.

Regarding the norms, Table 11 also shows the samples 5, 6, 8 have a high sensory point. The product tastes quite mellow, merge features. The sweetness of fruit sugar and subdued ferment merge with acid by fermentation, matching it's the top blade of CO_2 produced from the fermentation creates a distinctive taste to the product. Certified partner degrees brix and using yeast ratio in the form suitable for fermentation, no strange taste (sour). Also the samples 1, 2, 3 are sensory scores low due in this not enough to brix degrees the yeast fermenting yeast, weak activity well should junk microorganism growing. The infection makes sour, rancid tasting of the product.

The synthesis of the target colour, smell, taste is the samples 5, 6, 8 have a high sensory spots and acceptable. But in terms of economy, the decision to choose the model 5
(degrees Brix = 20, 0.05% yeast).

Effect of temperature and time of pasteurization to product quality

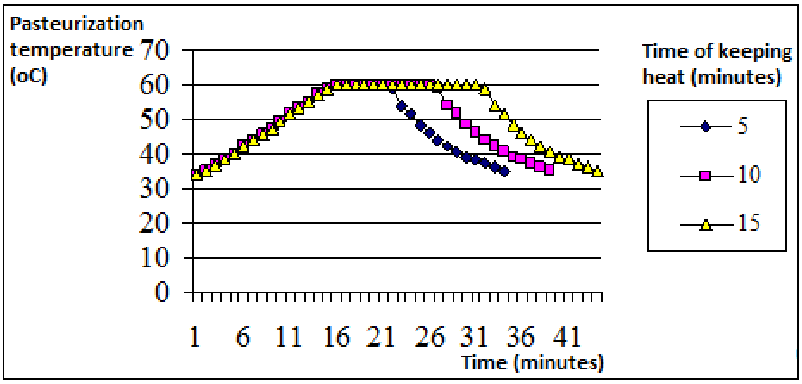

Figure 9. Product core temperature by pasteurization time at 60°C.

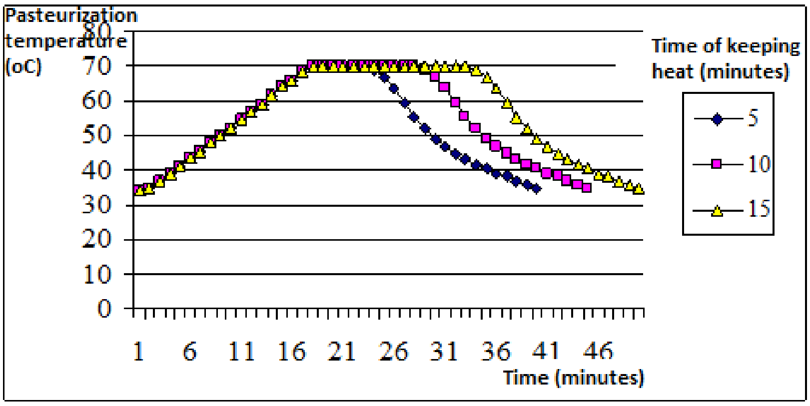

Figure 10. Product core temperature by pasteurization time at 70°C.

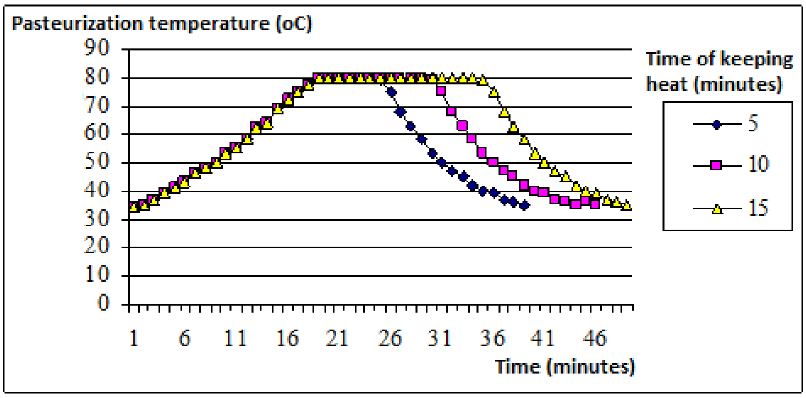

Figure 11. Product core temperature by pasteurization time at 80°C.

Table 14. F value by pasteurization steps.

Pasteurization temperature, °C	Time of heating, minutes		
	5	10	15
60	8.86	13.86	18.86
70	8.72	13.72	18.72
80	7.98	12.98	17.98

Table 15. Effect of pasteurization temperature and time on sensory product quality.

Pasteurization temperature, °C	Time of heating, minutes	Parameter		
		Colour and status	Aroma	Taste
60	**5**	3.80	4.05	3.75
	10	3.75	3.55	3.75
	15	3.50	3.55	3.65
70	**5**	3.50	4.00	3.70
	10	4.00	3.95	3.95
	15	3.30	3.60	3.45
80	**5**	3.25	3.55	3.60
	10	3.35	3.40	3.25
	15	3.05	3.25	2.95

Table 16. Effect of pasteurization temperature on sensory product quality.

Pasteurization temperature, °C	Parameter		
	Colour and status	Aroma	Taste
60	3.68^{a}	3.72^{a}	3.72^{a}
70	3.60^{a}	3.85^{a}	3.70^{a}
80	3.22^{b}	3.40^{b}	3.27^{b}
	F = 9.25 P = 0.0002	F = 7.25 P = 0.0009	F = 7.39 P = 0.0008

Table 17. Effect of pasteurization time on sensory product quality.

Pasteurization time, minutes	Parameter		
	Colour and status	Aroma	Taste
5	3.52^{a}	3.87^{a}	3.68^{a}
10	3.70^{a}	3.63^{ab}	3.65^{a}
15	3.28^{b}	3.47^{b}	3.35^{b}
	F = 6.51 P = 0.0019	F = 5.48 P = 0.0049	F = 3.83 P = 0.0236

Table 16 shows the pasteurization temperature the higher the score, the lower sensory means more colour, gold becomes more intense, more powerful cooking odors. Pasteurized samples at a temperature of 60°C and 70°C have sensory point of colour, smell, taste and status higher than the temperature 80°C pasteurization. Pasteurized samples at 60°C and 70°C retains its fresh yellow characteristic aroma and harmonious taste, there is no difference in terms of statistical significance. Also the template has 80°C temperature pasteurization darker rather than lighter cooking smell, appearance, taste sour and have differences with samples of pasteurized at a temperature of 60°C and 70°C. Due to the temperature 80°C, the amino acid and reducing sugar in products that work with each other to form dark caramel colour in the product more intensely. So product pasteurization at a temperature 80^{o}C was not selected.

Table 17 shows the sample time pasteurization temperature short (5 minutes, 10minutes) then very little affect sensory value product. The product has a high sensory value, retains the colour characteristics of the product, soothing fragrance, doesn't appear harmonious taste, cooking smells do not sharply and there is no difference in terms of statistical significance. While the model has time pasteurization temperature 15 minutes then lower sensory value. The product has a darker appearance. The smell of cooking, taste becomes strong and there are differences in terms of statistical significance compared to the sterilization time keeping heat 5 minutes and 10 minutes. It shows the time of keeping heat as long as product sensory values decrease. So we don't choose the pasteurized samples having time keeping heat at 15 minutes.

When combining all of the above factors is the pasteurization of 60^{o}C and 70^{o}C with heat keeping time 5 minutes, 10 minutes we can ensure good product quality. However, in order to choose the proper sterilization temperatures to be maintained so long that the quality has remained stable, we have to keep track of changes in the process of preserving all the templates on. Then select the templates to preserve much with little change.

Table 18. TPC in product.

Pasteurization temperature, ^{o}C	Time of heating, minutes	TPC, CFU/ml beverage	
		Initial	After 28th day
	5	0	>100
60	10	0	>100
	15	0	>100
	5	0	>100
70	10	0	3
	15	0	1
	5	0	0
80	10	0	0
	15	0	0

Table 19. Brix change in beverage by preservation time.

Pasteurization temperature, ^{o}C	Time of heating, minutes	Preservation time, weeks				
		Initial	1	2	3	4
	5	24.0	23.8	23.0	22.0	19.0
60	10	24.0	23.4	22.6	21.4	20.0
	15	24.0	24.0	23.6	23.0	21.2
	5	24.0	24.0	23.5	22.6	20.0
70	10	24.0	24.0	24.0	24.0	24.0
	15	24.0	24.0	24.0	24.1	24.1
	5	24.0	24.0	24.0	24.1	24.3
80	10	24.0	24.0	24.0	24.2	24.4
	15	24.0	24.0	24.0	24.0	24.0

Table 20. Acidity in beverage by preservation time, %.

Pasteurization temperature, °C	Time of heating, minutes	Preservation time, weeks				
		Initial	1	2	3	4
60	5	0.59	0.65	0.75	0.80	0.88
	10	0.59	0.68	0.72	0.78	0.84
	15	0.59	0.59	0.60	0.64	0.68
70	5	0.59	0.54	0.58	0.63	0.70
	10	0.59	0.53	0.52	0.55	0.57
	15	0.59	0.56	0.55	0.56	0.57
80	5	0.59	0.59	0.56	0.55	0.57
	10	0.59	0.57	0.55	0.56	0.57
	15	0.59	0.59	0.57	0.55	0.56

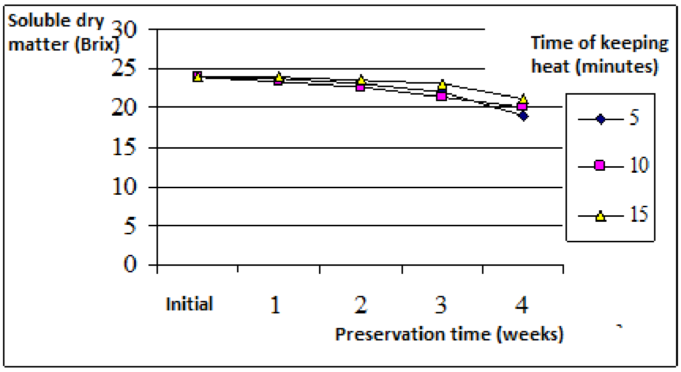

Figure 12. Brix change by preservation time at pasteurization temperature 60°C.

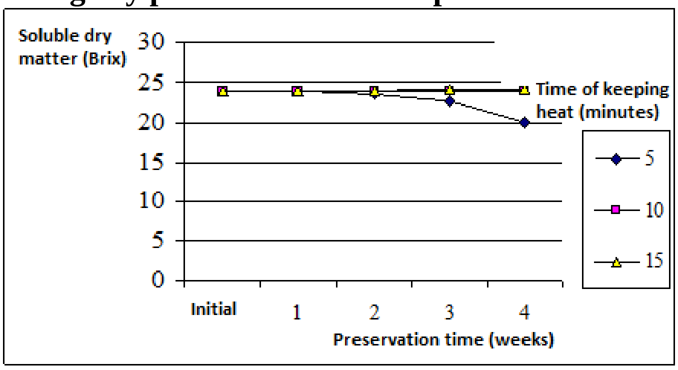

Figure 13. Brix change by preservation time at pasteurization temperature 70°C.

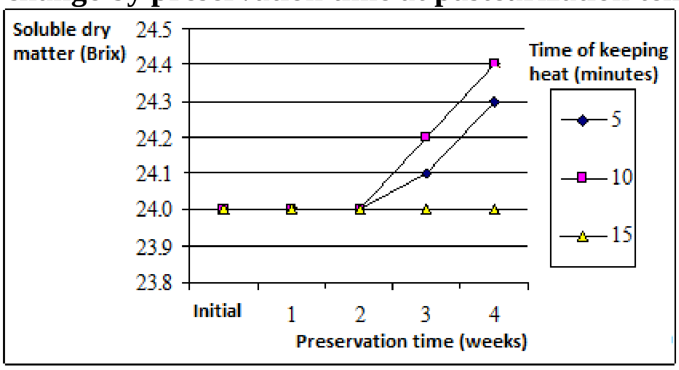

Figure 14. Brix change by preservation time at pasteurization temperature 80°C.

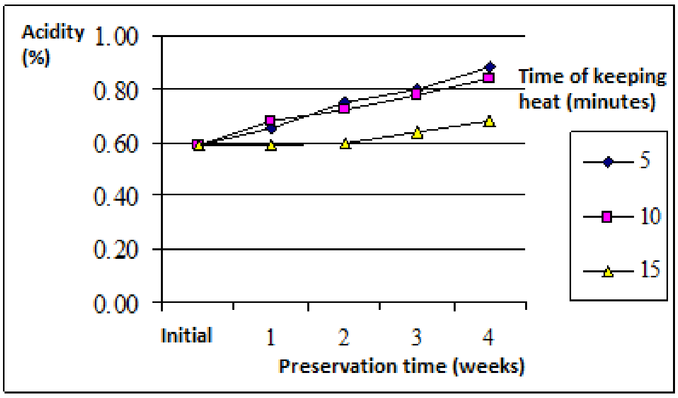

Figure 15. Acidity of beverage (%) change by preservation time at pasteurization temperature 60°C.

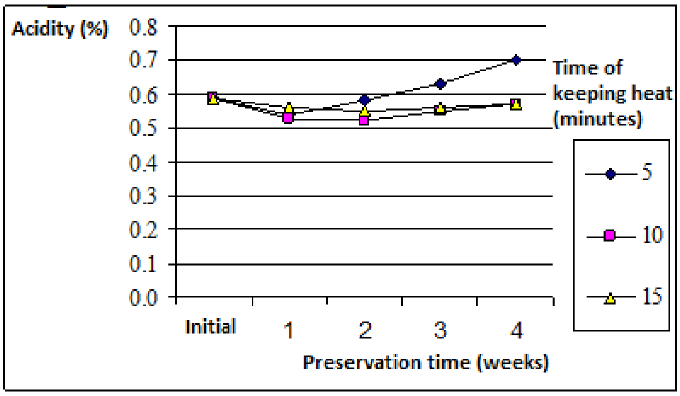

Figure16. Acidity of beverage (%) change by preservation time at pasteurization temperature 70°C.

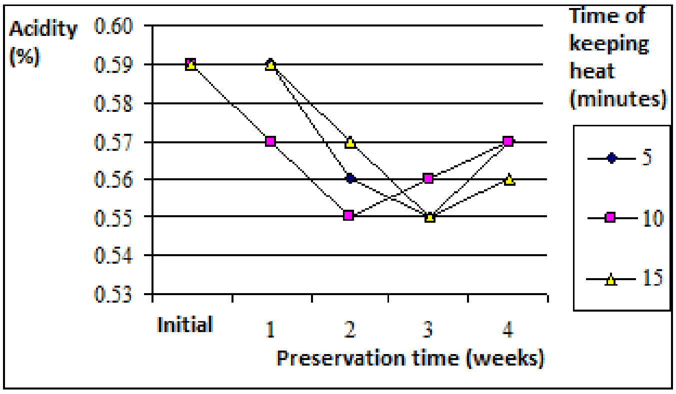

Figure 17. Acidity of beverage (%) change by preservation time at pasteurization temperature 80°C.

The formation of fermented drink products is very favorable environment for the growth of microorganism, microbial norms should be the most important criteria to assess product quality and ensure the product is preserved long term. Here only considers the presence of total aerobic bacteria (TPC). To identify products that were contaminated with microorganisms or not we can determine by biotechnology methods or track changes in degrees Brix and % acids in products. When the brix-acid content decreases and microorganism contamination of impurities will be increased. Means the product has started to exhibit damaged, microbial testing is needed to determine more precisely. If during the process of preserving the Brix products do not change and acid concentrations did not change that means the product is still good and usable.

Table 18 shows the cross check by microbiological methods the sample after sterilization at a temperature of 60^{o}C is not seen in the presence of the TPC. But over time preserving (28 days), then the template is pasteurized at the temperature of 60^{o}C TPC exceeds the allowed presence in products by ISO. Degrees Brix and % acid significantly reduced compared to the original. The cause is at a temperature of 60^{o}C is not enough to destroy the TPC. The early stages were inhibited activity, after a storage time they begin to adapt and operate powerful, nutrient use in the product to grow and increase in biomass reduces the dry matter content of soluble and increase the % of the acid in the products. Result in poor product sensory go remarkably, the product is opaque due to the activity of microorganisms, more sour and rancid smell. So don't choose sterilization temperature of 60^{o}C.

Also Table 18 shows product pasteurization at a temperature of 70^{o}C for 5 minutes, there is not enough time to destroy microorganisms. The early stages were inhibited not work should the Brix and % less acid changes, perception is still acceptable. To the 3rd week onwards, they began adapting, developing and running strong, increasing biomass. Lead to reduced levels of Brix and increased markedly in acid %. Sensory of products is poor and opaque due to the activity of microorganisms, more sour and rancid smell.

Tables 19 and 20 show when product pasteurization at a temperature of 70^{o}C, but for longer time, 10 hours and 15 minutes, the sample in storage time is negligible shift in terms of degrees Brix and % acid in microbial products, maximum amount is 3/1 ml colony forming unit bacterial products (for model with insulating time is 10 minutes). Product pasteurization at a temperature of 70^{o}C within 10 minutes and 15 minutes, there is enough to destroy microorganisms. This also ensures the product preserved for longer. About change of Brix and % acid in Tables 19 and 20 can mass-produce during storage time, the substance is not soluble would be dissolved to make a Brix increased. % acid decrease may be due to acid reacting with alcohol in the ester products reduces the amount of acid. So we choose the pasteurized regime at a temperature of 70^{o}C within 10minutes and 15 minutes.

Tables 18, 19 and, 20 illustrate when product pasteurization at a temperature 80^{o}C, then its better management, degrees Brix and % acidity changed little and without the presence of the TPC. This demonstrates the product not becoming infected. But the taste of the product is changed due to high temperatures do appear to smell the cooking. In terms of perception, then choose the pasteurized at a temperature of 60^{o}C and 70^{o}C within 5 minutes and 10 seconds, the next comment about the possibility of preserving the samples after sterilization, then choose the sample temperature of 70^{o}C pasteurization temperature with time is 10 minutes and 15 seconds and samples of pasteurized at a temperature 80^{o}C. When summing up the above factors, the decision to select pasteurized at a temperatureof 70^{o}Cfor 10 minute heating times as both achieved good sensory valuesand economics.

Conclusion

Jackfruit (*Artocarpus heterophyllus L.*) is one of the important under-utilized fruit which are available in plenty during the season. The overproduction of jackfruit during harvest season and its short shelf-life have caused serious losses for farmers. Fortunately, it is a good source of sugars, proteins and also flavouring compounds making the juice a potential substrate for beverage production. So the production of fermentable product like beverage from the jackfruit is the most suitable processing method to exploit these characters, to find out hygienic and scientific methods

Figure 19. Pasteurized jackfruit beverage

to process the fruit for making fermented fruit beverages using beneficial lactic acid bacteria for long time storage and consumption. This endeavor helps not only to utilize the excess produce of the jackfruit during the season but also ensures the development of a sustained jackfruit processing cottage industry in rural areas. Due to the duration of the limited subject, the study should also examine all the factors affecting product quality. So we also suggest more investigations about the influence of processing methods of sterilization room prior to fermentation as well as other preservation methods such as CO_2.

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