Evaluation of Nutritional and Phytochemical Properties of Dried Soursop Seeds

Canadian Journal of Agriculture and Crops
Vol. 5, No. 1, 25-34, 2020
e-ISSN: 2518-6655

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ABSTRACT

Utilization of fruits that possess a large range of medicinal and health benefit is limited due to their fast rate deterioration especially in developing countries. The research study methods of drying as means of preserving seeds of soursop and its effects on its chemical constituents. The samples were dried in the open sun and oven (30- 60° C). The dryer reduces the moisture content from the fresh seed from 42.6% (w.b) between 14.61% (w.b.) for open sun and 19.72% at 30°C and 13.75% (wb) at 60°C for oven drying. Soursop seeds had an increase in value from fresh to dried for the followings; ash, fat, fibre, alkaloid, total phenolic, phylate and flavonoid content. There is reduction in value of soursop from fresh to dried for moisture, crude protein, carbohydrate, tannin and tritatable content. Oven at drying temperature of 40°C had the best result in terms of nutritional and Phytochemicals constituents, which provides the health enhancing effects of the soursop seeds. The result is useful for farmers, researchers, and processors in agro processing industry in designing a reliable machine for processing soursop seeds which will boost production of soursop in Nigeria.

Keywords: *Soursop seeds, open sun and oven drying, proximate analysis, phytochemical constituents.*

DOI: 10.20448/803.5.1.25.34
Citation | Olabinjo, Oyebola Odunayo (2019). Evaluation of Nutritional and Phytochemical Properties of Dried Soursop Seeds. Canadian Journal of Agriculture and Crops, 5(1): 25-34.

Funding: This study received no specific financial support.
Competing Interests: The author declares that there are no conflicts of interests regarding the publication of this paper.
History: Received: 10 September 2019/ Revised: 15 October 2019/ Accepted: 20 November 2019/ Published: 2 January 2020
Publisher: Online Science Publishing

Highlights of this paper

- This study reports drying as means of preserving seeds of soursop and the effects on its nutritional and phytochemical constituents.
- Drying soursop seeds at temperature of 40ºC had little or no effects on nutritional, phytochemicals constituents and health enhancing benefits of the seeds.

1. INTRODUCTION

Annona muricata L. (*A. muricata L.*) indigenously called as soursop is well known for its lusciously sweet-sour taste. *A. muricata L.* has a long, copious record of use in herbal medicine as well as a being use for age indigenously. All parts of the soursop plant are suitable for consumption and use traditionally in the tropics, including the barks, leaves, roots, fruits, and fruit seeds. The fruits are universally utilized for the preparation of beverages, candy, ice creams, shakes and syrups. The fruit is not only recognized as food, but the juice is used as galactogogue to treat diarrhea, heart and liver diseases [1]. Recenly, the medicinal uses of *A. muricata* leaves include treatments for hypertension [1-3] diabetes [2, 4] and cancer [5-8]. The leaves of *A. muricata* are distributed as an ethnomedicine against tumors and cancer [9-11]. Bark and leaf extracts demonstrated contraction in wound [12, 13]. In addition of being a vital raw material for the food industry and a traditional medicinal plant, *A. muricata* possess a huge spectrum of biological activities. Among all former studies on this plant, the most promising activities are found to be its anticancer, anti-parasitic and insecticidal activity.

Beside medicinal uses, this plant provides significant sustenance support to local inhabitants due to its edible and nutritive fruit, leaves, bark. Despite the enormous nutritional and health benefits of the fruits, nearly 40% of the fruits produced are wasted globally every year due to improper processing, handling, packaging, and transportation. Food losses are on the increase in recent times. About 1.3 billion tons of food is predicted to be lost each year [14]. In Nigeria where the agriculture sector contributes more than 30% of the GDP and employs about 70% of the labor force [15], high postharvest losses has continued to be observed in food supply chains of perishable agricultural commodities like fruits and vegetables [16]. Conservatively, 60% of food supply from developing nations like Nigeria is wasted as a result of deterioration [17]. Furthermore, Idah, et al. [18] stated an estimated loss of fruits and vegetables commonly in the tropics occurred between production areas and consumption points to be between 50 – 70%.

Post-harvest technologies comprise of an inter-disciplinary science and skills applied to agricultural commodities as post-harvest for the purport of preservation, conservation, quality control/enhancement, processing, post processing (packaging and handling) and utilization to meet the food and nutritional requirements of the populace in relation to their needs. The research is on the study of drying as a means of preserving the seeds and the need to analyse effects of drying on nutritive and phytochemical properties of soursop seeds which will enhance post-harvest technologies and handling.

2. MATERIAL AND METHODS

2.1. Materials

Soursop fruits were procured from the main market (Oja Oba) in Akure, Ondo State, Nigeria. The samples (seeds) were manually removed and cleaned from the fruits, broken or immature seeds as well as foreign materials were sorted. Figure 1 shows the picture of mature and immature soursop seeds.

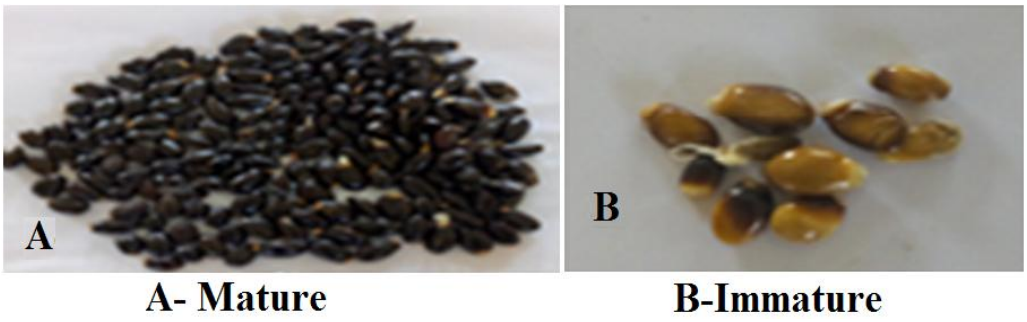

Figure-1. Soursop seeds.

2.2. Chemicals and Reagents

The analytical grade chemical reagents used in the study; 1 - diphenyl - 2 - picrylhydrazyl (DPPH), gallic acid, anthrone reagent and rutin, were procured from Sigma Chemical Co. (St Louis, MO, USA). Tannic acid, ascorbic acid, conc. hydrochloric acid, formic acid, sodium acetate, methanol, Folin – Ciocalteu reagent, potassium chloride, copper sulphate and sodium hydroxide were purchased from Merck (Darmstadt, Germany) and orthophosphoric acid, acetone and sodium carbonate solution were obtained from Rankem (RFCL Ltd, New Delhi, India).

2.3. Methods

2.3.1. Drying Procedures

The sample were placed in a laboratory oven (TT-9083; Gallenkamp Devices, UK) at temperatures 30, 40, 45, 50, and 60 ^{0}C with constant air velocity of 1.4 m/s^2 and open sun drying. The weights of the samples were taken at an interval of 30 minutes until a constant weight was obtained. The experiment was conducted at the Food Processing Laboratory, Federal University of Technology, Akure. All experiments were performed in triplicates.

2.3.2. Chemical Properties

a. Determination of Moisture Content

The moisture content of the seeds was determined by using the hot air (oven) method set at 103 ±2 °C for 72 hours. Four samples were heated in the oven until constant weight was reached using ASABE S352. standard and applied by Okoro and Osunde [19]; Abodenyi, et al. [20]; Oloyede, et al. [21]; Oniya, et al. [22] for soursop fruits and seeds. The experiment was replicated and the average weight recorded. The moisture content was calculated using Equation 1.

$$M.C_{(w.b)} = \frac{M_{b-M_a}}{M_{b-M_c}} \times 100\% \quad (1)$$

where:

MC_{wb} is moisture content (% wet basis).

M_b is the weight of moisture can plus sample weight before oven-drying (g).

$M_{a\,is}$ the weight of moisture can plus sample weight after oven-drying (g).

M_c is weight of moisture can (g).

b. Proximate analysis of Soursop Fruits

The Proximate analysis which include; Ash, fat, protein and crude fiber content of the samples were determined using the standard method of AOAC (Association of Official Analytical Chemists) [23] method.

c. Carbohydrate Determination

The carbohydrate content was determined using Equation 2, AOAC (Association of Official Analytical Chemists) [23].

$$\% \text{ Carbonhydrate} = 100 - (\% \text{ Protein} + \% \text{ Moisture} + \% \text{ Ash} + \% \text{ Fibre} + \% \text{ fat}) \quad (2)$$

2.3.3. Quantitative Phytochemicals Analysis

Fresh Soursop fruit (*Annona muricata*) which have been dried was directly crushed and blended into a fine powder. Powdered crude Soursop was extracted by maceration kinetic in stages using different solvent polarity is n-hexane, ethyl acetate, and ethanol 70% at room temperature until the extracted perfectly, then filtered with cotton and proceed with filter paper, pulp, and each extract n -hexane, ethyl acetate, and ethanol is 70% separated. Each extract was concentrated by vacuum rotary evaporator at a temperature of 45° C to obtain a viscous extract n-hexane, ethyl acetate and ethanol 70%.

i. Flavonoids

2 g of powdered fruit in each different techniques of drying were heated with 10 ml of ethyl acetate in a test tube over a steam bath for 3 minutes. The mixture was filtered and 4 ml of the filtrate was shaken with 1 ml of dilute ammonia solution. Yellow coloration was observed that indicated the presence of Flavonoids [24].

ii. Tannins

2 g of powder simplisia or 0.67 g of n-hexane extract and ethyl acetate extract, 0.15 g of extract ethanol 70% added 100 mL of water, boil for 15 minutes, cooled and filtered. Divided to each 5 mL filtrate (reaction tubes): Added a few drops of solution of iron (III) chloride 1 %, Changes blue or blackish green and Added a few drops of 1 % solution of gelatin to form white precipitate indicates the compounds of tannins.

iii. Phenolics

The total phenolic compounds (TPC) were evaluated by colorimetric analysis using spectrophotometry, as described by Singleton and Rossi [25] with modifications [26] and the absorbance data were registered at 760 nm. The TPC was measured using Garlic acid as standard phenol.

iv. Phytate

The phytic acid content was determined using a modified indirect colorimetric method of Wheeler and Ferrel [27]. The method depends on an Iron to phosphorus ratio of 4:6 and is based on the ability of standard ferric chloride to precipitate phytate in dilute HCI extract of the sample. 5 g of the sample was extracted with 20 ml of 3 % trichloroacetic acid and filtered. 5 ml of the filtrate was used for the analysis; the phytate was precipitated as ferric phytate and converted to ferric hydroxide and soluble sodium phytate by adding 5 ml of IM NaOH.

3. RESULTS AND DISCUSSIONS

The moisture content ranges from the fresh seed 42.6% (w.b) to 13.75% (wb). Moisture content of 14.61% (w.b.) of dried sample was recorded by open sun drying Table 1. The moisture content reduces with increase in drying temperature, however this leads to reduction in drying time. The result implies that the low moisture content value of the seed would therefore hinder the growth of spoilage microorganisms and enhance the shelf life.

3.1. Proximate Analysis of Drying Methods

The result of proximate analysis under different drying methods are stated as follows;

Table-1. Proximate composition of Soursop (Annonna Muricata) Seeds (%).

Nutrient content	Fresh	30°C	40°C	45°C	50°C	60°C	Sun
Moisture	46.51	19.72	18.11	16.10	15.78	13.75	14.61
Ash	5.09	5.91	5.93	5.65	5.76	5.11	5.66
Protein	18.43	17.41	17.57	17.35	17.85	17.79	17.84
Fat	14.99	16.61	16.59	16.36	16.41	15.47	16.39
fibre	14.83	18.69	18.36	18.18	18.18	18.20	18.22
Carbohydrate	32.36	18.37	18.82	19.20	19.33	19.85	19.44

a. Ash Content: The highest ash content of 5.93% was recorded by oven drying at 40ºC compared favorably with the value reported of soursop seed ash content of 5.915% [28]. The value of soursop seed was lower than the value of watermelon seeds (6.00±0.10%) higher than the value of ash content pawpaw, bitter melon (4.00±0.00%) which had the same ash contents, guava seeds (3.00±010%) and cherry seeds (2.00±0.00%) as reported by Mathew, et al. [29]. The sample with the highest ash content had the highest probability of being the one with the highest mineral contents, as the ash content of was taken as a rough measure of the mineral contents of the food material [30]. The result of the ash content of Soursop seeds (5.09 ±0.10%) which was higher than that of citrus seeds (4.60%) signified that soursop seeds will have higher mineral content than citrus seeds [30].

b. Crude Protein: The crude protein content value ranges from 17.35 to 18.52. The fresh seeds had relatively the highest value followed by open sun drying of 17.84 and least recorded by oven drying method Table 1. High amount of protein is essential for animal growth and increased milk production [31]. In developing countries like Nigeria, Plant proteins are broad source of food nutrient especially for the less privileged population. Proteins have huge molecules and act as an alternative energy source when other energy sources are inadequate in supply. They are building block units and food protein is needed to make major hormones, essential brain chemicals, antibodies, digestive enzymes, and necessary elements for the manufacture of DNA. The crude protein of soursop seeds of 18.52% is higher than cherry seeds crude protein content which was 7.00±0.04% and lower than reported protein content of watermelon, orange, grape and white roselle seeds which were found to be 21.50±0.13, 20.20, 21.40 and 22.70% respectively by Gerner and Poiters [32].

c. Crude Fiber: The crude fiber changes from 14.826% fresh samples to 18.69% under oven drying at 30ºC with oven dryer at 40ºC having a relative higher value of 18.36% Table 1. The seeds of *Annona muricata* contained crude fiber value of 18.69% which is higher when compared to pawpaw seeds (14.02 ±0.20%), Bitter melon seeds (12.00 ±0.20%), guava seeds (12.00 ±0.20%), and Cherry seeds (10.00 ±0.00%) as reported by Mathew, et al. [29]. Fiber purified the digestive tract by removing potential carcinogens from the body and aid the stoppage or absorption of excess cholesterol. Fiber acts as large concentrate to the diet and reduce the intake of excess starchy food [33] and may guard against metabolic activities such as hypercholesterolemia and diabetes mellitus [34]. The huge amount of fiber in *Annona muricata* seeds can help in keeping the digestive system in normal, healthy and functioning properly. Adequate intake of dietary fiber can lower the serum cholesterol level, risk of coronary heart disease, hypertension, constipation, diabetes, colon and breast cancer [34]. This is a nutritionally significant because fiber helps to improve gastro-intestinal tract functions and also helps to reduce absorption of excessive cholesterol by removing potential carcinogens from the body [35].

d. Fat Content: Fats play vital role in maintaining health skin and hair, insulating body organs against shock, maintaining body temperature and promoting health cell function. It is also vital in diets as they enhance the pleasant taste of food by absorbing and retaining their flavours [36]. This study also reveals that the seeds of soursop oil ranges from 14.987 % fresh sample to 16.607 % under oven drying at 30ºC and open sun of about 16.386 %. *Annona muricata* seed had a crude fat value of 16.386% the value is higher than crude fat of cherry seeds as reported by Mathew, et al. [29]. The crude fat contributes to the energy value of *Annona muricata* and could be source of oil.

e. Carbohydrate Content; The carbohydrate constitutes a major class of naturally occur organic compound which is essential for maintenance of both plant and animals. The carbohydrate content reduced from 32.356% after being dried to about 19.527 -18.369% under different drying methods as shown in Table 1. Thus, the carbohydrate content contributes to the energy value in *Annona muricata.* Carbohydrates are crucial for the maintenance of life in both plants and animals and also act as main input materials for many industries [37]. Carbohydrates produced by plants are one of the three major energy sources in food, along with protein and fat. Dietary fat increases the palatability of food by absorbing and retaining flavours [38].

3.2. Quantitative Phytochemical Screening

Phytochemical analysis helps detect the chemical constituents of plants extract in search of bioactive agents as basis for drug synthesis [39]. The phytochemical analysis of Soursop seeds as reveals a variation in the concentration of compounds such as alkaloids, phenols, phylate, and tannins, using different drying methods. The presence of tannins and phenol as the major constituents and trace amounts of flavonoids, alkaloids and phylate contribute immensely to the bioactivity of *A. muricata* and also to its usage in treating various diseases.

Table-2. Quantitative phytochemical analysis of Soursop seed under different drying methods.

Drying methods	Tannin (mg/100g)	Phylate (mg/kg)	Tritatable (mg/g)	Alkaloid (mg/100g)	Phenol (mgGAE/l)	Flavonoid (mg/100g)
30°C	4.53	100.33	1.27	16.65	126.8	5.47
40°C	4.82	94.45	1.36	16.73	120.1	5.69
45°C	4.51	91.73	1.44	16.89	120.3	5.62
50°C	3.95	91.24	1.48	16.84	118.5	5.71
60°C	3.72	90.55	1.55	16.91	113.4	5.89
Sun	3.67	100.22	1.32	16.21	119.7	5.58
fresh	7.92	90.03	1.84	16.36	113.39	5.17

3.3.1. Effect of Drying Methods on the Phytochemical Analysis

a. Flavonoid

The flavonoid increases from 5.17 mg/100g of fresh sample to 5.89 mg/100g at 60°C. Flavonoids are polyphenolic compounds that are ubiquitously present in practically all dietary plants, like fruits and vegetables.

The phytochemical result has been reported to contained flavonoids and phenolic that are free radical scavengers that prevent oxidative cell destruction and have high anticancer activities [40, 41] and they might accelerate mechanism that affect cancer cells and inhibit tumor invasion [42]. These activities could be the potential for their ability to neutralize and allay free radicals [40, 41, 43].

b. Tannin

Tannin in soursop seed ranges from 7.92mg/100g in fresh sample and the least value was recorded 3.63 mg/100g from open sun drying. Tannin content decrease in all the drying methods used in this research as shown in Table 2. Herbs that had tannins in their component are astringent in nature and are used for the curative measure of intestinal disorders such as diarrhoea and dysentery [44] thus confirming the reasons why *Annona muricata* plants is being used for the treatment of microbial infection. Tannins are known to be useful for the avert of cancer as well as curative measure of inflamed or ulcerated tissues [45-47].

c. Phenolic

The phenolic content increased progress for all the dried seeds. The phenolic content value ranges from 113.2 mg GAE/100g (fresh seeds) to 126.8 mg GAE/100g (oven drying at 30°C).

d. Phylates

The result showed rapid increase in the phylate from 90.03 mg/kg fresh sample to 100.33 mg/kg dried sample at 30°Cand open sun drying of 100.22 mg/kg Table 2. Oven drying which happens to be the highest based on phylates value followed by open sun drying were not an appropriate means of drying the seeds.

e. Alkanoid

The result showed rapid increase in the Alkanoid from 16.36 mg/100g fresh sample to 16.91 mg/100g dried sample at 60°Cand open sun drying of 16.21 mg/100g Table 2. The values of alkanoid increases with an increase in Oven drying temperature.

f. Tritatable

The tritatable value (citric acid content) reduced from 1.84mg/100g(fresh) to 1.27mg/100g at 30°C Oven drying. Oven drying method at 60°C had the highest value (1.55 mg/100g) of tritatable value.

4. CONCLUSION

The health benefits of eating generous amounts of fruits, whether fresh, frozen, canned, juiced or dried are invaluable. The proximate values of soursop seeds using different methods of drying shows that it may be the combination of nutrients and other substances (Phytochemicals) rather than the individual nutrients themselves, which provides the health enhancing effects of the soursop seeds. It was observed that temperature higher than 45±1°C should not be used in drying soursop seeds due to its reduction effects on proximate contents and other chemical compositions of the seeds. Preserving the seeds will make it available all year round which will aid further research.

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