Biotechnological
Communication

BBRC
Bioscience Biotechnology
Research Communications

Biosc.Biotech.Res.Comm. Vol 13 (2) April-May-June 2020 Pp-469-474

Some Variables Influencing The Jackfruit, *Artocarpus heterophyllus* Beverage Production

Minh Phuoc Nguyen
Faculty of Biotechnology, Ho Chi Minh City Open University, Ho Chi Minh City, Vietnam

ABSTRACT

Ripe jackfruit pulp containeds high amount of sugar with specific aroma and taste. There is a growing market for minimally processed jackfruit. In order to increase the added value of jackfruit, we decided to turn jackfruit into one instant beverage. We performed the extraction (ratio of water: jackfruit pulp, temperature and duration of pasteurization); juice formulation; storage. Our results revealed that the jackfruit drink having the highest overall acceptance when extracting with water: jackfruit pulp ratio (50:50) at 90oC in 3 minutes. Jackfruit juice was usually cloudy and colloidal suspensions that have an unstable cloud or the turbidity. The mixture was then cooled to 37°C before the supplementation of pectinase enzyme at 0.06%. The mixture was then incubated in a water bath at 37°C in 60 minutes. After the incubation, the mixture was heated at 100°C for 3 minutes to inactivate all existing enzymes. The hydrolyzed jackfruit juice will be formulated with sugar 3.5%, citric acid 0.06%, carrageenan 1.0%. Jackfruit beverage would be extended its shelf-life for 6 months. The use of pectinase in jackfruit juice processing is essential to get better juice yield, improve filtration rate and produce clear juice.

KEY WORDS: *JACKFRUIT, BEVERAGE*, CARRAGEENAN, PECTINASE, STABILITY.

INTRODUCTION

Jackfruit, Artocarpus heterophyllus is a tropical climacteric fruit, belonging to Moraceae family. Jackfruit tree has a relatively high productivity (Loizzo et al., 2010). Jackfruit has a green to yellow brown exterior rind (Prakash et al., 2009). Jackfruit colour alters from yellowish green to yellow owing to the conversion of chlorophylls, anthocyanins, and carotenoids during ripening (Tiwari and Vidyarthi, 2015). Jackfruit pulp is rich in nutrients including carbohydrates, proteins, vitamins, minerals, and phytochemicals such as carotenoids, favonoids, volatile acids sterols, tannins Arung et al., 2007; Chandrika et al., 2009; Lin and Lu, 1993; Ong et al., 2006; Venkataraman, 2001; and Wong et al., 1992). These functional components have capability to control high blood pressure, heart diseases, strokes, bone loss, anti-infammatory, anticancer, antiulcer, antiaging etc (Swami et al., 2012; S.-C. Fang et al., 2008; Wei et al., 2005). Owing to numerous health benefits, the utilization of jackfruit pulp has increased in recent years (Ruiz-Montanez et al., 2014 Ranasinghe et al., 2019).

The shelf life of the ripe jackfruit pulp is quite short at ambient condition (Andri et al., 2012). It is highly perishable and ofen undergoes favour loss, tissue sofening, and cut surface browning.The fruit softening makes it more susceptible to bruising and mechanical injury. Huge amount of ripe jackfruits undergo quick decomposition owing to lack of proper knowledge on postharvest practices resulting in poor handling and

ARTICLE INFORMATION

**Corresponding Author: minh.np@ou.edu.vn*
Received 8th April 2020 Accepted after revision 29th May 2020
Print ISSN: 0974-6455 Online ISSN: 2321-4007 CODEN: BBRCBA

Thomson Reuters ISI Web of Science Clarivate Analytics USA and Crossref Indexed Journal

Clarivate Analytics   crossref

NAAS Journal Score 2020 (4.31) SJIF: 2019 (4.196)
A Society of Science and Nature Publication,

Online Contents Available at: http//www.bbrc.in/
DOI: 10.21786/bbrc/13.2/16

inadequacy of sanitary practices and storage facilities (Mondal et al., 2013, Jagtap et al., 2011). Application of high yielding jackfruit varieties, together with proper harvesting and postharvest manipulations such as appropriate handling, transportation and preservation, innovation of novel processing technologies, and finding for new implementations to limit postharvest and production losses as well as conversion of jackfruit waste into value-added products would be better options for popularizing the jackfruit cultivation and consumption along with waste management of jackfruit processing industries. Its pulp has been converted into various forms such as jam, jellies, marmalades, and ice creams to improve its economic value (Shamsudin et al., 2009). Fresh-cut jackfruit bulbs may remove the difficulty in separating the bulbs from the rind and conserve time (Saxena et al., 2008). The edible coating prolongs the stability of precut jackfruit (Vargas-Torres et al., 2017).

The efficacies of calcium soaking, osmo-blanching and drying methods on physico-chemical and organoleptic properties of jackfruit slices were studied (Saxena et al., 2015). Salty snacks or chips from jackfruit flesh may attract the consumers. Various products such as jam, jelly, pickle, and squash have tried to developed (Mondal et al., 2013; Shwetha and Ranganna et al., 2018). Jackfruit wine is demonstrated to have good antioxidant properties and protective effects (Jagtap et al., 2011). In order to turn jackfruit pulp into instant healthy beverage, we tried to verify the enzymatic extraction (ratio of water: jackfruit, temperature and duration of pasteurization); formulation; and preservation.

MATERIAL AND METHODS

Material: We collected jackfruit fruit in Hau Giang province, Vietnam. They must be cultivated following VietGAP to ensure food safety. Only technical ripen jackfruit without any defect was selected. After collecting, they must be conveyed to laboratory as soon as possible for experiments. The jackfruit pulp were dehusked, separated from seeds and collected by hand. Apart from jackfruit we also used other ingredients such as sugar, citric acid, carrageenan, petrifilm. Lab utensils and equipments included thermometer, waterbath, viscometer, weight balance, refractometer, colony counter.

Effect of primary juice extraction: Jackfruit pulp was separated from seed by hand. Water was added by various ratio of 30:70, 40:60: 50:50, 60:40, 70:30 to primarily extract juice from jackfruit pulp. The mixture was filtered using a cotton cloth to collect juice. Total soluble solid (oBrix) was indicator to determine the optimal dilution ratio.

Effect of temperature and time in pasteurization: Jackfruit pulp was separated from seed by hand. Water was added by the ratio of 50:50 to primarily extract juice from jackfruit pulp. The mixture was filtered using a cotton cloth to collect juice. This juice will then be pasteurized at different temperature and time (80oC in 5 minutes, 85oC in 4 minutes, 90oC in 3 minutes, 95oC in 2 minutes). Beta-caroten (mg/100g) was indicator to determine the optimal temperature and time in pasteurization

Effect of enzymatic hydrolysis on jackfruit juice: After choosing the suitable dilution ratio (50:50), pasteurization (90oC in 3 minutes) in the primary juice extraction; the sample was then cooled to 37°C before supplementation of pectinase enzyme at different level 0%, 0.03%, 0.05%, 0.07% and 0.09%. The mixture was then incubated in a water bath at 37°C in 60 minutes. After the incubation, the juice was heated in a water bath at 100°C for 3 minutes to inactivate all existing enzymes. Juices were taken to verify sensory, yield, total soluble solids, and viscosity.

Effect of jackfruit juice formulation: The hydrolyzed jackfruit juice will be formulated with sugar (3.5%) different contents of citric acid (0.02%, 0.04%, 0.06%, 0.08%), carrageenan (0.5%, 0.75%, 1.0%, 1.25%). In each sample, we conducted the sensory evaluation to define the optimal contents of citric acid and carrageenan

Preservation: In order to verify the stability of jackfruit beverage during storage, we sampled the microbial (TPC, Coliform, *E. Coli*) at different intervals (2 month, 4 months, 6 months, 8 months). We also carried out the overall acceptance evaluation for jackfruit drink.

Physico-chemical and biological analysis: Jackfruit juice was filtered on a cotton cloth on the volumetric flask. Total soluble solids (TSS) were measured by refractometer. Beta-caroten (mg/100g) was measured by on-line near-infrared spectroscopy (Tamburini et al., 2017). The viscosity (cP) measurement was made by using a viscometer. Overall acceptance was evaluated by a group of panelists using the 9-point Hedonic scale. 3M-Petrilm was utilize to measure TPC, Coliform, *E. coli.*

Statistical analysis: The experiments were run in triplicate with three different lots of samples. Statistical analysis was performed by the Startgraphics Centurion XVI.

RESULTS AND DISCUSSION

Nutritional composition in jackfruit juice: We performed the primary analysis in ripen jackfruit. Our results showed in table 1. From table 1, we could see that durain had a good source of protein (1.51%), low fat (0.23%), high fibre (1.62%) and hihg carbohydrates (23.75%). Our results were similar to data from Ranasinghe et al., (2019), the moisture (72-94%), protein (1.2-1.9%), fat (0.1-0.4%), carbohydrate (16.0-25.4%), fiber (1.0-1.5%), vitamin A (175-540 IU). Rahman et al., (1995) have reported the presence of a high percentage of starch in jackfruit perianth. According to Goswami et al. (2011), the protein content of the flesh of different varieties of ripen jackfruit has ranged from 0.57 to 0.97%. The fiber content of jackfruit was 0.33-0.40% with no significant changes in different portions of the fruit at different ripening stages (B. T. Ong et al., 2006).

Table 1. Nutritional composition in ripe jackfruit pulp

Composition	Value
Moisture (%)	72.89±0.03
Protein (%)	1.51±0.00
Fat (%)	0.23±0.02
Fibre (%)	1.62±0.01
Carbohydrate (%)	23.75±0.03
Beta-caroten (mg/100g)	17.36±0.02

Note: the values were expressed as the mean of three repetitions;

Effect of primary juice extraction Effect of dilution ratio: According to Jadhav et al. (2018), the jackfruit juice contained total soluble solid, protein as 25oBrix, 1.5% respectively. In our research, jackfruit pulp was separated from seed by hand. Water was added by various ratio of 30:70, 40:60: 50:50, 60:40, 70:30 to primarily extract juice from jackfruit pulp. The mixture was filtered using a cotton cloth to collect juice. Total soluble solid was indicator to determine the optimal dilution ratio. Our results were elaborated in table 2. From table 2, we noticed the dilution (water: jackfruit pulp) at ratio of 50:50 appropriated for juice extraction. Comparing to other research, jackfruit must was prepared by diluting the juice as per the treatments (1:1, 1:2. 1:3 and 1:4), dilution level (1:1) recorded highest (11.7 mg/100ml) ascorbic acid content (Jadhav et al., 2018).

Table 2. Effect of dilution ratio in jackfruit juice extraction

Dilution ratio (water:jackfruit pulp)	Total soluble solids of jackfruit juice (oBrix)
30:70	9.85±0.03^{a}
40:60	9.24±0.00^{ab}
50:50	9.02±0.01^{b}
60:40	8.31±0.00^{c}
70:30	7.43±0.02^{d}

Note: the values were expressed as the mean of three repetitions; the same characters (denoted above), the difference between them was not significant (α = 5%).

Effect of temperature and time in pasteurization: Beta-carotene in jackfruit pulp increased gradually with the progress of ripening. The antioxidant activities of jackfruit fresh extracts were correlated with the total phenolic and flavonoids content (Jagtap et al., 2010). Jackfruit pulp was separated from seed by hand. Water was added by the ratio of 50:50 to primarily extract juice from jackfruit pulp. The mixture was filtered using a cotton cloth to collect juice. This juice will then be pasteurized at different temperature and time (80oC in 5 minutes, 85oC in 4 minutes, 90oC in 3 minutes, 95oC in 2 minutes). Beta-carotene (mg/100g) was indicator to determine the optimal temperature and time in pasteurization. Our results were elaborated in table 3. From table 3, we presumed that optimal temperature in jackfruit juice pasteurization should be kept at 90 oC in 3 minutes. Norjana, and Aziah (2011) proved that after the incubation process, the puree was again heated in a water bath at 90°C for 10 min to inactivate the enzyme present.

Table 3. Effect of temperature and time of Pasteurization on beta-carotene (mg/100g) in jackfruit juice

Temperature (°C) and time (minutes) in Pasteurization	Beta-carotene (mg/100g)
80°C, 5 minutes	9.07±0.00^{c}
85°C, 4 minutes	13.75±0.03^{ab}
90°C, 3 minutes	14.59±0.00^{a}
95°C, 2 minutes	12.04±0.0^{2b}

Note: the values were expressed as the mean of three repetitions; the same characters (denoted above), the difference between them was not significant (α = 5%).

After choosing the suitable dilution ratio (50:50), pasteurization (90oC in 3 minutes) in the primary juice extraction; the sample was then cooled to 37°C before supplementation of pectinase enzyme at different level 0%, 0.03%, 0.05%, 0.07% and 0.09%. The mixture was then incubated in a water bath at 37°C in 60 minutes. After the incubation, the juice was heated in a water bath at 100°C for 3 minutes to inactivate all existing enzymes. Juices were taken to verify sensory, yield, total soluble solids, and viscosity. From table 4, we notice that jackfruit juice should be incubated with 0.07% pectinase at 37 °C and in 60 minutes of incubation. Norjana, and Aziah (2011) proved that the juice treated with 0.05% pectinase concentration and 3 hour incubation time was the most preferred. In another report, juice and water ratio for preparation of jackfruit must should be 1:1 and for obtaining the better recovery of wine pectinase enzyme quantity should be 0.10% (Jadhav et al., 2018).

Effect of jackfruit juice formulation: There are different types of stabilizers or thickener suitable for fruit beverage production such as alginate, pectin, carrageenan, gellan, gelatin, agar, modified starch, methyl cellulose and hydroxypropyl methylcellulose (Banerjee and Bhattacharya, 2012). In our research, the hydrolyzed jackfruit juice will be formulated with sugar (3.5%) different contents of citric acid (0.02%, 0.04%, 0.06%, 0.08%), carrageenan (0.5%, 0.75%, 1.0%, 1.25%). In each sample, we conducted the sensory evaluation to define the optimal contents of citric acid and carrageen. The present results are depicted in table 5 where it can be noted that 0.06% citric acid with 1.0% carrageenan would give the best jackfruit beverage.

Preservation: In order to verify the stability of jackfruit beverage during storage, we sampled the microbial (TPC, Coliform, *E. coli)* at different intervals (2 month, 4 months, 6 months, 8 months). We also carried out the overall acceptance evaluation for jackfruit drink. We noted that jackfruit beverage could be stable for 6 months (see table 6).

Table 4. Effect of enzymatic hydrolysis on jackfruit juice

Pectinase (%)	Sensory (score)	Yield (ml)	Total sluble solids (oBrix)	Viscosity (cps)
0	4.18±0.00[c]	325±0.01[c]	9.02±0.01[c]	3.86±0.02[a]
0.03	7.01±0.01[b]	474±0.03[b]	10.65±0.01[b]	2.85±0.03[b]
0.05	7.23±0.03[ab]	491±0.00[ab]	11.17±0.02[ab]	2.56±0.00[bc]
0.07	7.64±0.02[a]	514±0.02[a]	11.86±0.00[a]	2.21±0.01[c]
0.09	7.67±0.00[a]	520±0.01[a]	11.92±0.03[a]	2.19±0.02[c]

Note: the values were expressed as the mean of three repetitions; the same characters (denoted above), the difference between them was not significant (α = 5%).

Table 5. Effect of jackfruit juice formulation on sensory evaluation

Citric acid (%)	Carrageenan (%)				Average
	0.5	0.75	1.0	1.25	
0.02	7.49±0.03	7.84±0.02	8.16±0.00	8.19±0.03	7.92±0.02[b]
0.04	7.73±0.00	7.97±0.00	8.31±0.02	8.35±0.00	8.09±0.01[ab]
0.06	7.98±0.02	8.21±0.03	8.49±0.01	8.52±0.02	8.30±0.02[a]
0.08	8.00±0.01	8.25±0.01	8.63±0.03	8.63±0.01	8.37±0.02[a]
Average	7.80±0.02[c]	8.07±0.02[b]	8.40±0.02a	8.42±0.02[d]	

Note: the values were expressed as the mean of three repetitions; the same characters (denoted above), the difference between them was not significant (α = 5%).

Table 6. Stability of jackfruit beverage during storage

Storage (months)	TPC (cfu/ml)	Coliform (cfu/ml)	E. coli (cfu/ml)	Sensory score
2	1.18x102±0.03[c]	0	0	8.21±0.01[a]
4	2.35x102±0.00[bc]	0	0	8.02±0.03[ab]
6	3.58x102±0.01[b]	0	0	7.94±0.02[b]
8	8.63x102±0.02[a]	0	0	7.15±0.01[c]

Note: the values were expressed as the mean of three repetitions; the same characters (denoted above), the difference between them was not significant (α= 5%).

CONCLUSION

At peak harvesting season, the overproduction of jackfruit (*Artocarpus heterophyllus*) and its perishability have caused significant damage for farmers. High sugar content of the jackfruit pulp makes its possibility for beverage production. We have successfully optimized some technical parameters in jackfruit drink production. Generally jackfruit drink products show more viscosity, low separation and stable shelf-life. Advanced processing technologies and sustainable waste management strategies should be considered when processing jackfruit in commercial scale.

REFERENCES

Andri Cahyo Kumoro, Dewi Riana Sari, Anggun Pangesti Putri Pinandita, Diah Susetyo Retnowati and Catarina Sri Budiyati (2012). Preparation of wine from *jackfruit* (*Artocarpus heterophyllus Lam*) juice using baker yeast: Effect of yeast and initial sugar concentrations. World Applied Sciences Journal 16: 1262-1268.

Arung ET, K. Shimizu, and R. Kondo (1992). Structure-activity relationship of prenyl-substituted polyphenols from *Artocarpus heterophyllus* as inhibitors of melanin biosynthesis in cultured melanoma cells. Chemistry and Biodiversity 4: 2166–2171.

Banerjee, S. and Bhattacharya, S. (2012). Food gels: gelling process. Critical Review In Food Science and Nutrition 52:334-346.

Chandrika UG , E. R. Jansz, and N. D. Warnasuriya (2004). Analysis of carotenoids in ripe jackfruit (*Artocarpus heterophyllus*) kernel and study of their bioconversion in rats. Journal of the Science of Food and Agriculture 85: 186–190.

Elena Tamburini, Stefania Costa, Irene Rugiero, Paola Pedrini and Maria Gabriella Marchetti (2017). Quantification of lycopene, β-carotene, and total soluble solids in intact red-flesh watermelon (*Citrullus lanatus*) using on-line near-infrared spectroscopy. Sensors 17: 746.

Fang SC, C.-L. Hsu, and G.-C. Yen (2008). Anti-inflammatory effects of phenolic compounds isolated from the fruits of Artocarpus heterophyllus. Journal of Agricultural and Food Chemistry 56: 4463–4468.

Goswami C, M. A. Hossain, K. A. Kader, and R. Islam (2011). Assessment of physicochemical properties of jackfruits (*Artocarpus heterophyllus Lam*) flesh. Journal of Horticulture, Forestry and Biotechnology 15: 26–31.

Jagtap UB., S. N. Panaskar, and V. A. Bapat (2010). Evaluation of antioxidant capacity and phenol content in jackfruit (*Artocarpus heterophyllus Lam.*) fruit pulp. Plant Foods for Human Nutrition 65: 99–104.

Jagtap UB, S. R. Waghmare, V. H. Lokhande, P. Suprasanna, and V. A. Bapat (2011). Preparation and evaluation of antioxidant capacity of jackfruit (*Artocarpus heterophyllus Lam.*) wine and its protective role against radiation induced DNA damage. Industrial Crops and Products 34: 1595–1601.

Lin CN and C. M. Lu (1993). Heterophylol, a phenolic compound with novel skeleton from Artocarpus heterophyllus. Tetrahedron Letters 34: 8249-8250.

Loizzo MR, R. Tundis, U. G. Chandrika, A. M. Abeysekera, F. Menichini, and N. G. Frega (2010). Antioxidant and antibacterial activities on foodborne pathogens of Artocarpus heterophyllus Lam. (*Moraceae*) leaves extracts. Journal of Food Science 75: 291–295.

Mondal C, R. N. Remme, A. A. Mamun, S. Sultana, M. H. Ali, and M. A. Mannan (2013). Product development from jackfruit (*Artocarpus heterophyllus*) and analysis of nutritional quality of the processed products. Journal of Agriculture and Veterinary Science 4: 76–84.

Norjana, I. and Noor Aziah, A. A. (2011). Quality attributes of jackfruit (*Durio zibethinus Murr)* juice after pectinase enzyme treatment. International Food Research Journal 18(3): 1117-1122.

Ong, BT S. A. H. Nazimah, A. Osman (2006). Chemical and favour changes in jackfruit (*Artocarpus heterophyllus Lam.)* cultivar J3 during ripening. Postharvest Biology and Technology 40: 279–286.

Prakash O, R. Kumar, A. Mishra, and R. Gupta (2009). Artocarpus heterophyllus (Jackfruit): An overview. Pharmacognosy Reviews 3: 353–358.

Rahman AKMM, E. Huq, A. J. Mian, and A. Chesson (1995). Microscopic and chemical changes occurring during the ripening of two forms of jackfruit (*Artocarpus heterophyllus L.*). Food Chemistry 52: 405–410.

Ranasinghe RASN, S. D. T. Maduwanthi, and R. A. U. J. Marapana (2019). Nutritional and health benefits of jackfruit (*Artocarpus heterophyllus Lam.*): A review. International Journal of Food Science 4327183: 12.

Ruiz-Montanez G, A. Burgos-Hernandez, M. Calderon-Santoyo (2014). Screening antimutagenic and antiproliferative properties of extracts isolated from jackfruit pulp (*Artocarpus heterophyllus Lam*). Food Chemistry 175: 409–416.

Saxena, A A. S. Bawa, and P. Srinivas Raju (2008). Use of modified atmosphere packaging to extend shelf-life of minimally processed jackfruit (*Artocarpus heterophyllus L.*) bulbs. Journal of Food Engineering 87: 455–466.

Saxenam A, T. Maity, P. S. Raju, and A. S. Bawa (2015). Optimization of pretreatment and evaluation of quality of jackfruit (*Artocarpus heterophyllus*) bulb crisps developed using combination drying. Food and Bioproducts Processing 95: 106–117.

Shamsudin, R., C.S. Ling, C.N. Ling, N. Muda and O. Hassan (2009). Chemical compositions of the jackfruit juice (*Artocarpus*) cultivar J33 during Storage. J. Applied Sci. 9: 3202-3204.

Shwetha MS and B Ranganna (2018). Studies on physico-chemical properties of developed jackfruit squash from different genotypes. International Journal of Chemical Studies 6: 966-970.

Swami SB, N. J. Takor, P. M. Haldankar, and S. B. Kalse (2012). Jackfruit and its many functional components as related to human health: a review. Comprehensive Reviews in Food Science and Food Safety 11: 565–576.

Tiwari AK and A. S. Vidyarthi (2015). nutritional evaluation of various edible fruit parts of jackfruit

(Artocarpus heterophyllus) at different maturity stages. International Journal of Chemical and Pharmaceutical Review and Research 1: 21–26.

Vargas-Torres A., A. S. Becerra-Loza, S. G. Sayago-Ayerdi, H. M. Palma-Rodrıguez, M. D. L. Garcıa-Magana, and E. Montalvo Gonzalez (2017). Combined effect of the application of 1-MCP and different edible coatings on the fruit quality of jackfruit bulbs (*Artocarpus heterophyllus Lam*) during cold storage. Scientia Horticulturae 214: 221–227.

Venkataraman K (2001). Wood of phenolics in the chemotaxonomy of the Moraceae. Phytochemistry 11: 1571–1586.

Wei,BL J.-R. Weng, P.-H. Chiu, C.-F. Hung, J.-P. Wang, and C.-N. Lin (2005). Antiinfammatory favonoids from *Artocarpus heterophyllus* and *Artocarpus communis*. Journal of Agricultural and Food Chemistry 53: 3867–3871.

Wong, KC C. L. Lim, and L. L. Wong (1992). Volatile flavour constituents of chempedak (*Artocarpus polyphema Pers*.) fruit and jackfruit (*Artocarpus heterophyllus Lam*.) from Malaysia. Flavour and Fragrance Journal 7: 307–311.