International Journal of Applied Engineering Research ISSN 0973-4562 Volume 13, Number 2 (2018) pp. 1313-1317

Production of Instant Soluble Herb Tea From Soursop Pulp

[1]Minh N. P.[*], [2]Stanly J. H.

[1]Faculty of Food Technology - Biotech, Dong A University, Da Nang City, Vietnam.
[2]Global Food Technolgy Corporation, England.
**Corresponding author*

Abstract

Annona muricata, a precious healthy fruit widely known as graviola or soursop is easily found in most of Vietnam and has long been used as a natural remedy for a variety of illnesses and subject of countless medicinal uses. Pulp of the fruit is eaten and used as an ingredient in many foods and beverages. Tea is drunk daily and often mixed with other herbals. We investigated a production of instant soluble herb tea from soursop pulp by investigating the raw soursop pulp, method of extraction and spray drying to get an optimal processing protocol for herb tea production. Our results showed that raw soursop pulp should be chopped and freeze-dried to 10% moisture; solvent for extraction of soursop herb tea should be 30% ethanol: 1% acetic acid; ratio of solvent to material should be 10:1 in 24 hours at 70ºC by deep soaking. Spray drying conditions to get herb tea powder should be 7% maltodextrin as carrier; 130ºC as drying temperature; 300 ml/h as volumn of input feeding for spraying, 8% of isomalt as supplementation.

Keywords: Soursop pulp, herb tea powder, extraction, spraying, maltodextrin, isomalt

INTRODUCTION

Soursop (*A. muricata)* is native to the warmest tropical areas in Vietnam. *A. muricata* is an evergreen, terrestrial, erect tree reaching 5–8 m in height and features an open, roundish canopy with large, glossy, dark green leaves. The fruit of *Annona muricata* Linn is of economic value and hence cultivated and used widely as an edible food. The fruit is very delicate dark green covered with soft spines. It is relatively large and very thin shell. The flesh is white, creamy, juicy and slightly acidic, measuring 2-3 cm long; it can weigh 2.5 kg (Rosemary I. Uchegbu, 2017). Soursop gives a flavor of custard when it is ripen condition. The soursop flavor has a maximum of 114 volatile compounds (Gajalakshmi, 2012). The fruits of soursop are extensively used to make candies; syrups, ice creams, shakes and beverages (Onyechi, 2012; Kesuma Sayuti, 2015; Nguyen Phuoc Minh, 2015; Sejal Patel, 2016). Soursop also used as food supplement against protein-energy deficiency (René G. Degnon, 2013).

The leaves from the tropical tree *Annona muricata*, also known as Graviola have been reported to have positive and effective properties against anticonvulsant, antiparasitic, anti-arthritic, antimalarial, antidiabetic hepatoprotective and andicancer activities (Leboeuf, 1980; Adewole, 2006; De Souza, 2009; Patrikios Ioannis, 2015). Soursop was used to stop diarrhea, used as muscle relaxant and lower the intestinal acidity (Jaramillo-Flores, 2000; Adewole, 2009; De Sousa, 2010). The granule produced from the juice of soursop fruit has acceptable physical features and proved effective to decrease high blood pressure (Prasetyorini Djarot, 2017). Soursop has been showed to have anti-cancer properties on multidrug resistant cancer cell lines (Rieser, 1996; Kim, 1998; Chang, 2001; Liaw, 2002; Chang 2003; Luna, 2006; Baskar, 2007; Vieira, 2010; Yahaya Gavamukulya, 2014; Yahaya Gavamukulya, 2014; Rajarajan, 2015; Yetri Elisya, 2015).

Over the last several years, Vietnamese local farmers have escapsed poverty by switching to soursop cultivation. The price of soursop is stable and farmers can earn a profit of VND150 million per hecta a year. In order to improve the added value of this fruit, we investigated a production of one functional instant soluble herb tea from soursop pulp by investigating the raw soursop pulp, method of extraction and spray drying to get an optimal processing protocol for instant herb tea powder.

MATERIAL & METHOD

Material

We collected soursop fruits from the South of Vietnam. Soursop fruits should be cultivated following Vietnamese Good Agriculture Practices (VietGAP) to ensure food safety.

Research method

Investigation of raw material storage

We monitored the flavonoid content in soursop fruits in two conditions: normal room temperature, cooling to 10ºC.

Investigation of sun drying for raw material

Our experiment focused on three groups: normal sun drying, conventional drying at 60-70ºC and freeze drying to 10% moisture content. After treatment, we tested these samples in 2 days periodically regarding to flavonoid content.

Investigation of solvent extraction

We investigated the effect of solvent extraction (30% ethanol: 1% acetic acid) in 3 groups: soaking with solvent, deep soaking with solvent and Soxhlet. After treatment, we analyzed flavonoid recovery in these samples.

Investigation of temperature, solvent/material, and time of extraction

Our experiments implemented on the temperature, solvent/material and time of extraction to verify the optimal parameters. Solvent for extraction was selected as 30% ethanol:1% acetic acid. Temperature of extraction was demonstrated as 50°C, 70°C, 90°C. Solvent/ material was demonstrated as ratio of 8:1, 10:1, 12:1. Time of extraction was demonstrated as 12 hours, 24 hours, 36 hours. After treatment, we analyzed flavonoid recovery in these samples.

Investigation of carrier, temperature, input feeding, and isomalt supplementation for spraying

Our experiments focused on testing optimal parameters for spraying such as maltodextrin carrier (5%, 7%, 9%), temperature (110°C, 130°C, 150°C), input feeding (250 ml/h, 300 ml/h, 350ml/h) and isomalt supplementation (6%, 8%, 10%). We analyzed flavonoid content in tea powder.

Sampling method

We collected 1,000 gram in each sample from 3-5 fruits randomly.

Analytical method

Color of soursop tea was measured by colorimeter (Minota); soluble dry matter was counted by refractometer; moisture content was analyzed by drying to constant weight; total flavonoids was measured by high performance liquid chromatography; yeast and mold were counted by Petrifilm (3M).

Sensory analysis

Sensory acceptance was evaluated by consumer satisfaction in score range from 1 to 9 (Hedomic) for the product color and taste.

Statistical analysis

Data were statistically summarized by Microsoft Excell.

RESULT & DISCUSSION

Determination of raw material storage

We monitored the weight change of soursop fruits by time in two different storage conditions: normal room temperature and cooling to 10°C. Our results were as follows:

Table 1. Weight loss of soursop fruits by different storage condition

Days of preservation	Normal room temperature		Cooling to 10°C	
	Weigh loss (%)	Flavonoid (g)	Weigh loss (%)	Flavonoid (g)
0	0	0.068	0	0.068
2	1.24	0.057	1.20	0.066
4	2.46	0.053	2.32	0.062
6	3.45	0.048	2.95	0.059
8	4.33	0.045	3.16	0.055

From table 1, we noticed that keeping soursop fruits in cooling temperature (10°C) was better than keeping in normal one.

Effect of sun drying for raw material

Our experiment focused on three groups: normal sun drying, conventional drying at 60-70°C and freeze drying to 10% moisture content. Our results showed as table 2. We clearly found that freeze drying was the best option to maintain the flavonoid content in soursop pellets.

Table 2. Change of flavonoid in soursop pellets by different drying methods

Days of preservation	Flavonoid (g) in soursop pellets by different drying methods		
	Normal sun drying	Conventional drying	Freeze drying
0	0.068	0.068	0.068
2	0.062	0.064	0.065
4	0.057	0.060	0.063
6	0.050	0.055	0.059
8	0.044	0.053	0.055

Effect of solvent extraction

We investigated the effect of solvent extraction in 3 groups: soaking with solvent, deep soaking with solvent and Soxhlet. Temperature for extraction was kept at 70°C. Our results showed as table 2. We clearly found that Sohxlet was the best choice to obtain as much as flavonoid. However, when applying in the industrial scale, Sohxlet will be not convenient so we believe deep soaking with solvent will be resonable.

Table 3. Recovery of flavonoid (%) in fluid by different extraction methods

Days of preservation	Recovery of flavonoid (%) in fluid by different extraction methods		
	Soaking with solvent	Deep soaking with solvent	Soxhlet
0	69.72	70.18	84.74
2	68.14	69.86	83.78
4	67.35	69.43	82.55
6	65.17	68.78	81.90
8	65.05	66.82	81.57

Effect of temperature, solvent/material, and time of extraction

Our experiments implemented on the temperature, solvent/material and time of extraction to verify the optimal parameters. Solvent for extraction was selected as 30% ethanol:1% acetic acid. Deep soaking was applied in this experiment. Temperature of extraction was demonstrated as 50ºC, 70ºC, 90ºC. Solvent/ material was demonstrated as ratio of 8:1, 10:1, 12:1. Time of extraction was demonstrated as 12 hours, 24 hours, 36 hours. After treatment, we analyzed flavonoid recovery in these samples. Our results depicted as in table 4.

Extraction at 90ºC gave us a little bit higher recovery of flavonoid to the extraction at 70ºC, however we consumped more energy for vapor. Solvent: material at 12:1 gave us a little bit higher recovery of flavonoid to the extraction at 10:1 however it's not benificial in economics. Similarly, extraction in 36 hours will obtain a little bit higher recovery of flavonoid to the extraction at 24 hours but it's too long. So we decided to choose 70oC as extraction temperature, 10:1 as solvent: material extraction, and extraction as long as 24 hours.

Effect of carrier, temperature, input feeding, and isomalt supplementation for spraying

Our experiments focused on testing optimal parameters for spraying such as maltodextrin carrier (5%, 7%, 9%), temperature (110ºC, 130ºC, 150ºC), input feeding (250 ml/h, 300 ml/h, 350ml/h) and isomalt supplementation (6%, 8%, 10%). After treatment, we analyzed flavonoid recovery in tea powder. Our results depicted as in table 5.

Table 4. Recovery of flavonoid (%) in fluid by temperature, solvent/material and time of extraction

Preservation days	**Temperature of extraction**			**Solvent: material**			**Time of extraction**		
	50ºC	70ºC	90ºC	8:1	10:1	12:1	12h	24h	36h
0	68.56	70.15	70.17	68.45	70.21	70.24	66.13	70.25	70.29
2	65.34	69.92	70.02	67.42	69.89	70.04	65.92	70.05	70.22
4	64.12	69.45	69.53	65.22	69.42	69.54	64.34	69.59	70.06
6	63.01	68.88	68.91	64.73	68.74	69.07	63.11	68.76	69.06
8	62.64	67.02	67.14	63.15	67.95	78.01	62.67	67.32	68.08

Table 5. Recovery of flavonoid (%) in soursop tea powder by different spraying parameters

Preservation days	Maltodextrin carrier (%)			Spraying temperature (ºC)			Input feeding for drying (ml/h)			Isomalt supplementation (%)		
	5	7	9	110	130	150	250	300	350	6	8	10
0	68.43	70.25	70.29	68.94	70.35	70.37	68.57	70.24	70.30	68.64	70.33	70.35
2	65.27	69.06	70.04	65.42	70.14	70.20	65.26	69.85	70.01	65.43	69.86	70.01
4	64.44	69.34	69.57	64.21	69.53	69.64	64.22	69.56	69.57	64.22	69.42	69.58
6	63.13	68.75	68.85	63.16	68.69	69.02	63.46	68.72	68.92	63.19	68.74	68.82
8	62.59	67.18	67.40	62.46	67.24	67.29	62.53	67.56	67.26	62.48	67.32	67.75

Spraying parameters were recorded with non-significant difference while comparing 7% and 9% maltodextrin as carrier; 130ºC and 150ºC as spraying temperature, 300 ml/ h and 350ml/h as input feeding, 8% isomalt and 10% isomalt as supplementation. So we decided to choose 7% maltodextrin as carrier, 130ºC as spraying temperature, 300 ml/ h as input feeding, 8% isomalt 10% isomalt as supplementation.

Evaluation on sensory, physical, biological aspects of soursop herb tea powder

Soursop herb tea powder was evaluated color by colorimeter (Minota); consumer tastes by Hedonic scale; soluble dry matter by refractometer; moisture content by drying to constant weight; total flavonoids by high performance liquid chromatography; yeast and mold by Petrifilm (3M). Our results were all acquired TCVN 9740:2013 and ISO 11287:2011.

Table 6. Quality of soursop herb tea powder

Criteria	Preservation days		
	1 month	6 months	12 months
Color value	0.95	0.95	0.95
Consumer tastes (Hedonic)	8.25	8.25	8.25
Soluble dry matter (%)	35	35	35
Moisture (%)	4.5	4.5	4.5
Flavonoid (%)	0.5	0.5	0.5
Yeast and mold (cfu/g)	0	0	0

CONCLUSION

The effects of climate change are now substantially manifested in the Vietnam. One remarkable tree is salinity-tolerantsoursop. Value of ripen soursop for fresh consumption can be accelerated by diversifying it into value added products. We have successfully studied to produce one kind of instant soluble tea powder from soursop pulp. In cultures where it occurs naturally it is known not only as a fragrant tea, but as having health and medicinal benefits as well.

REFERENCE

[1] Adewole, S.O.; Caxton-Martins, E.A. Morphological changes and hypoglycemic effects of *Annona muricata* Linn. (*Annonaceae*) leaf aqueous extract on pancreatic B-cells of streptozotocin-treated diabetic rats. *African Journal of Biomedical Resources* 9: 173-187 (2006).

[2] Adewole, S.; Ojewole, J. Protective effects of *Annona muricata* linn.(annonaceae) leaf aqueous extract on serum lipid profiles and oxidative stress in hepatocytes of streptozotocintreated diabetic rats. *Afr. J. Tradit. Complement. Altern. Med.* 6: 30-41 (2009).

[3] Baskar R, Rajeswari V, Kumar TS. In vitro antioxidant studies in leaves of annona species. *Indian J ExpBiol* 4: 480-485 (2007).

[4] Chang, F. R.; Wu, Y. C. Novel cytotoxic annonaceous acetogenins from Annona muricata. *J Nat. Prod.* 64: 925-930 (2001).

[5] Chang, F. R.; Liaw, C. C.; Lin, C. Y.; Chou, C. J.; Chiu, H. F.; Wu, Y. C. New adjacent Bis tetrahydrofuran Annonaceous acetogenins from *Annona muricata*. *Planta Medica* 69: 241-247 (2003).

[6] De Sousa, O.V.; Vieira, G.D.-V.; de Pinho, J.D.J.R.; Yamamoto, C.H.; Alves, M.S. Antinociceptive and anti-inflammatory activities of the ethanol extract of *Annona muricata* L.leaves in animal models. *Int. J. Mol. Sci* 11: 2067-2078 (2010).

[7] De Souza, R.; Benassi, E.; da Silva, R.R.; Afonso, S.; Scarminio, I.S. Enhanced extraction yields and mobile phase separations by solvent mixtures for the analysis of metabolites in *Annona muricata* L. Leaves. *J. Sep. Sci.* 32: 4176-4185 (2009).

[8] Gajalakshmi S, Vijayalakshmi S, Devi Rajeswari V. Phytochemical and pharmacological properties of *Annona muricata*: A review. *International Journal of Pharmacy and Pharmaceutical Sciences* 4(2):1-6 (2012).

[9] Jaramillo-Flores, M.; Hernandez-Sanchez, H. Thermal diffusivity of soursop (*Annona muricata* L.) pulp. *J. Food Eng.* 46: 139-143 (2000).

[10] Kesuma Sayuti, Rina Yenrina, Rizky Astricia Putri. Antioxidant activity and LC50 of soursop leaves jelly candy with addition of soursop fruit extract (*Annona muricata* L). *International Journal on Advanced Science Engineering Information Technology* 5(1): 10-12 (2015).

[11] Kim, G. S.; Zeng, L.; Alali, F.; Rogers, L. L.; Wu, F. E.; Sastrodihardjo, S. McLaughlin, Muricoreacin and murihexocin C, mono-tetrahydrofuran acetogenins, from the leaves of *Annona muricata*. L. *Phytochem.* 49: 565-570 (1998).

[12] Leboeuf, M.; Cavé, A.; Bhaumik, P.; Mukherjee, B.; Mukherjee, R. The phytochemistry of the annonaceae. *Phytochemistry* 21: 2783-2813 (1980).

[13] Liaw, C. C.; Chang, F. R.; Lin, C. Y.; Chou, C. J.; Chiu, H. F.; Wu, M. J.; Wu, Y. C. *J.* New cytotoxic monotetrahydrofuran annonaceous acetogenins from *Annona muricata. Nat. Prod.* 65: 470-475 (2002).

[14] Luna Jde S, De Carvalho JM, De Lima MR, Bieber LW, Bento Ede S, Franck X, Sant'ana AE. Acetogenins in *Annona muricata* L. (annonaceae) leaves are potent molluscicides. *Nat Prod Res* 20: 253-257 (2006).

[15] Nguyen Phuoc Minh. Production of fermented beverage from soursop fruit. *International Journal of Pure & Applied Bioscience* 3 (2): 231-236 (2015).

[16] Onyechi, Agatha Uchenna, Ibeanu, Vivienne Nkiruka, Eme, Paul Eze, Kelechi, Madubike. Nutrient, phytochemical composition and sensory evaluation of soursop (*Annona muricata*) pulp and drink in South Eastern Nigeria. *International Journal of Basic & Applied Sciences* 12(6): 53-57 (2012).

[17] Patrikios Ioannis, Stephanou Anastasis, Yiallouris Andreas. Graviola: A systematic review on its anticancer properties. *American Journal of Cancer Prevention* 3(6): 128-131 (2015).

[18] Prasetyorini Djarot, Moerfiah Badar. Formulation and production of granule from *Annona muricata* fruit juice as antihypertensive instant drink. *International Journal of Pharmacy and Pharmaceutical Sciences* 9(5): 18-22 (2017).

[19] Vieira GHF, Mourão JA, Ângelo ÂM, Costa RA, Vieira SDF. Antibacterial effect (in vitro) of *Moringaoleifera* and *Annona muricata* against gram positive and gram negative bacteria. *Rev Inst Med Trop Sao Paulo* 52(3):129-132 (2010).

[20] Rajarajan.P and Senthilkumar.R. Assessment of antineoplastic potential of *Annona muricata* Linn. in human cancer cell lines. *International Journal of Pharma and Bio Sciences* 6(3): 1101-1109 (2015).

[21] René G. Degnon, Euloge S. Adjou, Jean-Pierre Noudogbessi, Grâce Metome, Fortuné Boko, Edwige Dahouenon-Ahoussi, Mohamed Soumanou, Dominique C.K. Sohounhloue. Investigation on nutritional potential of soursop (*Annona muricata* L.) from Benin for its use as food supplement against protein-energy deficiency. *International Journal of Biosciences* 3(6): 135-144 (2013).

[22] Rieser, M. J.; Gu, Z. M.; Fang, X. P.; Zeng, L.; Wood, K. V.; McLaughlin, J. L. Five novel mono-tetrahydrofuran ring acetogenins from the seeds of Annona muricata. *J Nat. Prod.* 59: 100-106 (1999).

[23] Rosemary I. Uchegbu, Jacinta N. Akalazu, Kalu U. Ukpai and Irenus C. Iwu. Antimicrobial assessment of *Annona muricata* fruits and its chemical compositions. *Asian Journal of Medicine and Health* 3(1): 1-7 (2017).

[24] Sejal Patel, Jayvadan K Patel. A review on a miracle fruits of *Annona muricata. Journal of Pharmacognosy and Phytochemistry* 5(1): 137-148 (2016).

[25] Yahaya Gavamukulya, Faten Abou-Elella, Fred Wamunyokoli, Hany AEl-Shemy. Phytochemical screening, anti-oxidant activity and in vitro anticancer potential of ethanolic and water leaves extracts of *Annona muricata* (Graviola). *Asian Pacific Journal of Tropical Biomedicine* 4(1): 930-939 (2014).

[26] Yetri Elisya, Yusmaniar, Gloria Murtini. Effect of soursop leaf extract tablets (*Annona muricata L.*) against cancer cells. *Asian Journal of Applied Sciences* (3)2: 244-248 (2015).