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## RESEARCH ARTICLE

# PHYSICOCHEMICAL, NUTRITIONAL AND FUNCTIONAL PROPERTIES OF *ANNONA MURICATA* FRUIT PUREE AND JUICE

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**ABSTRACT**

This work had been made to determine the physicochemical, nutritional and functional properties of *Annona muricata* fruit puree and juice. Nine lots of juice were produced. The batches differ from each other by the pH or the dilution rate of the puree. The pH values of the types of juice produced were 3; 3.5 and 4.5; the dilution rate (water/mash) are 50/50, 60/40 and 33.33/66.66. Only the puree went under the physicochemical, nutritional and functional analyzes and as for the juice, the pH, titratable acidity, soluble sugar content and dry matter were the parameters evaluated. The characterization of the puree showed that it was pasty, sweet and acidic with a pH of 4.45 ± 0.1, a consistency of 18 ± 0.0 cm / 30s and a Brix degree of 10.5 ± 0.2. As for the physicochemical composition, the results showed that this puree contains 80% water and the composition per 100 g of mash gives glucose contents of 17.95 ± 0.05 g, proteins of 1.1 ± 0.01 g and lipids of 0.00 g. The functional properties revealed that this mash has an antioxidant capacity ($IC_{50}$ = 18.97 ± 0.46 ppm), with a total polyphenol content of 141.24 ± 0.14 mg-eq/100 g, a tannin content of 0.22 ± 0.03 g-eq/100 g, and a vitamin C rate of 1.66 ± 0.02%. However, the mash is devoid of anthocyanins. The analysis of the juicerevealed that the soluble sugar content varied from 3 to 5°Bx, the titratable acidity from 0.486% to 0.729% and the dry matter from 1.942% to 5.360%. The juice and particularly the puree studied are therefore rich in nutrients with interesting functional properties. Puree, acidic, pasty and consistent, with its antioxidant activity could then be an interesting food.



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## INTRODUCTION

The genus *Annona*, from the family of Annonaceae, comprises about 60 species, mainly from American. The well-known ones that carry edible fruits are *A. reticulate* Linn., *A. squamosa* Linn., *A. cherimola*, Mill. and *A. muricata* Linn (soursop tree also called graviola). The latter is the most tropical one and best suited for conservation and processing (Morton, 1966). The soursop tree, *Annona muricata*, is a small tree of the family Annonaceae, from South America, grown in the tropics for its edible fruits called soursop (Hutchinson, 1964). Its fruits contain natural compounds of characteristic structures possessing powerful biological properties, especially antiparasitic, insecticidal, antifungal and anti-tumor (Chithra, 2016). Several research on extracts of graviola helped discover antiviral, antiparasitic, antirheumatic, anti-inflammatory and antihyperglycemic properties; it has also been used as an antidepressant and at least one study has been shown to be effective against cancer cells (Filho, 2011 and Oberlies, 1997). Annonaceae are also used in traditional medicine in a variety of indications. The Health Sciences Institute, in the USA, revealed in the early 2000s that soursop therapy is 10 thousand times stronger than chemotherapy (Mclaughlin, 2008). But despite all the potential that tropical countries have, the cancer rate is still rising. The International Agency for Research on Cancer (IARC), a specialized agency of the World Health Organization on cancer, published in 2013, the latest data on the incidence, the mortality and prevalence of cancer in the world. The new version of the IARC online database (Ferlay, 2012), provides the most recent estimates for 28 types of cancer in 184 countries and provides a comprehensive overview of the global cancer burden. Ferlay *et al*. (Ferlay, 2012) uncovers outstanding trends in cancer in women and shows that at the global level, priority must be given to measures to prevent and fight breast and cervical cancer. In 2012, the global cancer burden is 14.1 million of new cases and 8.2 million of cancer deaths according to Ferlay *et al*. (Ferlay, 2012), compared to 12.7 million and 7.6 million in 2008, respectively. The most common causes of cancer deaths were lung cancer (1.6 million deaths, 19.4% of the total), liver (0.8 million deaths, 9.1% of the total) and stomach cancer (0.7 million deaths, or 8.8% of the total). Projections based on Ferlay *et al*. (Ferlay, 2012) estimates anticipate a substantial increase of 19.3 million of new cancer cases per year now till 2025 due to the population's growth and its aging. Thus, facing the diagnosis of cancer, patients often seek complementary therapies in addition to the medical treatments (Zine, 2018). In addition, the family of Annonaceae has an economic importance because it is a source of edible fruit with mainly the genus *Annona* (Morton, 1966). This research is part of an approach which promotes of the consumption of the fruits of the soursop through the characterization physicochemical, nutritional and functional properties of the soursop puree and by ricochet, attenuation of the increasing effects of the soursop Cancer.

## MATERIALS AND METHODS

### Materials

**Plant material:** The material used in the present study is *Annona muricata* (Photo 1) fruits. These fruits were bought from the local markets of Ouando in the department of Ouémé, Tokpa and Ganhi in the Littoral department in Benin.

**Photo 1.** ***Annona muricata*** **tree with fruits**

**Equipment:** The extraction of the puree was made by the SOVIGUIDI type Expeller screw press (PVETS). The soursop juice was produced with the puree by adding water. Citric acid has been used to adjust the pH of juices.

**Small production equipment:** The small production equipment consists of Chinese Type Expeller Screws (PVETC), gloves, mufflers, basins and pots, knives, skimmers, cups, a sieve, bottles, a work table and soap. The gloves and the muffler were used to avoid contaminating mashed potatoes and juice. Basins and pots served to contain the raw material and juice. The knives were used to cut the fruits. The skimmers were used to skim the juice. The cups allowed easy bottling of juices. The work table served as a work surface. The sieve was used to filter mashed potatoes and juice. 33 cl bottles, capsules, labels were used for packaging and packing the products. Soap and bleach to wash and disinfect production equipment.

**Small sample analysis equipment:** The analysis equipment for juice and puree samples consists of a thermometer, a refract meter (REF 103/113/103/bp), a pH-meter (Inolab), a DBS 60 desiccator, a CAMRY scale, a Heraeus oven (wilten/woltil/Bill), a DNP model incubator, a UVILINE 9100/9400 AQUALABO visible/UV/benchtop spectrophotometer, a vortex and crucibles. The thermometer and pH meter were used to measure respectively the temperature and pH of the product. The refractometer has made it possible to measure the soluble dry matter concentration of the juice. As for the other apparatus, the desiccator made it possible to preserve the samples of the humidity; the scale was used to weigh the samples; the oven made it possible to determine the dry matter; the incubator was used to grow microorganisms; the UV-visible spectrophotometer was used to measure the absorbance, the vortex is used to stir the mixtures.

### Methods

The first phase of this study involved the production of the mashed potato which was used as a raw material for juice production. This puree (Photo 2) is obtained by applying the method described in Figure 1.

**Photo 2.Puree of** ***Annonamuricata fruit***

**Production of soursop puree:** At the reception, the fruits were sorted to retain those that are ripe and firm, washed once, cut and trimmed. The fruits are peeled and pressed without being heated or seeded. Extraction consisted of squeezing the fruits in press until the maximum withdrawal of the puree. After extraction, the mash was collected, pasteurized and packaged in 1 liter glass jars.

**Soursop juice production:** As part of the work, several lots of soursop juice were produced. Soursop puree is removed from the pulp by filtration using a filter cloth. The resulting filtered puree of light flavor served as a basis for juice production. Nine (09) lots of juice are produced at the rate of 2 bottles of 33 cl per lot. The batches differ from each other by either pH or dilution ratio (Table 1).

**Production of diluted juice of 1L / kg:** 1kg of puree was weighed and diluted with 1L of water and filtered.

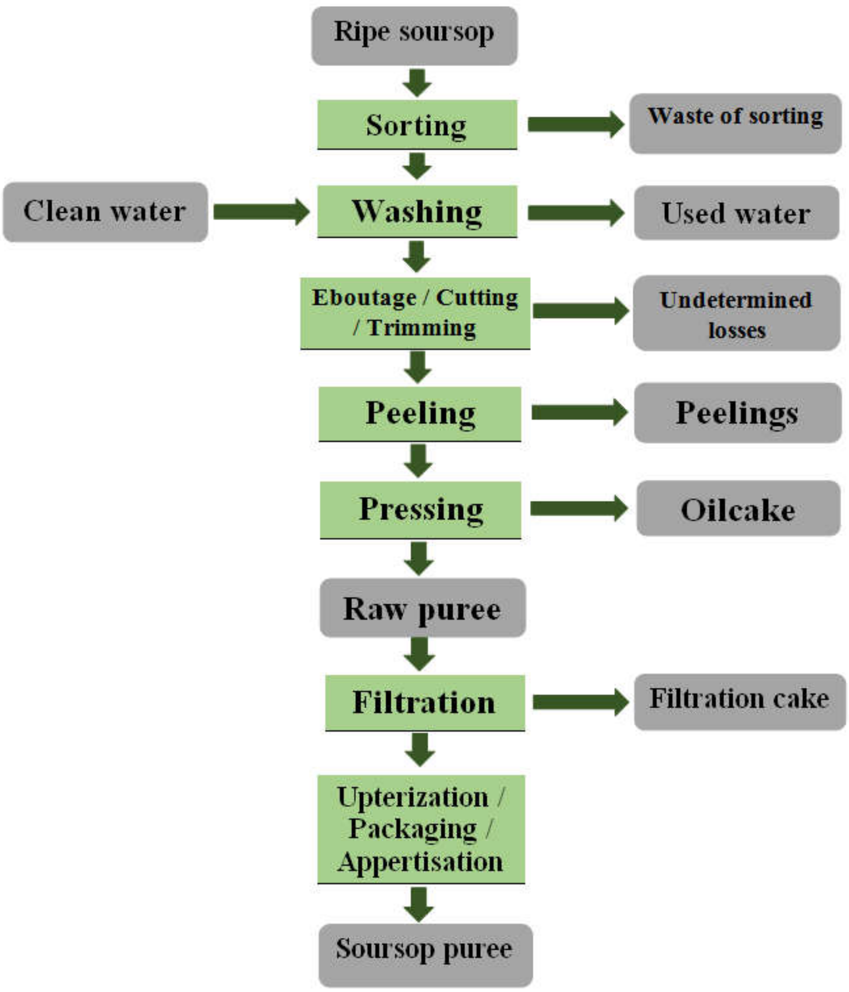


**Figure 1. Production process of the soursop puree with the SOVIGUIDI type expeller press**

**Table 1. Method of producing soursop juice samples**

| | Dilution rate (volume of water / mass of puree) | | |
|---|---|---|---|
| PH | 50/50 | 60/40 | 33 ,33/66,66 |
| 3 | $J_1$ (4,555 ml Ac. C) | $J_2$ (3,640 ml Ac. C) | $J_3$ (3,0366 ml Ac. C) |
| 3.5 | $J_4$ (4,555 ml Ac. C) | $J_5$ (3,640 ml Ac. C) | $J_6$ (3,0366 ml Ac. C) |
| 4 | $J_7$ (4,555 ml Ac. C) | $J_8$ (3,640 ml Ac. C) | $J_8$ (3,0366 ml Ac. C) |

The filtered juice was pasteurized at 85 ° C for 30 minutes, then its pH was reduced to 4 with 4.555 ml of citric acid. Then we had a soursop juice at 1L / kg (50% water for 50% puree) and pH 4 and labeled J7. To the rest of the juice, citric acid was added so as to have a pH of 3.5 and then pasteurized, packaged and labeled $J_4$. Citric acid was added to the remaining portion of the remaining juice to a pH of 3 ($J_1$) and the same conditioning technique applied. Thus, from a juice diluted to 1L / kg, we obtained 3 juices with the same dilution but with respective pH 4; 3,5 and 3. Then 1 kg of puree was removed and diluted with 1.5 L of water (60% water for 40% puree). Finally, 1kg of puree was diluted with 2 L of water (33.33% water for 66.66% puree). Then we operated as before.

**Sterilization method for bottles and capsules:** Bottles and capsules are first washed with soap and water and then rinsed with tap water. They are then quenched in boiling water for about thirty minutes. Bottles and capsules thus treated should no longer be exposed to the air or put in dirty containers to prevent further contamination.

Determination of physicochemical, microbiological and functional parameters of mashed potatoes. These analyzes are intended to evaluate the quality of *Annona muricata* fruit puree and juice by their chemical and functional composition.

**The methods of physicochemical analysis are as follows:** Dry matter was determined according to AACC 44-15A (AACC, 1984). It corresponds to the loss of mass experienced by the sample after heating in an oven at 103 ± 2 °C to constant weight. The soluble sugar content was determined by measuring the refractive index. The refractometric index (IR) characterizes the soluble solids content and is expressed in Brix degree (° Bx). The consistency of the mash is expressed by the flow velocity measured with a Bostwick consistometer. The distance traveled by the front of the purée, marked on the graduated surface, indicated the flow velocity (in cm / 30 sec). The titratable acidity is determined according to the standardized method NF V04-350, 1985 (Amiot, 2002). It is expressed in% of citric acid relative to the dry matter of the sample.

**Bromatological analyzes:** Crude protein content was determined on soursop syrup samples using the Kjeldahl method (AOAC, 1984). The method of determining lipid content is that of Soxhlet (AACC, 1984). It consists in extracting the free lipids from the sample with petroleum ether, which is evaporated subsequently.

**Mineralogical analyzes:** The method for the determination of mineral salts and trace elements is based on ISO / TC 27 / SC 5. Calcium (Ca), phosphorus (P) and iron ($F_e$) are determined by atomic absorption spectrophotometry from the ashes. The method is that of the standard NBN EN ISO 6865: 2000. This method consists of treating with formic acid the fraction of the purée having resisted hydrolysis during the hydrolysable carbohydrate assay.

**Phytochemical analyzes:** The methods are following: The measurement of the anti-radical power was the one which consists in trapping the free radicals of DPPH (2.2-diphenyl-1-picrylhydrazyl) (Sanchez-Moreno, 1998 ; Scherer, 2009; Fagbohoun, 2014). This method of DPPH was based on the reduction of an alcoholic solution of the stable radical species $DPPH^•$ in the presence of a hydrogen donor antioxidant (HA), which resulted in the formation of a non-radical form, the DPPH-H. The tannins are proportioned by the method of (Trease, 2009). This rate was given using a standard curve constructed from a range of gallic acid concentration. The determination of total polyphenols was done by the method of (Boizot, 2006). It used the Folin Ciocalteu reagent.

The coloration produced was proportional to the amount of polyphenols present in the plant extracts, whose maximum absorption was between 700 and 760 nm. The estimated of the anthocyanin content was carried out by the method of (Cam, 2009). Anthocyanins were assayed by the pH difference method. This anthocyanin assay was based on the color changing of anthocyanins at different pH. The determination of vitamin C was made by spectrophotometry (Linden, 1981).

**Sensory evaluation methods:** The sensory analysis of juice was done through a panel of 20 naive tasters. Each taster received a set sheet and a personal evaluation one. Acceptability was defined from the appearance frequency of a juice which criteria was the most loved. Finally acceptability defines the most liked juice.

## RESULTS

Physicochemical, functional, microbiological, characteristics and sensory quality of *Annonamuricata fruit* mash.

**Physicochemical characteristics:** The results obtained during the characterization of the mash are presented in Table 2. The results obtained from the physicochemical characterization show that the soursop puree is acidic and consistent. Indeed, the mash has a pH of the order of 4.45 ± 0, a titratable acidity of 1.455 ± 0.001% and a consistency of 18 cm / 30 s has a high water content of 80 ± 1%.

**Bromatological characteristics:** The results of the bromatological analyzes obtained during the characterization of the mash are presented in Table 3. The analysis of the results of the bromatological tests shows that the *Annona muricata* fruit puree is essentially carbohydrate with a carbohydrate value of 17.95 ± 0.05 / 100 g of purée whereas it is devoid of lipids with a value of 0 / 100g puree. In addition, the puree contains a very low protein value of 1.1 ± 0.01 / 100 g of puree.

**Table 2. Physicochemical characteristics of 100 g of mashed potatoes**

| Parameter | Averages | Référence values∗ | Référence fruit |
|---|---|---|---|
| Water (%) | 80±1.00 | 85 | *Annonasquamosa* |
| Consistancy (cm/30s) | 18±0.00 | 15 | *Annonasquamosa* |
| pH | 4,45±0.00 | 4,85 | *Annonasquamosa* |
| Titratrableacidity (%) | 1,455±0,001 | 1,5 | *Annonasquamosa* |

∗ Reference values proposed by Enweani *et al.* (2004).

**Table 3. Bromatological characteristics of 100 g of puree**

| Parameter | Averages | Reference values∗ | Reference fruit |
|---|---|---|---|
| Water (%) | 80.00±1.00 | 85.00 | *Annonasquamosa* |
| Energy (Cal) | 78.00±1.00 | 200.00 | *Annonamuricata* |
| Proteins (g) | 1.10 ± 0.01 | 3.10 | *Annonamuricata* |
| Carbonhydrates (g) | 17.95±0.05 | 50.30 | *Annonamuricata* |
| Lipids(g) | - | 9.00 | *Annonamuricata* |
| Soluble sugar (°Brix) | 10.50 ±0.00 | 12.00 | *Annona squamosa* |

∗ Reference values proposed by Enweani *et al.* in 2004.

**Table 4. Mineralogical characteristics of 100 g of mashed potatoes**

| Minerals | Averages | Reference values∗ | Reference fruit |
|---|---|---|---|
| Calcium (mg/100g) | 30.00 ±0.00 | 43.00 | *Annona muricata* |
| Iron(mg/100g) | 0,70 ±0,10 | 1.90 | *Annona muricata* |
| Phosphorus(mg/100g) | 25.00 ±5.00 | 83.00 | *Annona muricata* |

∗ Reference values proposed by Enweani *et al.* (2004).

**Mineralogical Characteristics:** The results of the mineralogical analyzes carried out are presented in Table 4. The results of the mineral characterizations show that the puree contains 30 ± 0 mg calcium, 25 ± 5 mg of phosphorus and 0.7 ± 0.1 mg of iron per 100 g of mash.

**Phytochemical characteristics:** Seeing the photochemical characteristics, it is found that soursop puree is biologically active. It has an antioxidant power of 18.97 ± 0.46 ppm and contains total tannins, total polyphenols and vitamin C respectively of 0.22 ± 0.03 g eq / 100g, 141.24 ± 0.14 mg -eq /

100g and 1.66 ± 0.02%. On the other hand, it is devoid of anthocyanins.

**Characteristics of juices made from *Annona muricata* fruit puree:** The characteristics of the juice are presented in the following Table 6.

represented following two axes. The first two axes carry all the information contained in the matrix, and are very largely sufficient to bring out the correspondences. Thus, it can be seen that axis 1 groups the information on juice $J_1$, $J_2$, $J_3$, $J_4$, $J_6$, $J_7$, $J_8$ and $J_9$ while axis 2 only summarizes the information concerning juice $J_5$.

**Table 5. Phytochemical Characteristics**

| Parameters | Averages | Reference values | Reference |
|---|---|---|---|
| Antioxydantpotency | 18,97± 0,46 ppm | 30.00 ppm | *Gingiber officinale* |
| Total tannins | 0,22±0,03 g-éq/100g | 51.10% | *Raphia gentiliana* |
| Total polyphenols | 141,24±0,14 mg-éq/100g | 34.30 mg/g MS | *Gingiber officinale* |
| Vitamin C | 1,66 ± 0,02 % | 0.194% | *Ziziphus lotus* |
| Anthocyanins | - | 1.50 g/kg | *Hibiscus sabdariffa L.* |

**Table 6. Physicochemical characteristics of soursop juice**

| Juice | pHf | pHm | SS (°Brix) | AT(%) | MS(%) |
|---|---|---|---|---|---|
| $J_1$ | 3 | 3.83 ±0.00 | 5.00 ±0.00 | 0.73±0.00 | 3.74 ±0.25 |
| $J_2$ | 3 | 4.03 ±0.00 | 4.00 ±0.00 | 0.58 ±0.00 | 3,16 ± 0.63 |
| $J_3$ | 3 | 3.61 ±0.00 | 3.00 ±0.00 | 0.49 ±0.00 | 1.94± 0.00 |
| $J_4$ | 3,5 | 3,83 ±0.00 | 5.00 ±0.00 | 0.73 ±0.001 | 5.36 ± 0.01 |
| $J_5$ | 3,5 | 4.03 ±0.00 | 4.00 ±0.00 | 0.58 ±0.00 | 4.46 ± 0.00 |
| $J_6$ | 3,5 | 3.61 ±0.00 | 3.00 ±0.00 | 0.49 ±0.00 | 3.94 ±0.00 |
| $J_7$ | 4 | 3.83 ±0.00 | 5.00 ±0.00 | 0.73 ±0.001 | 5.24 ± 0.00 |
| $J_8$ | 4 | 4,03 ±0.00 | 4.50 ±0.00 | 0.58±0.00 | 4.82 ± 0.04 |
| $J_9$ | 4 | 3,61 ±0.00 | 3.00±0.00 | 0.49 ±0.00 | 3.21 ± 0.00 |

pHf: fixed pH; pHm: measured pH; SS: Soluble sugars; AT: Titratable acidity; MS: Dry matter

**Table 7. Grouping perceptions to juice**

| AXIS | AXIS 1 | AXIS 2 |
|---|---|---|
| - | $J_2$, $J_4$, $J_6$, $J_7$, $J_8$, $J_9$, Indifferent | $J_5$, Unpleasant |
| + | $J_1$, $J_3$Nice | |

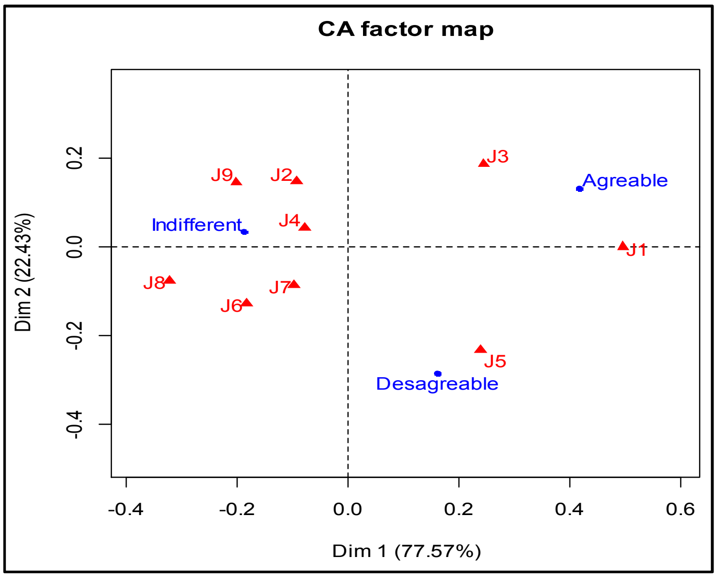


**Figure 2. Grouping of perceptions of juices**

The parameters evaluated on the juice produced from the mash extracted from the SOVIGUIDI Expeller-type multifunctional press are presented in Table 6. The soluble sugar contents vary from 3 to 5 °Bx. The titratable acidity varies in the same way as the soluble sugar content. It varies between 0.486% and 0.729%. It is the same for dry matter, which varies from 1.942% to 5.360%.

**Perception of juice:** Table 7 groups the perceptions of juice. The principal component analysis shows that all the juices are

The axis 1 shows that the juice $J_2$, $J_4$, $J_6$, $J_7$, $J_8$ and $J_9$ are perceived as indifferent opposite the juice $J_1$ and $J_3$ which are perceived as pleasant. Axis2 is represented by juice $J_5$ and is perceived as being unpleasant. The factorial map presented in Figure 3 shows that, seeing of the analysis of sensory data, consumers' appreciation of juices is grouped into three broad categories namely: Pleasant, indifferent and unpleasant. Consumers find juice $J_1$ and $J_3$ pleasurable. However the juice $J_1$ is more appreciated than the juice $J_3$. It is to recall that the juice $J_1$ is resulting from a mixture of one (01) kg of puree with

1 L of water adjusted to a pH of the order of 3. They are indifferent to juice$J_2$; $J_4$; $J_6$; $J_7$; $J_8$ and $J_9$. As for juice $J_5$, consumers find it unpleasant.

## DISCUSSION

The chemical composition values obtained during this work are compared with those of Enweani *et al*. (2004). The work of these authors focused on *Annona squamosa*. The chemical composition of the mash shows that there is no significant difference between the values of the parameters determined on *Annona squamosa* and *Annona muricata*. The pH value of 4.85 *Annona squamosa* obtained at room temperature of about 28 ° C shows that *Annona squamosa* appears slightly more acidic than *Annona muricata*, whose acidity translates into a pH of 4.45 in the same conditions. The mash is acidic with an average titratable acidity of about 1.5%. The titratable acidity is all the higher as the mash is pasty and consistent. Its consistency is 18 cm / 30s. Brix degree is 10.5. Whole soursop fruit composition values as highlighted in the United States Department of Agriculture Manual No. 8, Food Composition by Watt *et al*. (1963) are clearly superior to that of the extracted mash. Thus, the puree contains the following nutrients: Food energy, 78 calories; protein, 1.1 g; lipid, 0 g; total carbohydrate, 17.95 g; calcium, 30 mg; iron, 0.7 mg; phosphorus, 25 mg which are in any way below the nutrient composition in the edible portion of raw soursop (excluding skin and seeds constituting 32% of the fruit purchased), the values of which are as following: food, 200 calories; protein, 3.1 g; fat, 9 g; total carbohydrate, 50.3; calcium, 43 mg. ; Phosphorus, 83 mg; iron, 1.9 mg. The puree contains 0.8 g of formic insoluble in 100 g of puree. This quantity proves the abundance of the cellulose in the puree. In fact, hydrolysis from cellulose enzyme would increase the fluidity of the mash.
The analyzes of the functional compounds made on the puree corroborate the results on the biological properties of soursop according to which soursop is biologically active. For this purpose, the polyphenols and the antioxidants analyzed give respective values of 141.24 ± 0.14 mg-eq / 100g and 18.97 ± 0.46 ppm which are higher than those of *Gingiber officinale* with values of 34, 30 mg / g and 30 ppm (Cho, 2003). These rates show that these components are of great important, particularly because of their beneficial effects on health (Cho, 2003). In the same vein, their role as natural antioxidants is growing interest in the prevention and treatment of cancer (Curiel, 2004), inflammatory diseases (Laughton, 1991) and cardiovascular (Frankel, 1993) and neurodegenerative (Orogozo, 1997). As for the tannins, the value obtained following its analysis is 0.22 ± 0.03% against 51.1% for *Raphiagentiliana*. These compounds are plant molecules that can be used for their natural ability to precipitate proteins. This property also confirms the biological effects of soursop. The vitamin C content of 1.66 ± 0.02% in the soursop puree is higher than that of Ziziphus lotus with the value of 0.194% and gives it the capacity to fight against diseases such as scurvy (Leblanc, 1949). Thanks to the antimicrobial properties of certain polyphenols such as flavan-3-ols, flavanols and tannins, it is now possible to develop food preservatives and new therapies in many infectious diseases by considering microbial resistance to certain antibiotic treatments (Daglia, 2012). Polyphenols play a great role in the maintenance of a good state of health and could participate in the prevention of pathologies partly related to excess radicals and oxidative stress (cardiovascular and degenerative diseases) (CHEN, 1997; Natella, 1999 and Bruneton, 2009). These conclusions, although satisfactory, are not shared by all the researchers who worked on this fruit. Some authors believe that an alcoholic extract of soursop leaves showed no toxicity in mice (100 mg / kg intraperitoneally). However, when the concentration is 300 mg / kg, a reduction in the behavior of exploration and constrictions of the abdomen is noticed (N'gouemo, 1997). A strong lead on pigs showed high concentrations of soursop resulting in nausea and vomiting (Annonaceous, 2018). Soursop is an uterine stimulant and should not be consumed during pregnancy (Maignien, 2005). *Annona muricata* has hypotensive properties, and should not be used in people with low blood pressure. In addition, it may potentiate the antihypertensive effect of certain substances (Nwokocha, 2012) Annonaceae are therefore neurotoxic in many cell (in vitro) and animal (in vivo) models, and a recent study (the first on long-term oral exposure to acetogenins) reports hyperphosphorylation of tau protein, characteristic of parkinsonian syndromes (Yamada, 2014). Acetogenins, the molecules responsible for anticarcinogenic properties, are in fact the molecules most likely to be responsible for atypical parkinsonism, although their contribution is most likely to be multifactorial (Le Ven, 2012). Further research is needed to uncover the conditions under which the use of soursop fruit would be beneficial to the body. As the fruit is fibrous, the mash obtained is rich in hydrolyzable compounds that can make the functional compounds more available. In all cases, for a better extraction of the soursop puree while keeping the functional, physicochemical and nutritional properties, the use of a technique which combines a hydrolysis of the insolubles and a pressing using the press SOVIGUIDI type expeller should be recommended.

### Conclusion

The objective of the present work was to characterize physicochemical, nutritional and functional properties of the soursop puree and the juice produced from this puree in order to contribute to their valorization. At the end of this work, we notice that the puree is very acidic, pasty and consistent. From a nutritional and biological point of view, the purée extracted from soursop is rich in nutrients as well as in functional molecules. This richness gives the soursop pure the property of being active and being able to be used to put together functional foods. Phytochemical studies have made it possible to analyze the chemical composition of the mash and to confirm its antioxidant activity. This would be very useful in the management to prevent certain types of cancer and cardiovascular pathologies. Our results and the various known properties are in favor of a rational use of this plant, *Annona muricata*, in the treatment of cancer. Juice is produced by adding water to the puree in well-defined proportions. From the results obtained, we discover that consumers find the consumption of juice $J_1$ to be agreeable. More in-depth studies should be carried on in order to make the most of the potential of soursop. The identification, extraction or isolation of molecules with functional properties (anti-tumor) for the purpose of developing nutraceuticals will enhance the value of this fruit.

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