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Elaboration and assessment of processes for the production of *Annona muricata* fruit puree

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Abstract
The present study aim is to develop an appropriate process for the production of *Annona muricata* fruits puree whose strong metabolic activity is at the origin of its fragility and its perishability. The work involved is to evaluate the suitability of the presses through efficiency parameters of the extraction presses and studying the effect of different treatments (heating, peeling, seeds' removement) on the yield of the mash. Eight treatments are repeated on three presses. Initially, the fruits were sorted to retain those that are ripe and firm, washed once, cut and trimmed. The heating of the fruits was carried out for 5 minutes to boiling. The extraction consisted in squeezing the fruits until obtaining the maximum of puree. The three types of press used were the Chinese Expeller Type Press, the Manual Screw Press and the SOVIGUIDI Type Multifunction Press. After extraction, the mash is collected, filtered pasteurized and packaged in one-liter glass jars. The results obtained showed that the SOVIGUIDI Type Multifunction Press is more efficient because it presses on average 5.39 ± 1.11 Kg or 37.94 ± 8.25% puree from 11.06 ± 1.75 Kg of fruits in 284 ± 21.50 seconds. The mass of cake is evaluated at 1.04 ± 0.25 Kg while the mass of undetermined losses is in the order of 10.56 ± 2.24 Kg. This type of press can therefore be used for the production of *Annona muricata* fruits puree and juice.

Keywords: *Annona muricata*, fruits, processes for puree production, soviguidi type multifunction press

1. Introduction
The genus *Annona*, of the Annonaceae family, includes more than 60 species mainly from America among which *A. reticulata* Linn., *A. squamosa* Linn., *A. cherimola* Mill. and *A. muricata* Linn. species are better known as fruitful. In addition, *A. muricata* Linn. is the most tropical one and the most used species [1]. *Annona muricata* is a small tree (Photo 1), grown in the tropics for its edible fruits, called soursop (Photo 1 and 2) [2]. These fruits are full of natural compounds and characteristic structures with powerful biological properties, including antiparasitic, insecticidal, antifungal and anti-tumor [3]. But these fruits face a major problem in its storage and marketing. Indeed, the strong metabolic activity, after the picking, makes soursop fragile and very quickly perishable [4]. For this, the fruit must be picked firm in green-yellow color. Beyond a certain threshold of ripping, abscisic acid and ethylene make the fruit to fall down and becomes useless. In most cases, the ripe fruit softens on the tree, falls down and crushes [1]. The ripe fruit can be stored for only a few days at room temperature [4]. Compared to room temperature storage, the leaking can still take 2 or 3 days more in a refrigerator. However, in this conservation condition, the skin of the fruit blackened and becomes unsightly while the flesh is still intact and usable [1]. The fruits on the tree should then be monitored daily to select those that are ripe and ready for direct consumption or juicing [1]. Beyond this time of picking, the taste becomes less pronounced and an unpleasant odor develops [5].

Photo 1: Tree of *A. muricata* bearing fruits [6]

Photo 2: Stem of *A. muricata* bearing fruit [6]

The fragility and insufficiency of soursop preserving means represent a limiting factor for the industrial growing of *A. muricata* to export or process to produce juice [1]. In order to contribute to the valorization of the soursop and to allow the population to benefit from the pharmaco-nutritional potential of its fruits at any time of the year, it is very relevant to invest in the means of its conservation and transformation. It is in this context that this study was conducted to help promote the use of soursop through its mash and juice. The aim is to evaluate and develop processes for the extraction and stabilization of not only soursop puree but also the juice of this fruit with interesting pharmaco-nutritional characteristics.

Materials and Methods

Plant material

The plant material used in the present study consists of *Annona muricata'* fruits (Photo 1 and 2). These fruits are bought on the local market in Bénin especially at Ouando in the department of Ouémé, Tokpa and Ganhi along the Littoral Side.

Equipment

The extraction of the puree was made from three (03) types of press during the various production tests. These extractors are: the Chinese Type Expeller Screw Press (PVETC), the Manual Screw Press (PVM) and the SOVIGUIDI Type Expeller Screw Press (PVETS). For the Chinese type Expeller screw press (Photo 3), squeezing squeeze is deposited between the cage and the rotating screw, propelled by the latter in the direction of the axial movement of the shaft of the screw. The configuration of the screw is such that the fruit is gradually compressed in its movement towards the discharge port of the cylinder. The compression effect carries out the extraction of the puree contained in the soursop pulp. This one passes through the mesh of the cage and is collected by an outlet port. While the press cake continues to move in the direction of axial movement, towards a discharge port installed at the other end of the machine. The Chinese type Expeller screw press combines the pressing and filtering process. The SOVIGUIDI Type Spare Screw Press (Photo 4) is built on the same principle as the Chinese type expeller screw press. This juice press combines the pressing and filtering process. The extraction of the puree is carried out according to the same principle. The Manual Screw Press (Photo 5) presses the fruit into four (04) percale tissues so that the fruit-percale unit can withstand the pressure of extraction. The set is placed on the fixed plate. A second mobile plate through the action of the screw, comes down and exerts pressure on the fruit pulp. This pressure is maintained by a moment to allow the mash to come out. The operation is repeated until the complete flow of the puree.

Fig 1: Chinese Type Expeller Screw Press

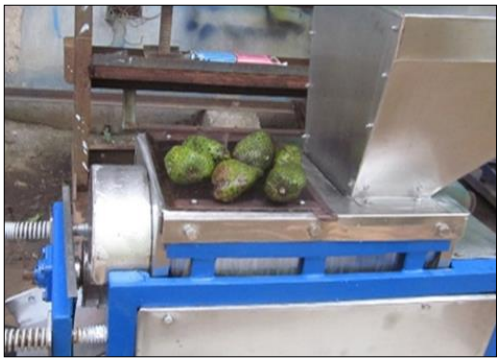

Fig 2: Soviguidi Type Expeller Screw Press

Fig 3: Manual Screw Press

Methods

The processing performed is the result of a combination of different unit operations performed in the order as defined in the following:

Treatment 1: The fruits are heated∗, peeled, removed seeds and squeezed.

Treatment 2: The fruits are heated, peeled and pressed with seeds.

Treatment 3: The fruits are heated, removed seeds and pressed without being peeled.

Treatment 4: The fruits are heated and pressed with seeds and without being peeled.

Treatment 5: The fruits are peeled, removed seeds and pressed without being heated.

Treatment 6: The fruits are peeled with seeds and pressed without being heated.

Treatment 7: The fruits with seeds removed are pressed without being heated or peeled.

Treatment 8: The fruits with seeds are pressed without being heated or peeled.

∗ Heating is done at boiling temperature for 5 minutes.

These eight (08) processes are repeated on each of the three (03) presses. At the reception, the fruits are sorted to retain the ones that are ripe and firm, washed once, cut and trimmed. The heating of the fruits was carried out for 5 minutes after boiling. The extraction consists in pressing the fruits in press until obtaining the mash in maximum. After extraction, the mash is collected, pasteurized and packaged in 1 liter glass jars.

The extraction parameters considered are the following

Residue rate (RR%)

This parameter represents the residue rate (non-extracted

puree, skin and soursop seeds) that comes out as waste.

$$RR\ (\%) = \frac{\text{mass of residue}}{\text{mass of fruits}} \text{ X } 100$$

Extraction rate (ER%)
This rate makes it possible to apprehend the yield when extracting the puree.

$$ER\ (\%) = \frac{\text{mass of puree}}{\text{mass of fruits}} \text{ X } 100$$

Indefinite loss rate (ILR%)
This rate makes it possible to know the quantity of mash remaining trapped in the machine per unit mass of fruit used. It is obtained by the following formula:

$$ILR\ (\%) = 100 - (RR + ER)$$

ILR: Indeterminate Loss Rates
RR: Residue Rate
ER: Extraction rate (Puree yield)

Results
Pretreatment operations effects on yielded mash
Shows the impact of treatments on mashed yield.

Table 1: Mash yielded versus treatments (%).

Treatment	Trial1	Trial 2	Average
T_1	33,5	32,5	33 ± 0,5 [a]
T_2	26,8	26,2	26,5 ± 0,3 [a]
T_3	31,5	31,1	31,3 ± 0,2 [a]
T_4	29,6	29	29,3 ± 0,3 [a]
T_5	32,2	31,2	31,7 ± 0,5 [a]
T_6	40,3	39,1	39,7 ± 0,6 [b]
T_7	32,3	31,09	31,69 ± 0,6 [a]
T_8	33,5	33,1	33,3 ± 0,2 [a]

The risk considered in the interpretation of the results is 0.05. Averages show no similarity and are significantly different. T: Treatment
Each value represents the mean ± SEM of the yields obtained according to the type of treatment. The comparison of averages is done by the analysis of one-factor variances and linear regression. ($P < 0.05$).
The Table 1 analysis shows that the yield varies according to the treatments. The treatment with the low yield is T_2 while the one with the highest yield is T_6. It should therefore be said that in order to extract the maximum amount of soursop, the fruits are peeled and pressed with seeds without being heated.

Evaluation of the efficiency of different presses
The efficiency of the presses is evaluated on three presses. Chinese Type Screw Expeller, SOVIGUIDI Screw Type Expander and Manual Screw Press. On these presses, the parameters evaluated are: the extraction time, the extraction capacity of the press, the yield, the indeterminated losses and the weight of residues. The results obtained on each type of press are presented in Tables 2, 3 and 4.

Table 2: Effectiveness of Chinese Type Screw Expeller

Parameters	Trials				Average
	1	2	3	4	
Mass of soursop used (Kg)	5	3,9	4,1	6,8	4,95 ± 0,95
Mass of cut soursop (Kg)	3,5	2,19	2,06	4,7	3,11 ± 0,99
Loss of material after cutting (%)	30	46	49,75	30,88	39,16 ± 9,71
Mass of extracted puree (Kg)	0,52	0,38	0,49	0,7	0,52 ± 0,08
Extraction time (seconds)	600	375,42	353,14	805,71	533,56 ± 169,29
Extraction capacity of the press (Kg/H)	30	37,39	41,79	30,38	34,89 ± 4,7
Mass of cakes (Kg)	2,04	1,05	1,30	2,95	1,84 ± 0,61
Mass of indeterminate losses (Kg)	0,94	0,76	0,27	1,05	0,76 ± 0,22
Yield in puree (%)	14,85	17,35	23,78	14,89	17,72 ± 2,67

Through this Table 2, it is found that the Press Chinese Type Screw Expeller presses on average 0.52 ± 0.08 Kg either 17.72 ± 2.67% puree from 4.95 ± 0.95 Kg of soursop in 533.56 ± 169.29 seconds. The mass of residues is evaluated at 1.84 ± 0.61 Kg while the mass of indeterminated losses is in the order of 0.76 ± 0.22 Kg. Thus, it is found that the residues mass is 3 times greater than that of the puree obtained. In addition, the juice tray, as it is constructed, does not facilitate the flow of the puree and promotes losses.

Table 3: Effectiveness of the Screw Press Expeller Type SOVIGUIDI

Parameters	Trials				Average
	1	2	3	4	
Mass of soursop used (Kg)	24.8	31.3	23.5	22.3	25.48 ± 2.91
Mass of cut soursop (Kg)	14.7	16.75	14.21	12	14.42 ± 1.31
Loss of material after cutting (%)	10.1	14.55	9.29	10.3	11.06 ± 1.75
Mass of extracted puree (Kg)	3.33	6.43	5.22	6.57	5.39 ± 1.11

Extraction time (second)	289.61	330	279.99	236.42	284.00 ± 21.50
Extraction capacity of the press (Kg/H)	182.72	200	190	187	189.93 ± 5.07
Yield in puree (%)	22.65	38.39	36.73	54	37.94 ± 8.25
Mass of cakes (Kg)	0.90	1.08	1.5	0.7	1.04 ± 0.25
Mass of indeterminate losses (Kg)	10.47	9.24	7.49	15.03	10.56 ± 2.24

Through Table 3, it can be seen that the Press Expeller with Screw Type SOVIGUIDI presses on average 5.39 ± 1.11 Kg either 37.94 ± 8.25% puree from 11.06 ± 1.75 Kg of soursop in 284 ± 21.50 seconds. The mass of residues is evaluated at 1.04 ± 0.25 Kg while the mass of undetermined losses is in the order of 10.56 ± 2.24 Kg. Thus, it is found that the mass of indeterminate losses is 2 times greater than that of the mash obtained. Moreover, the filter disposed around the shaft (auger) constituting the mash boat does not channel the mash very well to the outlet and thus leads to the imprisonment of the mash in the machine making the rate of losses high. The provision of a belt around the filter would thus limit losses.

Table 4: Effectiveness of the Manual Screw Press

Parameters	Trials				Average
	1	2	3	4	
Mass of soursop used (Kg)	2.5	3.3	2.4	3.5	2.93 ± 0.48
Mass of cut soursop (Kg)	1.6	2.03	1.48	2.49	1.9 ± 0.36
Loss of material after cutting (%)	0.9	1.27	0.92	1.01	1.02 ± 0.12
Mass of extracted puree (Kg)	0.1	0.25	0.12	0.31	0,2 ± 0.08
Extraction time (second)	214	282	205	300	250.25 ± 40.75
Extraction capacity of the press (Kg/H)	42	44	39.8	41.6	41.85 ± 1.15
Yield in puree (%)	6.25	12.31	8.10	12.44	9.78 ± 2.6
Mass of cakes (Kg)	1.5	1.78	1.36	2.18	1.71 ± 0.28
Mass of indeterminate losses (Kg)	-	-	-	-	-

Through Table 4, it is found that the Manual Screw Press presses on average 0.2 ± 0.08 Kg either 9.78 ± 2.6% puree from 1.9 ± 0.36 Kg of Soursop 250.25 ± 40.75 seconds. The mass of residues is evaluated to 1.71 ± 0.28 Kg. In addition, the mass of indeterminated losses has not been determined because it is incorporated into the residues. Thus, it can be seen that the fabric used (< 0.05 mm) has mesh sizes smaller than the size of the particles of the soursop puree then limiting its extraction.

Comparison of the efficiency of the presses

Comparison of yield presses

Table 5: Comparison of Returns Average

Press	Juice yield
PVM	14,85[a]
PVM	17,35[a]
PVM	23,78[a]
PVM	14,89[a]
PVETS	10,47[b]
PVETS	9,24[b]
PVETS	7,49[b]
PVETS	15,03[b]
PVETC	6,25[b]
PVETC	12,31[b]
PVETC	8,1[b]
PVETC	12,44[b]

The risk considered in the interpretation of the results is 0.05. Averages with no letter are significantly different. T: Treatment; PVETC: Chinese type expeller screw press; PVM: Manual Screw Press; PVETS: Screw press expeller type SOVIGUID.

Table 5 shows that the yields average are significantly different. As a result, the yield of mash of the Manual Screw Press is lower than that of the SOVIGUIDI Screw Type Expanding Press and the Chinese Style Screw Expeller. Thus, these last presses have similar yields which are higher than those of the Manual Screw Press (Figure 4).

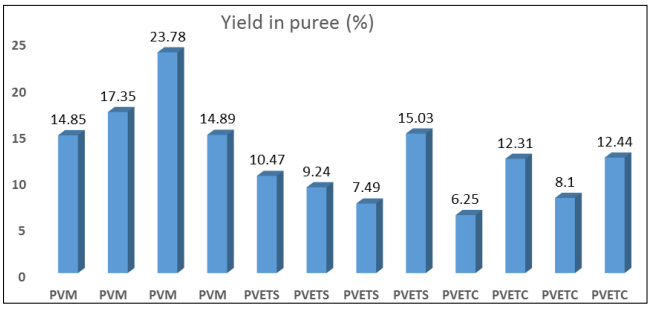

Fig 4: Yield in puree versus presses

Comparison of the means of the mass of residues

Table 6: Averages yields of residues

Presses	Proportion of residues (%)
PVM	58.28 [a]
PVM	47.94 [a]
PVM	63.1 [a]
PVM	62.76 [a]
PVETS	6.12 [b]
PVETS	6.45 [b]
PVETS	10.56 [b]
PVETS	5.83 [b]
PVETC	93.75 [c]
PVETC	87.68 [c]
PVETC	91.89 [c]
PVETC	87.55 [c]

The risk considered in the interpretation of the results is 0.05. Averages with no letter are significantly different. T: Treatment; PVETC: Chinese type expeller screw press; PVM: Manual screw press; PVETS: Screw press expeller type SOVIGUIDI.

Table 6 shows that the averages yields of residues are significantly different from one press to another. The press with the highest residues is the PVM, while the one with the lowest is the PVETS. As a result, the yield of residues

obtained using the Manual Screw Press is higher than those of the Chinese Type Screw Expander and the SOVIGUIDI Type Screw Expander. This finding is best shown in Figure 2

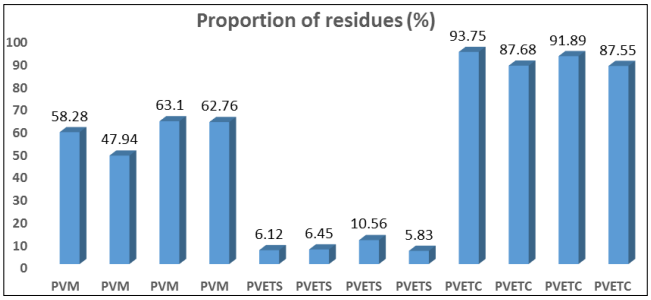

Fig 5: Residues rate according to the press

Comparison of loss averages

Table 7: Comparison of loss averages

Press	Proportion of indeterminate loss (%)
PVETC	26.87 [a]
PVETC	34.71 [a]
PVETC	13.12 [a]
PVETC	22.35 [a]
PVETS	83.41 [b]
PVETS	84.31 [b]
PVETS	81.95 [b]
PVETS	79.14 [b]
PVM	0 [c]
PVM	0 [c]
PVM	0 [c]
PVM	0 [c]

The risk considered in the interpretation of the results is 0.05. Averages with no letter are significantly different. T: Treatment; PVETC: Chinese type expeller screw press; PVM: Manual screw press; PVETS: Screw press expeller type SOVIGUIDI.

Table 7 shows that the losses average are significantly different from one press to another. The press with the highest loss rate is the PVETS while, the one with the lowest is the PVETC. As a result, the meal rate obtained using the SOVIGUIDI Screw Type Expander is higher than that of the Manual Screw Press (Figure 3).

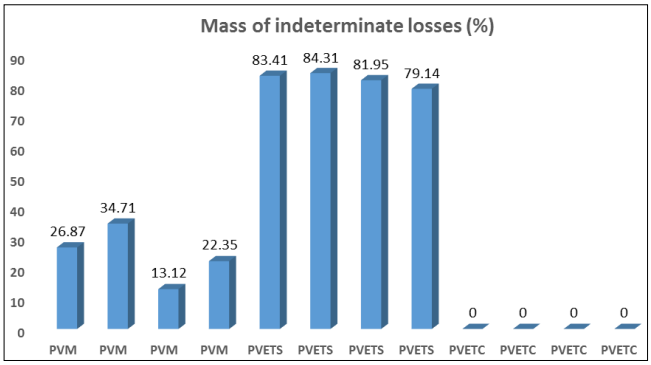

Fig 6: Loss Rates by Presses

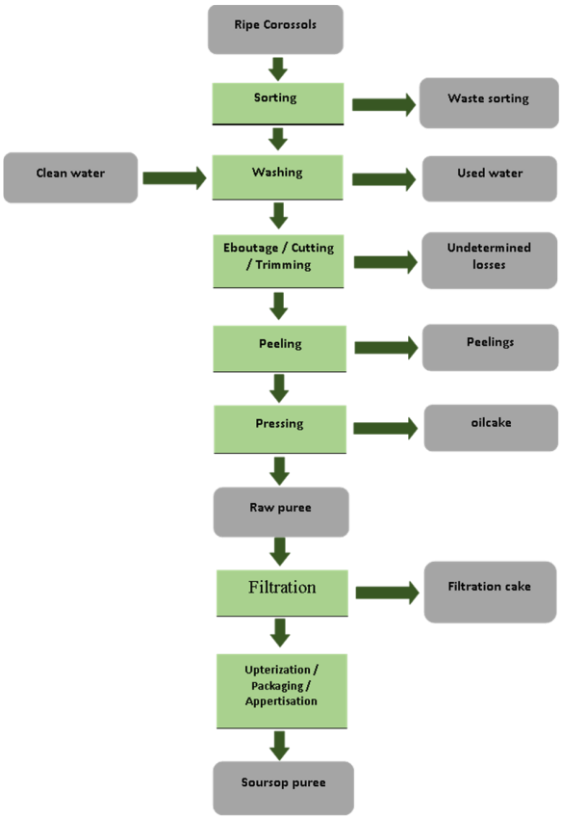

Fig 4: Process in producing soursop puree with the SOVIGUIDI Type Expeller Press

Discussion

The Annonaceae family is economically important because it is a source of edible fruit plants with mainly the genus *Annona*. Its species are cultivated and derived food products exist. For this work, the efficiency of the presses and unit operations were tested through the following parameters: yield, loss rate and residue rate in order to maximize the extraction yield of soursop puree. *Annona muricata* L. is a plant widely used in the tropics where it grows, particularly in the West Indies and Southeast Asia. It is used in food because of the aromatic flavor of its fruit, or in traditional medicine because of its various pharmacological properties. In Bénin, its harvest is from December to August. Because of its strong metabolic activity after picking, soursop is fragile and quickly perishable. For this, the fruit must be picked still firm, mature (immature fruits are shiny) and yellow-green in color. Exceeding a certain threshold of maturity, abscisic acid and ethylene cause the fruit to fall and become unfit for harvest. A ripe fruit can be stored for only 2-3 days at room temperature [5]. The fragility and poor preservation of this fruit is a limiting factor for its industrial culture for export [4]. In producing countries, soursop can be consumed as it is, pressed or prepared in milkshake or ice [7, 8]. For this purpose, the pulp can be pressed into a sieve or pressed into a cheesecloth to extract the rich creamy juice [1]. However, the ideal would be to consume soursop within 5 to 6 days after picking. Beyond that, the taste is less pronounced and develops an unpleasant odor. This reality had negative effects on fruit consumption and caused the rejection of its by-products by the populations. The same observation was made by [9]. However, various methods of valorization in alcohol, juice, wine, jam and others have been developed and disseminated. These various processes were also identified in Bénin by [10]. Thus, at the end of the experiment, it can be seen that the type of press influences the yield and the quantity of residues. The best yield in the extraction of the soursop puree obtained during this work is 5.39 ± 1.11 Kg either 37.94 ± 8.25% with the SOVIGUIDI type expeller which is less than to that obtained by [11] when he obtained about 70% of pineapple fruit juices at high pressure and the yield average of raw juice extracted from cashew apples by 60.62% [12]. The observed yields were variable, not only because of the importance or adherence of the seeds, the level of maturity of the sours but because the fruits often too ripe had parts chard that were rejected. This result is justified differently depending on the type of press. The expeller screw presses limit the yield because of the consistency of the mashed potato, and also by the constitution of the screw presses expeller that traps the mashed potatoes in the juice trays. The constraints on the extraction of soursop for the manual screw press are at the level of the fine mesh of the mouselin that does not let the puree. Indeed, because of the low extraction rate of the mash, a significant amount of mash is still retained by the residues after pressing. This output of the screw press is less important than that obtained by [13] using an expeller type juice extractor which is 67.88%. The Chinese type expeller screw cylinder is wider and/or longer than the SOVIGUIDI type screw press so the PVETC has a longer grinding cylinder than the PVETS so the soursop travels a greater distance in the PVETC before leaving then involving more deposition on the walls of the cylinder during its passage from where the rate of indeterminate losses higher in the PVETC also acting on the yield. From this Note on the length of the cylinder, the efficiency could be increased by decreasing the length of the rolls or by using presses of shorter roll length. The residues rates at the screw press are higher (87.5 ± 0) compared to the rates of the other two because it has the ability to squeeze the mash by retaining the wastes or these residues would still contain liquid which would increase its yield hence the low yield at the manual screw press (0.2 ± 0.08 kg either 9.78 ± 2.6%). The absence of in determinated losses in the manual screw press also confirms the assumption that the manual screw press presses to expel the liquid by retaining the residues; there is a form of pre-filtration. PVETS (1.04 ± 0.25 Kg / 14.42 ± 1.31 Kg pressed pulp) had a low residues content relative to PVETC (1.84 ± 0.61 Kg / 3.11 ± 0.99 Kg of pulp pressed) while the mass of indeterminated losses is in the order of 10.56 ± 2.24 Kg / 14.42 ± 1.31 Kg for the PVETS against 0.76 ± 0.22 Kg / 3.11 ± 0.99 Kg pressed pulp for PVETC. Thus, the PVTES has a device allowing it to minimize the cake and thus increase the yield. Heating to boiling temperature for 5 minutes has no effect on the yield of soursop unlike the results of [10] on pineapple, which indicate that heating the fruits before extraction softens fruit cells and maximizes the yield. Heating juice for a relatively long time produces much darker juices with no aroma. The same observation was made by [14] during the heat treatment of cajuina at 80 and 121 ° C. For these authors, the loss of ascorbic acid during the heat treatment could be the main factor responsible for the browning of the juice. According to [13], the increase in the browning index is due to the caramelization of the sugar of the juice. Soursop puree is very consistent in contrast to cashew juice whose clarity values are in the range of (88.53 to 98.0%) obtained by [16, 17] for juices raw and clarified cashew apples. Results on the effects of peeling and pre-extraction of soursop puree corroborate those of [10], which states that the application of these two unit operations to pineapple fruit improves yield. As fruit juices are generally very unstable because of their total sugar content and their nutrient content, it is therefore essential that they be subject to technological treatment (the use of preservatives being forbidden), in order to have long-term stability. In this study, the stabilization tests are performed on the mash produced by pasteurization at a temperature of 80 ° C after 30 min. The bottles after closure then undergo a canning and slow cooling. A report has been made about the fibers resulting from the extraction of puree, the fibrous and especially cellulosic and lignified part can be used as fuel for boiler; however, as no press can still extract more than 50% puree, residues that contain more or less sugar and therefore can be used as feed, provided they are shredded or crushed by machine. In the same way, the skin, which does not present any particular advantages such that it is possible to preserve it with the pulp, in spite of its smell sometimes more pronounced, involves in the peeling a certain portion of the pulp and, as such can be considered as food for livestock; the problem is to prevent putrefaction as it is the case for mango through the work done by [15].

Conclusion

The objective of this work was to develop an appropriate process for the production of *Annona muricata* mash. To do this, different treatment combinations were applied to define the best extraction conditions to maximize yield. The production of juice made from soursop sourdough allowed to know the effects and the interactions of the unit

operations on the yield of the puree extracted from three types of press. To maximize the rate of extraction, it is therefore recommended to squeeze the soursop after peeling without heating or dehorning. As the fruit is fibrous, the mash obtained is rich in hydrolyzable compounds that can make the functional compounds more available. Although, the quality of the products obtained during various preparation tests described has been rather variable, it can nevertheless be remembered that if a healthy raw material and of suitable maturity are available, it is possible to extract with a good performance soursop puree of good appearance and taste suitable for African or European consumers, and dried pulp which interest lies especially in the high calorific value to reduce weight and easy transport. This yield would be better if a way was found to prevent the puree from accumulating in the juice boat before being collected. Further studies should be conducted to optimize the extraction of soursop puree. The study of the other factors that can influence the yield such as the level of fruit maturity coupled with the enzymatic hydrolysis of the fibers will make it possible to better value the soursop puree.

References

1. Morton JF. The soursop, or guanabana (Annona muricata linn.). florida state horticultural society, 1966, 12.
2. Hutchinson J. Genera of flowing plants (angiospermae), 1964.
3. Chithra KN, Chinju S, Binu T. Evaluation of major phytochemical constituents of two edible fruit yielding species of annonaceae: annona muricata l. and annona reticulata l. journal of medicinal plants studies, 2016, 4-5.
4. Zine S. Le corossol (*Annona muricata* l.) et ses propriétés thérapeutiques: état des lieux. docteur en pharmacie, université grenoble alpes, 2018.
5. Maignien E. le Corosol: *Annona muricata* l. [thèse d'exercice]. [1970-2013, France]: université de bordeaux, 2005, 128.
6. Le Ven J. Contribution à l''etude du lien entre annonaceae et parkinsonisme : identification et quantificationd' acétog´ enines par d´er´eplication; m´etabolisation de phase i et approche de la distribution de l'annonacine. thèse de doctorat, universit´e paris sud -paris xi, 2012. fran¸cais, 2012.
7. Morton JF. Fruits of warms climates. univerty of miami, 1987.
8. Popenoe W. (reprinted 1938) Manual of tropical and subtropical fruits. the macmillan co., n. y, 1920, 182-6.
9. Lacroix e. les anacardiers, les noix cajou et la filière anacarde à Bassila et au Bénin. *térra systems*, 2003, 47.
10. Kpanou m. Fabrication de l'alcool à partir de la pomme de cajou. Article no, 1537, cta, 2003, 11.
11. Dupaigne P. L'extraction à haute pression et l'évaluation de la teneur en jus des fruits, 1968, 277-279.
12. Dedehou ESCA, Dossou J, Soumanou MM. Etude diagnostique des technologies de transformation de la pomme de cajou en jus au bénin. int. j. biol. chem. Sci. 2015; 9:16.
13. Akinwalé to, Aladesua OO. Comparative study of physico-chemical properties and effect of different techniques on the quality of cashew juice from brazilan and local varieties. nig. j. tree crop research. 2001; 3(1):56-58.
14. Damasceno lf, Fernandes fanm, brito es. evaluation and optimization of non enzymatic browning of "cajuina" during thermal treatment. bra. j. chem eng. 2008; 25(02):313-320.
15. Talasila U, Vechalapu RR, Shaik KB. clarification, preservation, and shelf life evaluation of cashew apple juice. food sci. biotechnol. 2012; 21(3):709-714.
16. Talasila U, Vechalapu RR, Shaik KB. Storage, stability of cashew apple juiceuse of chemical preservatives. j. food technol. 2012; 10(4):117-123.
17. Kouassi MEKA. Contribution à la valorisation des sous-produits agricoles en bioproduits. doctorat de l'université de toulouse, université de toulouse, 2018.