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Drying of *Annona reticulata* for Production of Herbal Tea

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Abstract.

Herbal tea plays a vital role in human health care system. *Annona reticulata* L. is well known for its nutritive and medicinal properties. Most important phytochemicals in *A. reticulata* are alkaloids, tannins, flavonoid and phenolic compounds. Drying also has become a widely used way of food processing allowing the extension of shell life. In this research, we investigated an optimization of different parameters for processing of dried *Annona reticulata* slices. We penetrated on the investigation of maturity of *Annona reticulata* fruit, soaking time with Citric acid, blanching time and temperature, sugar concentration and time o soaking, drying temperature to the dried *Annona reticulata* slice quality. We also monitored product shelf-life during preservation. Our result showed that 2 mm in depth of *Annona reticulata* slice, deep soaking in Citric acid 0.2% in 30 minutes; blanching at 95^{o}C in 30 seconds; drying at 40 ^{o}C to get 7.5% moisture content in the dried *Annona reticulata* slice. Shelf-life of this product could be extended to 6 months without deterioration in PA bag.

Keywords: *Annona reticulata, blanching, soaking, drying, shelf-life*

1. INTRODUCTION

Annona reticulata belongs to family Annonaceae (Saad JM et al., 1991). A. reticulata is a small tree of about 6.0-7.5 m in height having glabrous and numerous lateral branches. Its leaves are oblong, cylindrical, and membranous and rounded at the basis (Thang TD et al., 2013). The ill smelling leaves are deciduous, alternate, oblong or narrow lanceolate, 10-20 cm long, 2-5 cm wide, with conspicuous veins. Flowers, in drooping clusters, are fragrant, slender, with 3 outer fleshy, narrow petals 2-3 cm long; light-green externally and pale-yellow with a dark-red or purple spot on the inside at the base. The flowers never fully open. The compound fruit, 8-16 cm in diameter, may be symmetrically heart shaped, lopsided, irregular, or nearly round, or oblate, with a depression at the base. The skin, thin but tough, may be yellow or brownish when ripe, with a pink, reddish or brownish-red blush, and faintly, moderately, or distinctly reticulated (M. Prathapa Reddy et al., 2015). The pulp has insecticidal properties and is used to kill lice. The unripe and dry fruits yields black die. The unripe fruit is considered astringent, anthelmintic, antidysenteric and antidiarrhoeic and used in fever and enlarged spleen. The ripe fruits are alleviating biliousness, thirst and stop vomiting. The flesh may be scooped from the skin and eaten as is or served with light cream and a sprinkling of sugar. Often it is pressed through a sieve and added to milk shakes, custards or ice cream. The raw fruit peel possesses antioxidant and antimicrobial properties (Kaladhar DSVGK et al., 2014). The unripe fruit is rich in tannin; it is dried, pulverized and employed against diarrhoea and dysentery. Seeds are astringent, vermifugal and useful in diarrhea and dysentery; these are irritant to conjunctiva and abortifacient. This plant is reported to possess various biological properties like anti-oxidant, antimicrobial, antiinflammatory, antihelmintic, antipyretic, antihyperglycemic, analgesic, wound healing, antisickling and cytotoxic effects (T. Satyanarayana et al., 2013). Leaf extract of *Annona reticulata* Linn possesses significant hepatoprotective activity (Bijesh Vatakkee, Pramod. C, 2014). These properties are due to the presence of numerous naturally occurring phytochemicals like tannins, alkaloids, phenols, glycosides, flavonoids and steroids (N. Krishdanev and A.D. Meleth, 2010; Koto-Te-Nyiwa Ngbolua et al., 2018).

Drying also has become a widely used way of food processing allowing the extension of shell life. Conventional air drying is the most frequently used because of low- cost drying method in food industry. However, significant quality changes of dried products may occur (Liuping Fan et al., 2012). Oven drying able to dried up herbs more quickly than conventional air drying technique but have a greater chances to loss in flavour, colour and oils due to over dried (P. V. Hung and T. L. Duy, 2012). Freeze drying is method of dehydration of frozen materials by sublimation under vacuum and it could produce the high quality dried foods. However, its major problem is the long drying time needed, which leads to high energy consumption and capital costs (Liuping Fan et al., 2012). The commercial utilization of this fruit is hindered by the lack of adequate processing techniques. A study investigated the effects of different drying methods towards antioxidant, anti-inflammatory and antibacterial of *A. reticulata* leaves extract (Nazira M. et al., 2014). The information about effects of drying towards fruit of *A. reticulata* is rather scarce. Therefore, the objectives of our research were to optimize various parameters for processing of dried *Annona reticulata* slices. We focused on the investigation of Citric acid concentration in soaking; blanching time and temperature, drying temperature to the dried *Annona reticulata* slice quality. We also monitored product shelf-life during preservation.

2. MATERIAL & METHOD

2.1 Material

Figure 1. *Annona reticulata*

Annona reticulata was collected in gardens from Bac Lieu province, Vietnam. After harvesting, they must be stored and conveyed to laboratory within 4 hours for experiments. Besides *Annona reticulata* fruit, we also used other materials such Citric acid. Lab utensils and equipments included pH meter, weight balance, thermometer, refractometer, cooker, drying oven.

2.2 Research method

2.2.1 Effectiness of primary treatment time with Citric acid

The sliced *Annona reticulata* pulp (sliced in 2mm) must be deep soaked in different Citric acid concentration (0.05%, 0.1%, 0.15%, 0.20%, 0.25%). Then the sliced Annona reticulata would be dried at 55^{o}C to 7.5% of moisture content. Optimal parameter was selected owing to the values of total phenolic (mg GAE/g), vitamin C (mg/100g) and sensory score of dried *Annona reticulata.*

2.2.2 Effectiveness of blanching time and temperature

Four levels of blanching temperature (^{o}C) namely (i) 85^{o}C in 60 seconds (ii) 90^{o}C in 45 seconds (iii) 95^{o}C in 30 seconds (iv) 100^{o}C in 15 seconds were carried out. During blanching, all samples were treated with Citric acid 0.20%. The best blanching temperature and time was selected based on the values of total phenolic (mg GAE/g), Vitamin C (mg/100g), sensory score of dried *Annona reticulata*.

2.2.3 Effectiness of drying temperature

Five different levels of drying temperature (35^{o}C, 40^{o}C, 45^{o}C, 50^{o}C, 55^{o}C) were carried out. Before drying, all samples were treated with Citric acid 0.20% and blanched at 95^{o}C in 30 seconds. The best drying temperature was selected based on the values of total phenolic (mg GAE/g), Vitamin C (mg/100g), sensory score of dried *Annona reticulata*.

2.2.4 Observation the shelf-life of finished products

The dried *Annona reticulata* slice must be monitored the changes of a_w, color (avalue) and moisture (%) in finished product by time (0, 2, 4, 6 months) in PA bag to evaluate the product shelf-life.

2.3 Physico-chemical and statistical analysis

Total phenolic (mg GAE/g) content was determined by the method based on oxidation–reduction reaction by Folin–Ciocalteu reagent using gallic acid as a standard. Ascorbic acid content **(**mg/100g**)** was measured by 2,6-dichlorophenolindophenol titration. Sensory score was based on 9-point hedonic scale. Water actitity (a_w) was measured was measured by a water activity meter. Color (a_{value}) was measured by colorimeter. Moisture content (%) was determined by comparing the weights of the sample with the electronic balance.

2.4 Statistical analysis

Data were statistically summarized by Statgraphics Centurion XVI.

3. RESULT & DISCUSSION

3.1 Effectiveness of primary treatment time with Citric acid to sensory characteristics of dried *Annona reticulata* slices

Citric acid treatments strongly affected to sensory characteristics of *Annona reticulata* fruit, especially color and firmness. By 30 minutes of treatment with Citric acid 0.2%, we would get the optimal sensory score of *Annona reticulata* (see table 1) so we decided to choose this value for next experiments.

3.2 Effectiveness of blanching time and temperature

Four levels of blanching temperature (^{o}C) namely (i) 85^{o}C in 60 seconds (ii) 90^{o}C in 45 seconds (iii) 95^{o}C in 30 seconds (iv) 100^{o}C in 15 seconds were carried out. During blanching, all samples were treated with Citric acid 0.20%. From table 2, the optimal blanching time and temperature should be 95^{o}C in 30 seconds.

The application of heat facilitates molecule damage of constituents of pulp by denaturation of protein, evaporation of volatile constituents and gelatinization of starchy material of *Annona squamosa* L. (K. J. Kamble and S. B. Soni, 2010). A study was designed to probe into the effects of blanching and drying treatment of the *Annona squamosa* peel. Results demonstrated that blanching and drying had considerable effects on colour and phytochemical properties of the powdered peel. The colour values revealed that the blanched-dried sample exhibited greater L* value (74.590) at 7 min than the unblanched sample (63.033) dried at 55°C. An increasing trend of lightness (L*) followed with the increase in blanching time and drying temperature. Antioxidant activity for unblanched sample dried at 50°C and sample blanched for 5min and dried at 50°C exhibited better IC_{50} values of 104.712 µg/ml and 148.23 µg/ml respectively. The unblanched-dried (50°C) and blanched-dried (50°C-5min) sample similarly exhibited better retention of total polyphenols, 20.06 ± 0.6mg/mL and 37.9 ± 1.0mg/mL, respectively. Thus, this study suggests that combination of drying temperature of 50 °C and blanching time of 5 min are the optimum processing conditions for good retention of antioxidant property of *Annona squamosa* peel **(**Nilam Roy and Sasikala S, 2016**).**

Table 2. Effect of blanching and time to total phenolic (mg GAE/g), vitamin C (mg/100g) and sensory score of the dried *Annona reticulata*

Blanching	Total phenolic (mg GAE/g)	Vitamin C (mg/100g)	Sensory score
100°C, 15 seconds	5.49±0.00^{ab}	12.68±0.00^{ab}	8.22±0.01^{ab}
95°C, 30 seconds	**5.83±0.03^{a}**	**13.29±0.02^{a}**	**8.40±0.01^{a}**
90°C, 45 seconds	5.21±0.02^{b}	12.20±0.00^{b}	8.09±0.00^{b}
85°C, 60 seconds	4.92±0.03^{c}	9.41±0.03^{c}	7.32±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%).

Table 3. Effectiveness of drying temperature to total phenolic (mg GAE/g), vitamin C (mg/100g) and sensory score of the dried *Annona reticulata*

Drying temperature (°C)	Total phenolic (mg GAE/g)	Vitamin C (mg/100g)	Sensory score
35	6.15±0.01^{a}	14.00±0.02^{a}	8.77±0.02^{a}
40	**6.13±0.03^{a}**	**13.98±0.01^{a}**	**8.75±0.01^{a}**
45	5.99±0.01^{ab}	13.78±0.01^{ab}	8.64±0.00^{ab}
50	5.91±0.02^{ab}	13.51±0.02^{ab}	8.49±0.03^{ab}
55	5.83±0.03^{b}	13.29±0.02^{b}	8.40±0.01^{b}

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 1. Effectiveness of treatment time with Citric acid in different concentration to total phenolic (mg GAE/g), vitamin C (mg/100g) and sensory score of the dried *Annona reticulata*

Citric acid concentration (%)	Total phenolic (mg GAE/g)	Vitamin C (mg/100g)	Sensory score
0.05	4.85±0.01^{b}	11.24±0.02^{b}	5.49±0.01^{c}
0.10	5.01±0.02^{ab}	11.47±0.01^{ab}	6.30±0.03^{bc}
0.15	5.21±0.01^{ab}	11.58±0.03^{ab}	7.11±0.01^{b}
0.20	**5.49±0.00^{a}**	**12.68±0.00^{a}**	**8.22±0.01^{a}**
0.25	5.52±0.01^{a}	12.71±0.01^{a}	7.20±0.03^{ab}

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 4. Physico-chemical and sensory characteristics of dried *Annona reticulata* slice by preservation time

Preservation time (months)	Water activity (a_w)	Color (a value)	Moisture (%)
0	0.35±0.01^{b}	69.58±0.001^{a}	7.50±0.02^{b}
2	0.35±0.02^{b}	69.42±0.03^{ab}	7.56±0.01^{ab}
4	0.36±0.02^{ab}	69.21±0.00^{ab}	7.59±0.02^{ab}
6	0.37±0.00^{a}	69.03±0.01^{b}	7.62±0.01^{a}

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%).

3.3 Effectiveness of drying temperature

Drying is one of the oldest and easiest methods of food preservation known to man and ranges from open sun drying to industrial drying. It is a process that involves the removal of water from food products in order to avoid or to slow down food spoilage by microorganism and deteriorative enzymes. The sliced *Annona reticulata* would be dried at different temperature (35°C, 40°C, 45°C, 50°C, 55°C) to get down to 8% moisture content. The higher temperatre applied the shorter drying time noticed. In table 3, we clearly saw that drying at 40°C was appropriated to get a good product appearance.

A study investigated the effects of different drying methods towards antioxidant, anti-inflammatory and antibacterial of *A. reticulata* leaves extract. 4 type of drying methods were selected namely air dry, freeze dry, oven dry 40°C and oven dry 60°C. Air dried was selected as the best drying method for *A. reticulata* leaves (Nazira M. et al., 2014).

3.4 Shelf-life of finished product

Drying is used to remove water from foods so as to prevent or inhibit micro-organisms, preserve the food, reduce the weight and bulk of the food hence, facilitating for storage (Danso-Boating, 2013). The quality of dried foods is greatly influenced by the drying operation and is judged by the amount of physical, chemical and biochemical changes occurring during the drying process (Jokic *et al.*, 2009). We monitored the changes of a_w, color and moisture in finished product by time (0, 2, 4, 6 months) to evaluate the product shelf-life. After 6 months, we didn't see any change of water activity, color and moisture. However, we noticed a little bit of color change at the 6th month so we strongly believed our products could be intact within 6 months of preservation.

4. CONCLUSION

Annona reticulata L. is one of the useful medicinal plant for various diseases, especially known for its nutritive and medicinal properties. *Annonareticulata Linn* is a multipurpose tree with traditional uses as an antioxidant, antidiabetics, hepatoprotective, cytotoxic activity, genetoxicity, antitumour activity, antilice agent. It is related to contain alkaloids, carbohydrates, fixed oils, tannins & phenolic. Fruits of *A. reticulata* have many medicinal properties like anti-cancerous, antidysenteric, antihelmintic, and astringent, sweet, useful in blood complaints. We have successfully optimized some technical drying parameters for dried *Annona reticulata* slices. By applying different treatment processes, we could preserve this product with high a product shelf-life.

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