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FRUTOS TROPICAIS

Annual Activity Report 2009

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Introduction

On the initiative of Ministry of Science and Technology (MCT) of Brazil, The National Council for Scientific and Technological Development (CNPq) in the year 2008 established 122 National Institutes of Science and Technology in prominent and strategic areas of importance for the development of the country. One of these institutes designated as National Institute of Science and Technology for Tropical Fruits (INCT-FT) was created with the participation of a team of scientists and researchers with proven experience of working in a wide range of fruit science and technology areas and these being associated with three principal institutes – Federal University of Sergipe (UFS), Federal University of Ceará (UFC) and Embrapa Tropical Agroindustry, all of these located in the North-east region of Brazil which contributes to the major share of tropical fruits production.

The fruit culture, is without doubt, one of the most strategic form of rural employment and income in Brazil, which is the third largest producer of fruits (43 million tons), lagging behind China (175 million tons) and India (57 million tons). In the last year (2009), the annual exportation of fresh fruits reached to about 560 million dollars, attaining a volume of 780.413.735 Kg. Brazil still appears in world scenario with an insignificant proportion of exportation and hence there is a large scope of commercialization of fresh tropical fruits and their high-quality derived products. Moreover time is just ripe for exploitation of tropical fruits and their products as consumers are becoming more conscious and aware of the need for consuming fruits which play a major part of furnishing important nutrients specially of vitamins, minerals and antioxidants. Thus to meet the expanding demand for highly nutritious and quality products derived from tropical fruits which possess distinct exotic flavors, there is an urgent need to develop technological advances for obtaining novel quality products along with the data on their characterization with regard to nutritional, sensorial and functional properties.

The Institute (INCT-FT) dedicates its research in fulfilling this task for technological innovations for the conservation and processing of tropical fruits which have large production volume such as that of cashew apple, pineapple, mango and acerola, followed by development of products and processes utilizing other Brazilian tropical fruits which have lower scale of production such as caja, umbu, seriguela, soursop, sapota, mangaba, açai and cupuaçu fruits and this project also contemplates exotic fruits which are not very much commercialized in large scale although they possess strong pleasant and appreciable aroma either in domestic or external market.

In the first year, priority was given for importing equipments needed for improving laboratory infrastructure. Also the first Conference of INCT-FT was organized in a grand scale and held in April 2010 in which 439 persons including professors, specialists, students (Post-Graduate and Graduate), technicians, managers belonging to academic institutions and industry participated. A stand dedicated for mass communication of the institute´s activity was maintained and various fruit products elaborated were displayed for tasting and testing by participants. In the conference, there was a great preoccupation expressed on passing on technological know-how generated by the INCT-FT to industry and this requires a coordinated effort on the part of fruit producers, traders, researchers, industry owners, marketers, planters and other organizations involved with the promotional activities in fruit and derived products commerce.

I would like to express my gratefulness to MCT, CNPq and others associated for the approval and financing of this project as well as to our team colleagues (professors, technicians, fellowship holders and students) whose effort and dedication is very much appreciated and acknowledged.

Finally I would like to conclude by stating that there is a big challenge ahead and which we would like to meet by developing technology of processing high quality tropical fruit products so that society at large can benefit and all those involved, directly or indirectly, in production and commercialization of fruit chain may avail the fruits of it.

Narendra Narain
Coordinator – INCT-FT

INCT-FT Mission

Develop technological know-how by means of a consortium of specialized human resources on different fields of interests in science and technology of tropical fruits, from different institutions.

The INCT-FT will be dedicated on the study and development of promising products (fruit juices, powder fruit juices, minimal processed fruits, dried fruits, biofilms, fruit essences).

Institutions

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Federal University of Ceará (UFC)
Embrapa Tropical Agroindustry (Embrapa-CNPAT)

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Activities Summary

The year of 2009 was marked by the commemoration of the first year of existence of the National Institute of Tropical Fruits (INCT-FT). Over the first year of operation, INCT-FT developed into a scientific complex of laboratories dedicated to the development of processes for the tropical fruit industry, focusing on some areas of high priority for the country such as minimal processing of fruits, development of innovative processes for fruit conservation, development of fruit-based products, having focus on flavor retention along with physicochemical analysis of fruits and their products.

New equipment was added to complement the efforts of all laboratories of the INCT-FT. A summary of the results obtained is presented in this Report. Another milestone of the year was the completion of the building extension that hosts the biotechnology laboratory in Federal University of Ceara. The efforts of the research team and the synergy among the facilities combined to create the necessary environment for more efficient use of the laboratory equipments by its users and for the development of an aggressive research program.

The most rewarding result achieved this year is undoubtedly the implementation of the INCT-FT. This is well exemplified by the results attained in 2009/2010, highlighting the publication of 25 scientific papers by members of our team in international level journals. Selections of these are highlighted in this Report. These works confirm the multidisciplinary approach of the INCT-FT, with impressive results attained in subjects such as biotechnology, drying, ultrasound technology, minimal processing, flavor characterization, fruit-based products development.

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Scientific Highlights

1

Effect of Osmosis and Ultrasound on Pineapple Cell Tissue Structure during Dehydration

Fernandes, F. A. N. ; Gallao, M. I. ; Rodrigues, S.

Federal University of Ceará

Publication
Journal of Food Engineering
90, 186-190 (2009)

Funding
INCT/CNPq

The effect of ultrasound-assisted osmotic dehydration applied for different lengths of time on pineapple tissue structure was evaluated. Using distilled water as the liquid medium, ultrasound induced disruption of cells and formation of microscopic channels in the fruit structure but did not induce breakdown of the cells. Consequently, ultrasound application increased sugar loss and water diffusivity because of the formation of microscopic channels, which offered lower resistance to water and sugar diffusion. Osmotic dehydration induced gradual distortion of shape of the cells, disconnection between the cells and the formation of channels by breakdown of the tissue. The changes caused by the application of osmotic dehydration in the fruit tissue structure resulted in a higher water loss and higher sugar gain. During the air drying process, the effective water diffusivity increased when an osmotic solution with low sugar content was used (35Brix). It decreased when an osmotic solution with high sugar content was used (70Brix) because the high sugar gain observed under this condition has saturated of the microscopic channels with sugar creating an extra mass transfer resistance for water and sugar diffusion through the channels.

The results showed that water loss increased with increasing processing time and with the increase of the soluble solids content of the osmotic solution (ºBrix). Sugar gain also increased with the increase in the soluble solids content of the osmotic solution. When distilled water was used as the liquid medium, the fruit lost 23.2% of its sugar to the liquid medium after 30 min of treatment. Using an osmotic solution of 35 ºBrix (soluble solids content), the sugar gain did not increase with time. Using an osmotic solution of 70 ºBrix, the sugar gain showed a steep increase between 10 and 20 min of treatment. Tukey test showed that the sugar gain was statistically different among the treatments. Except for the process carried out using an osmotic solution of 70ºBrix the processing time did not affect sugar gain.

The microscopic image analysis of the fresh fruit showed typical thin-walled cells with normal morphology and no visible intercellular spaces (Figure 1). Most cells had undulated walls.

Few changes were detected in the fruit tissue structure, during the first 20 min under ultrasound application, when distilled water was used as the liquid medium (Figure 2). At the end of the ultrasonic pre-treatment little change was observed in the fruit moisture content.

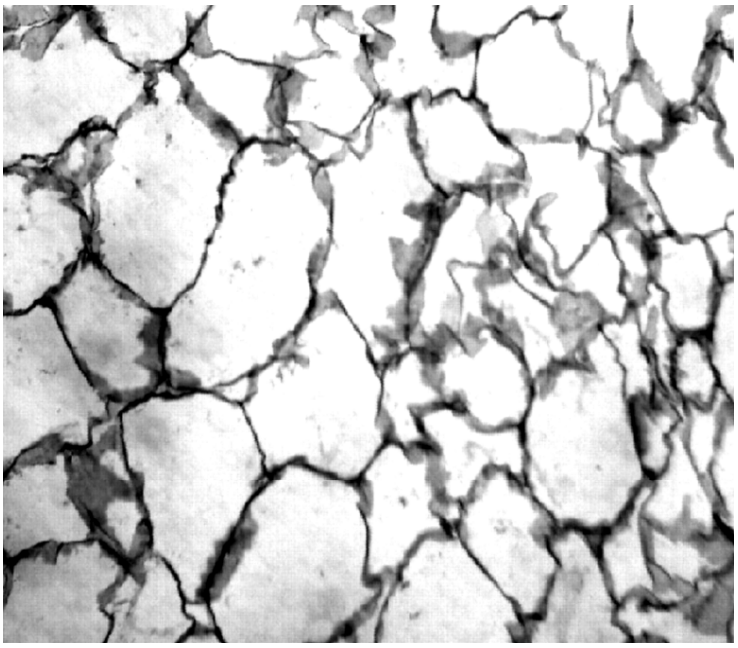

Figure 1. Photomicrographs of pineapple cubes before processing (raw fruit).

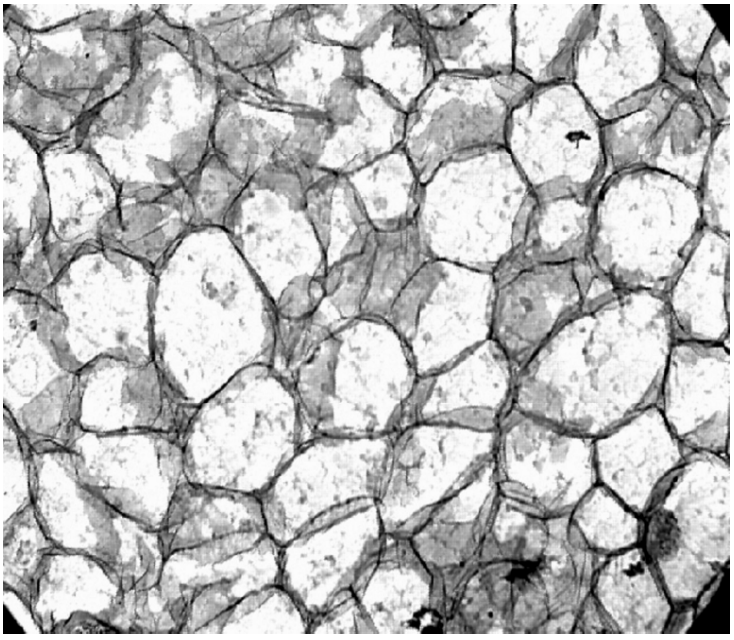

Figure 2. Photomicrographs of pineapple cubes after 20 min of ultrasonic pre-treatment.

The fruit lost 3.1% of water after having been subjected to ultrasound, which may be related to the sponge effect of the ultrasonic waves. In the same period the changes observed when an osmotic solution was applied was 2 fold at 35 ºBrix and 4 fold at 70 ºBrix.

After 30 min of ultrasonic treatment, the cells became more distorted and microscopic channels began to form. Formation of microscopic channels in pineapples was mostly formed because of loss of cellular adhesion (disruption of contiguous cells), which produced large cell interspaces.

The application of ultrasound increased the effective water diffusivity in the fruit by 64.3% during the air-drying process. Consequently, the time required for drying was reduced.

Significant differences were observed when an osmotic solution was employed in the pre-treatment, with formation of larger micro-channels and rupture of cells.

After 30 min immersed in the osmotic solution with sugar content of 35 ºBrix, the cells of the fruit became more distorted and the formation of microscopic channels was accompanied by break-down (rupture) of cell walls.

The cell walls became distorted and smaller in all regions of the samples. Loss of adhesion of the cells was observed in some regions causing an increase of intercellular spaces that may be caused by the solubilisation of chelator-soluble pectin of the middle lamella. Chelator-soluble pectin is the substance that most contributes to cell adhesion and firmness and according to the microscopic images may become solubilised at the early stages of osmotic dehydration.

A greater change was observed for osmotic solutions with high sugar content (70 ºBrix). The use of this treatment produced micro-channels in the first 10 min of processing. Formation of microscopic channels was also accompanied by a significant degree of cell rupture. Most cells were severely distorted and solubilisation of pectin could be visually noted by the decreasing cell wall strength.

Water loss and sugar gain were highest when an osmotic solution of 70 ºBrix was employed. This can be attributed not only to higher osmotic pressure of the process but also to changes that occurred in fruit tissue. The formation of micro-channels in the early stages of the pre-treatment facilitated the mass transfer of water and sugar through the tissue.

Although the fruit presented micro-channels that might ease water diffusion during the air-drying process, the water diffusivity of the osmotically dehydrated fruit decreased. The decrease can be explained by a high sugar gain. Sugar may have entered into the micro-channel, saturating the channel and creating an extra resistance for water diffusion during air-drying. This theory is also supported by the results shown in Table 1 where between 20 and 30 min of osmotic dehydration the sugar gain did not increase significantly as it did between 0 and 20 min.

The changes in the effective water diffusivity were significant during the air-drying stage. For example, if pineapples were dried aiming at a reduction of 95% of their initial water content, it would take 249 min to dry the fresh pineapples (which presented a water diffusivity of 8.41×10^{-9} m^2/s).

By subjecting the pineapples to 30 min of ultrasound treatment, in distilled water, the drying time would be reduced to 202 min because of the increase in water diffusivity to 10.22×10^{-9} m^2/s. Yet, by subjecting the pineapples to 30 min of osmotic dehydration, in an osmotic solution of 70 ºBrix, the drying time would increase to 325 min because of the decrease in water diffusivity to 7.10×10^{-9} m^2/s.

Tukey test showed that the water effective diffusivity was statistically different among the treatments. The test also showed that processing time has affected the water effective diffusivity.

2

Effect of Immersion Time in Osmosis and Ultrasound on Papaya Cell Structure during Dehydration

Rodrigues, S. ; Oliveira, F. I. P. ; Gallao, M. I. ; Fernandes, F. A. N.

Federal University of Ceará

Publication
Drying Technology
27, 220-225 (2009)

Funding
INCT/CNPq

The effect of ultrasound-assisted osmotic dehydration applied at atmospheric pressure for different lengths of time on papaya tissue structure was evaluated. Ultrasound induced the loss of cellular adhesion, formation of large cell interspaces and light rupture of the cell walls. The changes in the tissue structure caused by ultrasound application increased sugar loss, water loss and effective water diffusivity. Ultrasound-assisted osmotic dehydration induced a gradual distortion in the shape of the cells, loss of cellular adhesion and the formation of large channels caused by rupture of the cell walls. The changes caused by the application of osmotic dehydration resulted in high water loss and sugar gain.

The results show that water loss increased with time and also increased when an osmotic solution was employed. The increase in water loss because of increasing soluble solids concentration in the osmotic solution is consistent with the greater osmotic pressure of the system. When distilled water was used as the liquid medium the fruit transferred sugar to the liquid medium losing 13.8% of sugar after 30 minutes of treatment. Using an osmotic solution of 25ºBrix (soluble solids content), the sugar gain increased with time and showed a steep increase between 20 and 30 minutes of treatment.

The microscopic image analysis of the fresh fruit showed typical thin-walled cells with normal morphology and no visible intercellular spaces. The tissue of the fruit showed a high degree of disruption of cells, creating several large cell interspaces, during the first 10 minutes under ultrasound application when distilled water was used as the liquid medium. The disruption of cell has contributed to the high sugar loss observed during ultrasound application.

At the end of the ultrasonic pre-treatment the fruit lost 9.7% of water, which may be related to the sponge effect of the ultrasonic waves and to the changes on the fruit tissue. After 30 minutes of ultrasonic treatment, the cells became slightly distorted and some cells began to breakdown (Figure 2A). The disruption of cells continued and more microscopic channels were formed (Figure 2B). Microscopic voids in papayas were mostly formed by disruption of contiguous cells, which produced large cell interspaces. The formation of microscopic voids in papayas differed from the mechanism observed in melons, where microscopic channels were formed by flattening and elongation of cells. The formation of microscopic channels in papayas, however, was similar to the formation of channels in pineapples where smaller cell interspaces were formed by disruption of cells.

The sugar loss observed for papayas was lower than the sugar loss observed for other fruits such as banana, pineapples and malay apples, which have lost respectively 21.3, 23.2 and 17.0% after 30 minutes under the same conditions.

The use of ultrasound increased the effective water diffusivity by 28.7% during the air-drying process. The increase in effective water diffusivity reduced the total time required for drying.

Significant differences were observed when an osmotic solution was employed in the pre-treatment. Longer micro-channels were formed by disruption of cells and also by breakdown of cells. After 10 minutes immersed in an osmotic solution (25°Brix), the cells became more distorted (Figure 3A) and several cell interspaces formed by disruption of cells and channels formed by breakdown of cell walls appeared (Figure 3B).

Breakdown of the cells were observed, in some regions, and produce large spaces that may be formed by solubilizing of chelator-soluble pectin of the middle lamella. Chelator-soluble pectin is the substance that most contributes to cell adhesion and firmness and according to the microscopic images may solubilize at the early stages of osmotic dehydration and ultrasound application.

After 20 minutes, several cells showed loss of pectin and groups of cells (two or three) became contiguous with the solubilizing of part of the cell wall (Figure 4).

Water loss and sugar gain increased steeply between 20 and 30 minutes subjected to ultrasound-assisted osmotic dehydration. Figure 5 shows that after 30 minutes the tissue of papayas presented a high degree of cell breakdown, forming some very large spaces where water and sugar could flow more easily, which have contributed for the steep increase in water loss and sugar gain observed during this period. Effective water diffusivity also has increased steeply after this period, influenced by the very large spaces formed in papaya tissue.

From an economical point of view, the ultrasonic pre-treatment is cost-effective. To process 1 kg of papaya, an ultrasonic bath requires 11.1 kJ/min of operation. This value required value per kilogram of fruit is higher than the required by a circulating oven or a tray dryer, which requires 4.5 kJ/min of operation. The higher power consumption of the ultrasonic process is compensated by the reduction in the air-drying time.

Calculating the total energetic cost at the best operation conditions, the fresh fruit will require 314 min to reduce its moisture content by 95% and will consume 1397 kJ/kg of fruit; and the ultrasonic process using distilled water as the liquid medium will require 20 min of ultrasound and 244 min of air-drying, consuming 1308 kJ/kg of fruit. On the other hand, the use of ultrasonic-assisted osmotic dehydration will require 30 min of ultrasound and 279 min of air-drying, consuming 1574 kJ/kg of fruit. The latter result is higher because of the lower value of the effective diffusivity of water, which increases the required air-drying time. If the cost of energy is assumed to be US$ 0.306/kWh (cost of electrical power in Brazil in June of 2008) the cost of the ultrasonic process would stand at US$ 0.119/kg. The cost of using the air-drying process without pre-treatment of the fruit would cost US$ 0.134/kg.

The result show that the ultrasonic process is economically viable being 11% less expensive than the air-drying process to dry papaya. It is important to notice that these values were calculated based on small scale equipment and that lower operating cost may be expected for large scale production.

3

Effect of Ultrasound-Assisted Osmotic Dehydration on Cell Structure of Sapotas

Rodrigues, S. ; Gomes, M. C. F. ; Gallão, M. I. ;
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Drying is a traditional way of fruit preservation. Because of the high energy costs related to air-drying, osmotic dehydration is traditionally applied as pre-treatment to reduce air-drying time. Ultrasound arose as an emerging technology with several applications in food processing. The effect of ultrasound on the tissue depends on the fruit tissue structure and composition and might be beneficial to improve air-drying efficiency with consequent reduction on process costs. In this work, the effect of ultrasound and ultrasonic assisted osmotic dehydration on sapota tissue structure was evaluated. Ultrasound induced cell disruption and breakdown of cell with high phenolic content (dense cells) and has also induced elongation of parenchyma cells. Ultrasound application combined with high osmotic gradient enhanced water loss and sugar gain because of the formation of microscopic channels. Ultrasound assisted osmotic dehydration induced gradual distortion of the cells' shape, cell breakdown and the formation of microscopic channels. Micrographs of the fruit tissue showed that ultrasound affected preferentially the dense cells. The ultrasonic pre-treatment was able to preserve the tissue structure of the fruit when distilled water was used as liquid medium. The application of ultrasound assisted osmotic dehydration resulted in severe changes on the tissue structure of the fruit with consequent increase in the water effective diffusivity because of the formation of microscopic channels and cell rupture.

The effects of both pre-treatments on water loss and solids gain are presented in Table 1. The analysis of the fresh fruit showed that sapotas had an initial moisture content of 0.70 ± 0.01 g water g^{-1} fresh fruit and a soluble solids content of 159 ± 0.2 g kg^{-1}.

Little change was observed in the fruit moisture content during the ultrasonic treatment. For the ultrasonic treatment carried out with distilled water, the water loss observed after 10 minutes was 5.2% but this value decreased to 4.0% when the fruit was subjected to ultrasound for 30 minutes (Table 1). This effect may be influenced by the lower solid content of the fruit after 30 minutes.

The results showed that water loss increased with time only when an osmotic solution at a soluble solids content of 700 g kg^{-1} (70ºBrix) was employed, which is consistent with the greater osmotic pressure gradient of the system.

When distilled water was used as the liquid medium, the fruit lost solids to the liquid medium. The amount of sugars transferred to the liquid medium during the process increased from 2.7% after 10 minutes in ultrasonic bath to 7.8% after 30 minutes.

Table 1. Sugar gain and water loss of sapotas subjected to different pre-treatments and to different pre-treatment times, and water diffusivity of sapotas in air-drying process after application of pre-treatment.

Operating condition	Treatment Time [min]	Solid Gain [%]	Water Loss [%]	Water Diffusivity* [$m^2 s^{-1}$]
No pre-treatment (air-drying only)	---	---	---	$4.71.10^{-9} \pm 0.42.10^{-9}$
ultrasound (distilled water)	10	- 2.7 ± 0.3	- 5.2 ± 0.7	$4.76.10^{-9} \pm 0.68.10^{-9}$
ultrasound (distilled water)	20	- 3.3 ± 0.5	- 4.1 ± 0.2	$5.80.10^{-9} \pm 0.55.10^{-9}$
ultrasound (distilled water)	30	- 7.8 ± 0.3	- 4.0 ± 0.2	$5.38.10^{-9} \pm 0.10.10^{-9}$
ultrasound (35ºBrix)	10	- 12.13 ± 0.3	- 3.7 ± 0.2	$5.58.10^{-9} \pm 0.22.10^{-9}$
ultrasound (35ºBrix)	20	- 9.23 ± 1.8	- 4.1 ± 0.8	$4.15.10^{-9} \pm 0.05.10^{-9}$
ultrasound (35ºBrix)	30	- 8.10 ± 1.9	- 2.4 ± 0.7	$4.86.10^{-9} \pm 0.09.10^{-9}$
ultrasound (70ºBrix)	10	- 11.20 ± 2.1	1.0 ± 0.7	$4.80.10^{-9} \pm 0.23.10^{-9}$
ultrasound (70ºBrix)	20	7.74 + 1.7	12.1 + 1.7	$4.94.10^{-9} + 0.01.10^{-9}$
ultrasound (70ºBrix)	30	10.01 ± 1.7	13.2 ± 1.3	$5.72.10^{-9} \pm 0.31.10^{-9}$

When distilled water was used as the liquid medium, the fruit lost solids to the liquid medium. The amount of sugars transferred to the liquid medium during the process increased from 2.7% after 10 minutes in ultrasonic bath to 7.8% after 30 minutes.

Using an osmotic solution of 350 g kg^{-1} (35ºBrix), the solid gain increased with time, but an overall solid loss was observed. The ultrasound-assisted osmotic dehydration, in this case, did not show significant difference from the pre-treatment carried out using distilled water as the liquid. The low water loss during the process may be related to the starch content of the fruit, which may favor water uptake from the liquid media.

After 10 minutes under ultrasound-assisted osmotic dehydration, sapotas lost 12.1% and 11.2% of soluble solid to osmotic solution, respectively for osmotic solution of 35 and 70ºBrix. However, after 30 minutes under ultrasound-assisted osmotic dehydration, the sugar gain for the pre-treatment carried with the osmotic solution of 70ºBrix increased and a final sugar gain of 10.0% was observed. This behavior may be explained by the sponge effect caused by ultrasound application. At first, the sponge effect may be responsible for expelling small soluble solid molecules, such as glucose and fructose, which are easily transferred to the osmotic solution due to the small size of these sugar molecules and due to the porosity of the fruit. Large molecules, such as sucrose molecules, have lower diffusivity and showed to diffuse into the fruit only when osmotic solutions with high sucrose concentration (70ºBrix) were applied. This effect may occur because sapotas contain high amounts of sucrose (250 ± 50 g kg^{-1}, dry basis) and higher sucrose concentration in the osmotic solution is required to create a reasonable osmotic pressure.

The microscopic image analysis of the fresh fruit showed that sapotas presented two types of cells: parenchyma cells and dense cells. The parenchyma cells (white cells) of the fresh fruit were mostly round shaped with diameter ranging from 50 to 150 mm. Only few parenchyma cells were slightly distorted. The tissue presented few small cell interspaces, mostly near the junction between three cells. Dense cells (black cells) were found near one another and contain high concentration of phenolic compounds. Some dense cells showed a light detachment of the dense phenolic content from the cell wall Few dense cells were broken down.

After 10 minutes subjected to ultrasound application using distilled water as liquid medium, several dense cells became ruptured. Also, some small microscopic channels began to be formed. At the end of the ultrasonic pre-treatment, the fruit lost 4.1% of water, which may be related to the sponge effect of the ultrasonic waves and the changes on the fruit tissue. After 20 minutes of ultrasonic treatment, the cells became severely distorted in some regions and the dense cells presented a higher degree of collapse.

The loss of the phenolic content of sapotas was confirmed by immunofluorescence microscopy. This confirmation was possible because sapotas contain phenolic compounds that are fluorescent and the samples showed loss of fluorescence.

The application of ultrasound increased the effective water diffusivity in the fruit by 23.1% during the air-drying process (Table 1). Consequently, the time required for drying reduced.

This increase in water diffusivity observed on sapotas was lower than the value found for melons and pineapples where an increase by 39.3% and 64.3% were observed.[12,17] The lower increase may be related to the length of the elongated cell formed in sapotas tissue that were shorter then those observed in melons.

Some differences were observed when an osmotic solution was employed in the pre-treatment. Longer microscopic channels were formed by breakdown of dense cells. After 10 minutes immersed in the osmotic solution, with sugar content of 35°Brix, most dense cells had their inner phenolic content fragmented. In some regions the cells became severely distorted as noticed in the upper right corner of Figure 4B. The breakdown of cells created large regions where no cell membrane was observed.

The breakdown of dense cells was more intense than when distilled water was used as liquid medium. The higher osmotic pressure gradient may be responsible for the enhancement of cell breakdown.

After 20 minutes subjected to ultrasound, in an osmotic solution of 35°Brix, several continuous channels were formed in the dense cells.

The formation of this continuous channels resulted in the uptake of sugar from the osmotic solution, increasing the sugar gain in 2.9%. The sugar incorporated by the fruit might have saturated the channels resulting in a reduction in the effective water diffusivity from 5.58×10^{-8} to 4.15×10^{-8} $m^2\ s^{-1}$ (decrease by 25.6%).

The use of an osmotic solution of 70ºBrix had great influence on the fruit tissue and on the dehydration process. After 10 minutes of ultrasound application, all dense cells presented some degree of collapse. The parenchyma cells of the fruit became highly distorted. Long microscopic channels were formed by disruption and breakdown of cells. The formation of the long microscopic channels were probably cause by intense mass transfer between the fruit and the osmotic solution.

After 20 minutes, the microscopic channels of the samples subjected to an osmotic solution of 70ºBrix became wider allowing an intense increase in soluble solids gain and in water loss. Some dense cells collapsed completely, showing that the influence of ultrasound combined with high osmotic gradient has a great effect on dense cells.

It would be expected that the wider channels would significantly increase the effective water diffusivity during the air drying process, but because of the uptake of sugar by the fruit that creates an extra resistance to water diffusion, the effective water diffusivity increased only by 4.3%.

No significant change to the tissue structure was observed after 30 minutes subjected to ultrasound.

4

Free Radical Scavenging Behavior of Some Brazilian Northeast Fruits in DPPH System

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Embrapa Tropical Agroindustry
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Food Chemistry
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Funding
INCT/CNPq

The antiradical capacity (radical scavenger capacity, RSC) of seven tropical fruit from the Brazilian Northeast (açaí, acerola, cashew apple, mangaba, murici, umbu and uvaia) were studied using the 2,2-diphenyl-1-picrylhydrazyl radical (DPPH•). To determine their RSC, the second-order rate constants (k_2) for the oxidation of these extracts by DPPH• were calculated. The values of k_2 were compared to that used in the food industry as natural (a-tocopherol) and synthetic antioxidants (butylated hydroxytoluene - BHT and butylated hydroxyanisole – BHA). The k_2 values (L/mol.s), in methanol at 25°C, were 37.97, 29.65, 21.33, 20.07, 10.05, 9.54 and 5.47 for acerola, cashew apple, mangaba, umbu, açaí, uvaia and murici.

Recording of spectrophotometric data was taken till the disappearance of DPPH• in the presence of fruit extracts.

Fitting of the experimental data were carried out by using the Levenberg-Marquardt method implemented in Origin v6.0 program for Windows.

Second-order rate constants (k_2) were calculated to determine the RSC of the tropical fruits. The antioxidant of the fruit extract was depleted from the medium under pseudofirst-order conditions, ($[DPPH•]_0 >> [FE]_0$) following the equation:

$$\frac{d[FE]}{dt} = -k \cdot [FE] \qquad (1)$$

$$[FE] = [FE]_0 \cdot \exp(-k \cdot t) \qquad (2)$$

Where [FE] is the fruit extract concentration, $[FE]_0$ is the initial fruit extract concentration, k is the pseudofirst-order kinetic rate constant, and t is the time.

The concentration of DPPH• was calculated by mass balance using the following equation:

$$[DPPH•] = [DPPH•]_0 - [FE]_0 \cdot \exp(-k \cdot t) \qquad (3)$$

Where [DPPH•] is the radical concentration, $[DPPH•]_0$ is the initial radical concentration, k is the pseudofirst-order kinetic rate constant, and t is the time.

[DPPH•] concentration in the reaction medium was calculated according to the method of Brand-Williams et al. (1995) obtained from the calibration curve with the equation as determined by linear regression:

$$Abs(515nm) = 0.0137 \cdot [DPPH•] - 0.029 \qquad (4)$$

Where [DPPH•] is expressed as mmol/L.

The pseudofirst-order kinetic rate constant (k) was linearly dependent on the concentration of the fruit extract and the second-order rate constant (k_2) was determined by the equation:

$$\frac{d[DPPH•]}{dt} = -k_2 \cdot [FE] \cdot [DPPH•] \qquad (5)$$

The results showed that the absorbance decreased as a result of a color change from purple to yellow as the radical was scavenged by antiradicals through donation of hydrogen to form the reduced form DPPH-H.

In the presence of the tropical fruit extracts, a decrease in the absorbance at 515 nm was measured until the fruit antioxidant was depleted under pseudo-first-order assay conditions. The pseudo-first-order rate constant, k was linearly dependent on initial radical scavenger concentration ($[FE]_0$).

The second-order rate constants k_2 are presented in Table 1.

This rate constant is related to the RSC present in the fruit extracts. Five fruits have presented more than one kinetic period: açaí, mangaba, murici, umbu and uvaia. Fruits may present several natural antioxidants in their composition with different scavenging capacity and in this case the scavenging of DPPH• will be carried out by all antioxidants present on the fruit. Antioxidants with higher RSC will scavenge the DPPH• radicals at a higher rate while antioxidants with lower RSC will take more time to reduce the amount of DPPH• present in the assay.

Table 1. Second-order kinetic rate constants (k_2) for the reaction between DPPH• and antioxidant compounds

	k_2 (phase 1) [L/mol.s]	k_2 (phase 2) [L/mol.s]	k_2 (phase 3) [L/mol.s]
Fruit extract			
Açaí (*Euterpa oleracea* Mart.)	10.05 ± 0.75	1.17 ± 0.10	0.16 ± 0.01
Acerola (*Malpighia punicifolia* L.)	37.97 ± 2.57	---	---
Cashew apple	29.65 ± 1.12	---	---
Mangaba (*Hancornia speciosa* Gomes)	21.33 ± 0.64	1.51 ± 0.11	---
Murici (*Byrsonima crassifolia* L.)	5.47 ± 0.34	0.31 ± 0.02	---
Umbu (*Spondias tuberosa*)	20.07 ± 2.71	2.70 ± 0.31	0.11 ± 0.02
Uvaia (*Eugenia pyriformis*)	9.54 ± 0.44	0.75 ± 0.3	---
Antioxidant (natural and synthetic)			
-tocopherol*	37.10 ± 0.90		
BHA**	3.70 ± 0.90		
BHT*			

The RSC obtained for the tropical fruits studied herein was compared to that of other synthetic (BHA and BHT) and natural (tocopherol) antioxidants used in the food industry. Tocopherol (vitamin E) is a natural antioxidant abundant in oils and other foodstuffs with high fat content such as butter, margarine, etc. Vitamin E was the best antioxidant assayed with a k_2 value of 31.70 L/mol.s.

The order of RSC, according to k_2 values (the higher k_2 value, the better RSC) was acerola > tocopherol > cashew apple > mangaba > umbu > açaí > uvaia > murici > BHT (Table 1). The tropical fruits studied herein presented k_2 values ranging from 37.97 to 5.47 L/mol.s (Table 1).

The order of RSC, according to k_2 values (the higher k_2 value, the better RSC) was acerola > a-tocopherol > cashew apple > mangaba > umbu > açaí > uvaia > murici > BHT (Table 1). The tropical fruits studied herein presented k_2 values ranging from 37.97 to 5.47 L/mol.s (Table 1).

The results showed significant higher activity for acerola, cashew apple, mangaba, umbu and açaí compared to BHT. The activity of acerola was also significantly higherompared to BHT. pple, mangaba, umbu and açaty of e first 15 minutes and than than tocopherol.

The activity of the Brazilian tropical fruits was also high if compared to other antioxidants reported in the literature. Suja et al. (2004) have studied the RSC of antioxidants compounds of sesame (*Sesamum indicum* L.) and found that the purified sesamol showed an RSC of 40.00 L/mol.s and others purified compounds showed an RSC below 5.0 L/mol.s. Acerola showed a significant activity, only 5.1% lower than purified sesamol. The results also showed significant higher activity for cashew apple, mangaba, umbu and açaí compared to the other compounds present in sesame.

5

Physical properties of spray dried acerola pomace extract as affected by temperature and drying aids

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The objective of this study was to assess the impact of some processing parameters on moisture content, flowability, hygroscopicity and water solubility of spray dried acerola pomace extract using maltodextrin and cashew tree gum as drying aids. The experiment was conducted according to Response Surface Methodology, with the independent variables being: inlet temperature (170–200°C), drying aid/acerola ratio (2:1–5:1), and percent replacement of maltodextrin by cashew tree gum (0–100%). Higher inlet temperatures favored the desired physical properties of the powders, decreasing their moisture contents and hygroscopicity, and increasing flowability. The drying aids decreased the powder hygroscopicity, especially cashew tree gum (CTG), which also enhanced the powder flowability. The best processing conditions to obtain a free-flowing and least hygroscopic acerola pomace extract powder by spray drying were: inlet temperature above 194°C; drying aid/acerola solid ratio, 4:1; percent replacement of maltodextrin by CTG, at least 80%.

Under the ranges studied in this work, the best processing conditions to obtain a free-flowing and least hygroscopic acerola pomace extract powder by spray drying were the following: inlet temperature above 194°C; drying aid/acerola ratio of 4.0, the drying aid being constituted by at least 80% cashew tree gum (Figure 1). The cashew tree gum, besides being abundant and inexpensive in several tropical developing countries, was presented as a good drying aid agent. If properly exploited, cashew tree gum can greatly impact the cashew tree business and bring social-economical benefits to those countries.

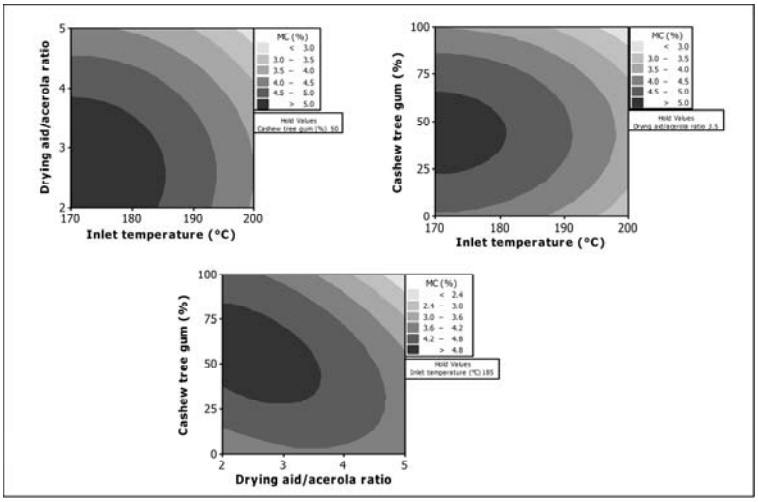

Figure 1. Contour plots for moisture content (in g/100g) of the powders produced by spray drying acerola pomace extract.

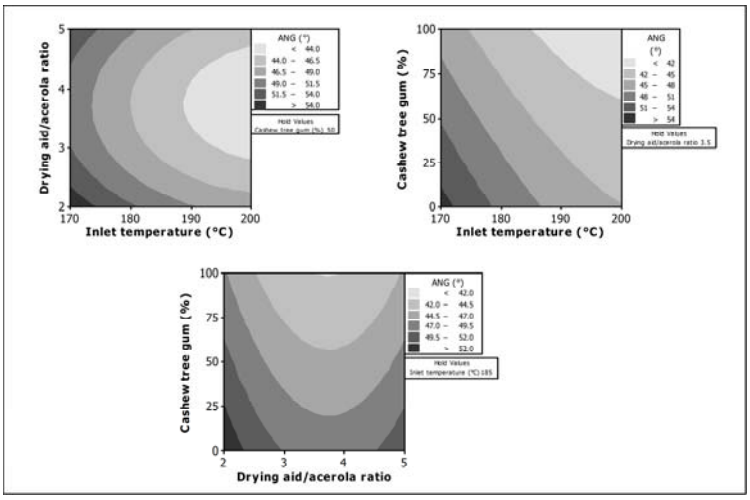

Figure 2. Contour plots for angles of repose (in degrees) of the powders produced by spray drying acerola pomace extract.

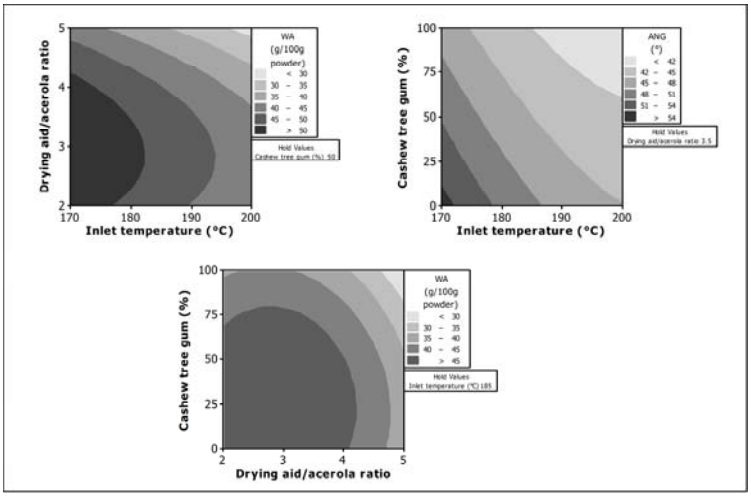

Figure 3. Contour plots for water absorption (g water/100 g powder) by the powders produced by spray drying acerola pomace extract, after 7 days of storage at 25°C and 90% RH.

6

Addition of cashew tree gum to maltodextrin-based carriers for spray drying of cashew apple juice

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This study involved an attempt to totally or partially replace maltodextrin DE10 (MD10) by cashew tree gum (CTG) as a drying aid agent in spray drying of cashew apple juice. The objective was to evaluate the impact of drying aid/cashew apple juice dry weight ratio (D/C, ranging from 3 to 5) and degree of replacement of MD10 with CTG (CTGR, ranging from 0% to 100%) on ascorbic acid retention (AAR), hygroscopicity, flowability and water solubility of spray dried cashew apple juice powder. AAR was increased from 72.90% to 95.46% by increasing D/C from 3 to 5. CTG was shown as a promising maltodextrin replacer, being more effective than the latter to decrease powder hygroscopicity. The most adequate drying conditions (D/C = 5, CTGR ‡50%) resulted in more than 90% of AAR, and produced a powder with good flowing properties and water solubility.

The drying aid agents were useful in spray drying of cashew apple juice (Figure 1), as increasing the proportion drying aid:cashew apple not only resulted in improved physical properties of the powder (that is to say, decreased its hygroscopicity and increased flowability), but also enhanced ascorbic acid retention during the process.

The cashew tree gum was presented as a good drying aid agent, reducing the hygroscopicity of the spray dried cashew apple juice powder when compared with that produced by using maltodextrin as drying aid. When using a drying aid/cashew apple juice dry weight ratio of 5:1, CTG replacing maltodextrin in 50%, more than 90% of the ascorbic acid was retained during spray drying, and a powder with good flowing properties and water solubility was obtained.

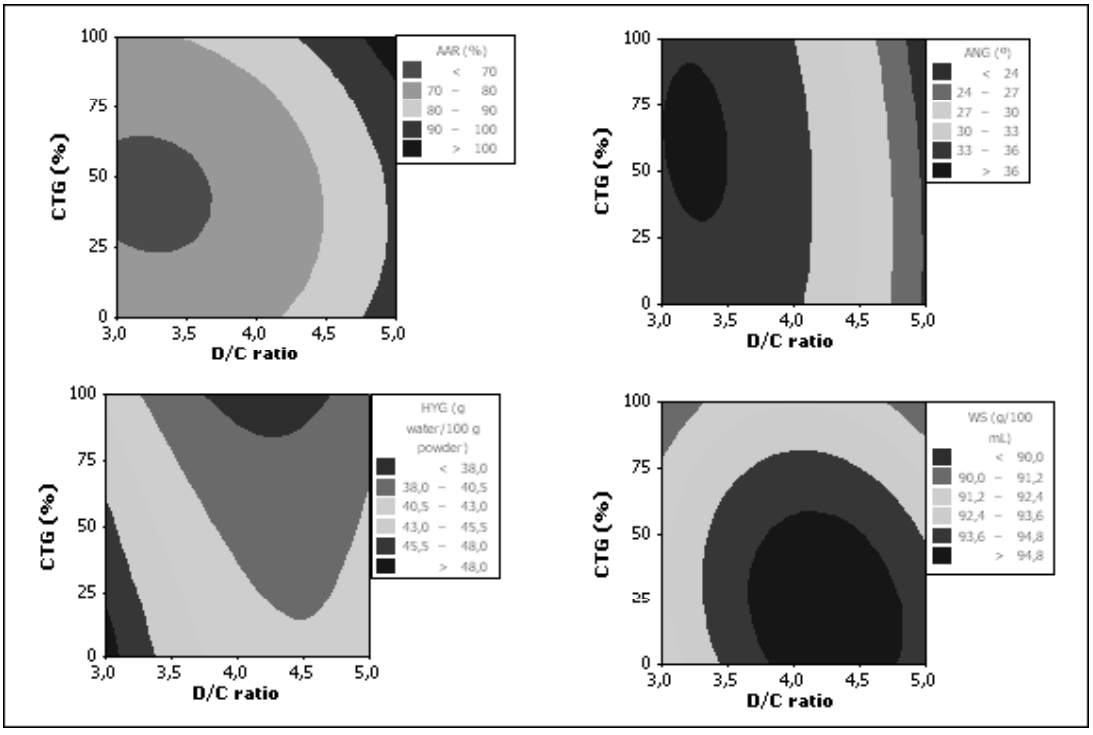

Figure 1. Contour plots representing the responses (AAR = ascorbic acid retention; ANG = angle of repose; HYG = hygroscopicity; WS = water solubility). D/C ratio: drying aid to cashew apple juice dry weight ratio; CTGR: degree of replacement of maltodextrin DE10 by cashew tree gum.

7

Nanocomposite edible films from mango puree reinforced with cellulose nanofibers

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Cellulose nanoreinforcements have been used to improve mechanical and barrier properties of biopolymers, whose performance is usually poor when compared to those of synthetic polymers. Nanocomposite edible films have been developed by adding cellulose nanofibers (CNF) in different concentrations (up to 36 g/100 g) as nanoreinforcement to mango puree based edible films. The effect of CNF was studied in terms of tensile properties, water vapor permeability, and glass transition temperature (T_g) of the nanocomposite films. CNF were effective in increasing tensile strength, and its effect on Young's modulus was even more noticeable, especially at higher concentrations, suggesting the formation of a fibrillar network within the matrix. The addition of CNF was also effective to improve water vapor barrier of the films. Its influence on T_g was small but significant. The study demonstrated that the properties of mango puree edible films can be significantly improved through CNF reinforcement.

The performance of mango puree edible films was noticeably improved by CNF reinforcement. Table 1 indicates that the mechanical properties except elongation were improved by the addition of cellulose nanofibers to mango puree edible films. The elastic modulus was the most drastically affected property. Elongation was not impaired at CNF concentrations up to 10 g/100 g. The water vapor permeability was significantly decreased when CNF was incorporated at loadings of at least 10 g/100g. The effect of the filler on glass transition temperature was low but significant.

Table 1. Physical properties of mango puree edible films with different concentrations of CNF nanoreinforcements.

CNF (g/100g)*	TS (MPa)	EB (%)	YM (MPa)	WVP (g.mm/ kPa.h.m^2)	T_g (^{o}C)
0	4.09 ^{e}	44.07 ^{a}	19.85 ^{e}	2.66 ^{a}	-10.63 ^{e}
1	4.24 ^{de}	42.42 ^{ab}	21.55 ^{e}	2.40 ^{ab}	-8.51 ^{d}
2	4.42 ^{de}	43.30 ^{ab}	22.56 ^{e}	2.17 ^{bc}	-8.57 ^{d}
5	4.58 ^{cd}	41.79 ^{b}	30.93 ^{d}	2.16 ^{bc}	-7.72 ^{c}
10	4.91 ^{c}	43.19 ^{ab}	40.88 ^{c}	2.03 ^{c}	-6.81 ^{b}
18	5.54 ^{b}	39.8 ^{b}	78.82 ^{b}	1.90 ^{cd}	-5.88 ^{a}
36	8.76 ^{a}	31.54 ^{c}	322.05 ^{a}	1.67 ^{d}	-6.04 ^{a}

•Mass of CNF added to 100g of mango puree, on a dry basis. TS: tensile strength (MPa); EB: elongation at break (%); YM: Young's Modulus (MPa); WVP: water vapor permeability (g.mm/kPa.h.m^2); T_g: glass transition temperature (^{o}C). Means in same column with different letters are significantly different at $p<0.05$

8

Bioactive compounds and antioxidant capacities of eighteen non-traditional tropical fruits from Brazil

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The bioactive compounds and antioxidant capacities of polyphenolic extracts of 18 fresh and dry native non-traditional fruits from Brazil were determined using ABTS, DDPH, FRAP and β-carotene bleaching methods. The study provides an adaptation of these methods, along with an evaluation of the compounds related to antioxidant potential. The results show promising perspectives for the exploitation of non-traditional tropical fruit species with considerable levels of nutrients and antioxidant capacity. Although evaluation methods and results reported have not yet been sufficiently standardised, making comparisons difficult, our data add valuable information to current knowledge of the nutritional properties of tropical fruits, such as the considerable antioxidant capacity found for acerola – Malpighia emarginata and camu-camu – Myrciaria dubia (ABTS, DPPH and FRAP) and for puçá-preto – Mouriri pusa (all methods).

In conclusion, it is not always a simple task to choose the most appropriate method to determine antioxidant capacity. The FRAP and ABTS + methods are generally indicated for hydrophilic compounds, while the β-carotene bleaching method is suitable for lipophilic compounds. The DPPH method may be employed routinely with aqueous-organic extracts containing hydrophilic and lipophilic compounds.

Regarding the considerable amounts of vitamin C (camu-camu and acerola), anthocyanins (Myrtaceaes – murta, java plum, jaboticaba and camu-camu), carotenoids (Melastomaceae – gurguri, puçá-preto e puçá-coroa-de-frade) and phenolic compounds, our results indicate promising perspectives for the exploitation of non-traditional tropical fruit species with considerable levels of nutrients and antioxidant capacity. The considerable amounts of anthocyanins for several of the non-traditional fruits included in this study are likely to draw attention to these species as potential commodities. Although evaluation methods and results reported have not yet been sufficiently standardised, making comparisons difficult, the data add valuable information to current knowledge on the nutritional properties of tropical fruits, such as the considerable antioxidant capacity found for acerola and camu-camu (ABTS+, DPPH and FRAP) and for puçá-preto (all methods).

Table 3
Polyphenols and antioxidant capacity in aqueous-organic extracts of 18 non-traditional Brazilian tropical fruits based on fresh matter.[a]

Fruits	Extractable polyphenols mg GAE/100 g	DPPH· EC_{50} (g/g DPPH·) [b]	ABTS·+ μmol trolox/g	FRAP μmol Fe_2SO_4/g	β-Carotene bleaching % O.I. [c]
Açaí, assaí	454 ± 44.6	4264 ± 1381	15.1 ± 4.1	32.1 ± 6.5	31.9 ± 3.2
Acerola	1063 ± 53.1	670 ± 64.5	96.6 ± 6.1	148 ± 16	n.d.
Bacuri	23.8 ± 0.7	n.d.	n.d.	n.d.	n.d.
Cajá, yellow mombim	72.0 ± 4.4	9397 ± 64.8	7.8 ± 0.2	11.8 ± 0.2	92.7 ± 1.1
Caju, cashew apple	118 ± 3.7	7142 ± 205	11.2 ± 0.04	22.9 ± 0.7	25 ± 8.9
Camu-camu	1176 ± 14.8	478 ± 1.2	153 ± 2.6	279 ± 1.5	n.d.
Carnaúba	338 ± 36.4	3549 ± 184	10.7 ± 0.2	15.5 ± 0.4	87.7 ± 2.7
Gurguri	549 ± 22.2	1385 ± 102	35.5 ± 1.6	70.4 ± 7.8	69.7 ± 8.2
Jaboticaba	440 ± 9.9	1472 ± 16.9	37.5 ± 1.4	87.9 ± 1.9	90.7 ± 0.1
Jambolão, java plum	185 ± 3.8	3025 ± 65.4	29.7 ± 0.3	35.5 ± 1.4	67.6 ± 3.1
Juçara, jussara	755 ± 8.3	1711 ± 46	78.3 ± 13.3	84.9 ± 16.1	70.8 ± 7.9
Mangaba	169 ± 21.5	3385 ± 349	14.6 ± 1.8	18.3 ± 1.6	n.d.
Murici, nance	n.d.	n.d.	n.d.	n.d.	n.d.
Murta	610 ± 17.7	936 ± 33.3	49.1 ± 0.2	108 ± 2.3	74 ± 9.2
Puçá-coroa-de-frade	268 ± 4.8	1272 ± 51.4	38.5 ± 1.2	84.9 ± 1.3	77.3 ± 1.4
Puçá-preto	868 ± 51.0	414 ± 14.4	125 ± 9.7	208 ± 3.9	85.9 ± 7.4
Umbu	90.4 ± 2.2	7074 ± 218	6.3 ± 0.2	17.2 ± 0.3	63.4 ± 8.4
Uvaia	127 ± 3.3	3247 ± 392	18 ± 0.8	38.4 ± 4.1	79.8 ± 5.9

[a] Mean value ± standard deviation; $n = 3$; n.d. = not detected.
[b] Concentration of antioxidant required to reduce the original amount of free radicals by 50%.
[c] Oxidation inhibition.

Table 4
Polyphenols and antioxidant capacity in aqueous-organic extracts of 18 non-traditional Brazilian tropical fruits (dry matter).[a]

Fruits	Extractable polyphenols mg GAE/100 g	DPPH[c] EC_{50} (g/g DPPH·)	ABTS[d] μmol Trolox/g	FRAP[e] μmol Fe_2SO_4/g	β-Carotene bleaching % O.I.[b]
Açaí, assai	3268 ± 527	598 ± 164	64.5 ± 19.2	220 ± 32.9	76.1 ± 6
Acerola	10,280 ± 77.7	49.2 ± 2.5	953 ± 34.1	1996 ± 47	n.d.
Bacuri	1365 ± 43.3	6980 ± 854	18.1 ± 3.7	16.1 ± 1.4	74.9 ± 0.7
Cajá, yellow mombim	579 ± 12.9	1064 ± 162	40.7 ± 2.2	97.6 ± 0.6	84.9 ± 3.4
Caju, cashew apple	830 ± 26.5	906 ± 78.2	79.4 ± 15.7	154 ± 7.8	44.6 ± 11.7
Camu-camu	11,615 ± 384	42.6 ± 1.4	1237 ± 33.8	2502 ± 74.5	n.d.
Carnaúba	830 ± 28.3	4877 ± 24.3	16.4 ± 0.2	18.8 ± 0.1	94.2 ± 3.2
Gurguri	1364 ± 24.8	360 ± 32.7	136 ± 20.1	274 ± 15.7	97.5 ± 0.7
Jaboticaba	3584 ± 90.9	138 ± 3.1	317 ± 2.7	635 ± 11.9	90.6 ± 0.6
Jambolão, java plum	1117 ± 67.1	938 ± 46.9	125 ± 10.8	173 ± 10.8	88.4 ± 6.8
Juçara, jussara	5672 ± 55.9	70.1 ± 4.8	606 ± 142	834 ± 142	96.1 ± 2.5
Mangaba	935 ± 37	890 ± 69.1	65.6 ± 7.4	163 ± 11.7	34.7 ± 12.3
Murici, nance	2380 ± 104	238 ± 17.7	412 ± 13	334 ± 3.9	61.5 ± 1.6
Murta	2055 ± 75.7	363 ± 27.4	166 ± 4	299 ± 22.4	92.5 ± 0.6
Puçá-coroa-de-frade	1047 ± 77	316 ± 2	161 ± 3	380 ± 0.4	95.9 ± 1.2
Puçá-preto	2638 ± 48.9	65.6 ± 2.4	346 ± 21.7	909 ± 28.4	99.1 ± 0.5
Umbu	742 ± 19	933 ± 109	77 ± 15.4	143 ± 1.3	79.3 ± 14.6
Uvaia	1930 ± 129	276 ± 22.2	182 ± 14.2	408 ± 34.9	63.7 ± 5.3

[a] Mean value ± standard deviation; $n = 3$; n.d. = not detected.
[b] Oxidation inhibition.

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Total Phenolic Content and Antioxidant Activity in Acerola, Açaí, Mangaba and Uvaia Fruits by DPPH Method

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This research has been done to evaluate the kinetic of DPPH (2,2 diphenyl-1-picryl-hidrazil) radical scavenge by some tropical fruits (acerola - Malpighia emarginata), açaí - Euterpe oleracea, mangaba - Hancornia speciosa and uvaia - Eugenia pyriformis) extracts. The fruits were harvested in the Ceará and Piauí States, Brazil. The capacity to reduce 50% the DPPH (EC_{50}) concentration by different fruit extracts was evaluated. The absorbance at 515 nm decreased until stabilization was reached. Reaction stabilized at 10 minutes for acerola, 30 minutes for mangaba, and 120 minutes for açaí and uvaia. Acerola had the highest antioxidant activity (AA) (670 g/g DPPH), followed by uvaia (3246 g/g DPPH), mangaba (3385 g/g DPPH) and açaí (3778 g/g DPPH). Antioxidant potential of these fruits could be attributed to different compounds evaluated, such as vitamin C (1357 mg/100 g) and phenolics (1063 mg/100 g) in acerola.

Açaí, mangaba and uvaia had longer stabilization times than acerola by the DPPH method, probably because they contained high lipophilic compounds content. Acerola pulp contained high levels of ascorbic acid and phenolic compounds and, therefore, the antioxidant behavior, as measured by the DPPH method, was similar to that of ascorbic acid. The high content of bioactive compounds in acerola fruits resulted in high antioxidant activity. The ability of these fruits to protect the cell components from oxidative damages needs to be investigated further.

Table 1. Total extractable polyphenols (TEP) and total antioxidant activity by DPPH method in acerola, açaí, mangaba, and uvaia extracts.

Fruits	Total phenolics – GAE (mg gallic acid/100 g)	DPPH EC_{50} (g/g DPPH)
Acerola	1063.3 ± 53	670.1 ± 64.5
Açaí	517.8 ± 115.5	5383.4 ± 2170.8
Mangaba	171.8 ± 31.1	3385 ± 349
Uvaia	126.5 ± 3.3	3246.5 ± 392.3

Each value is the mean ± standard deviation of three replicate experiments.

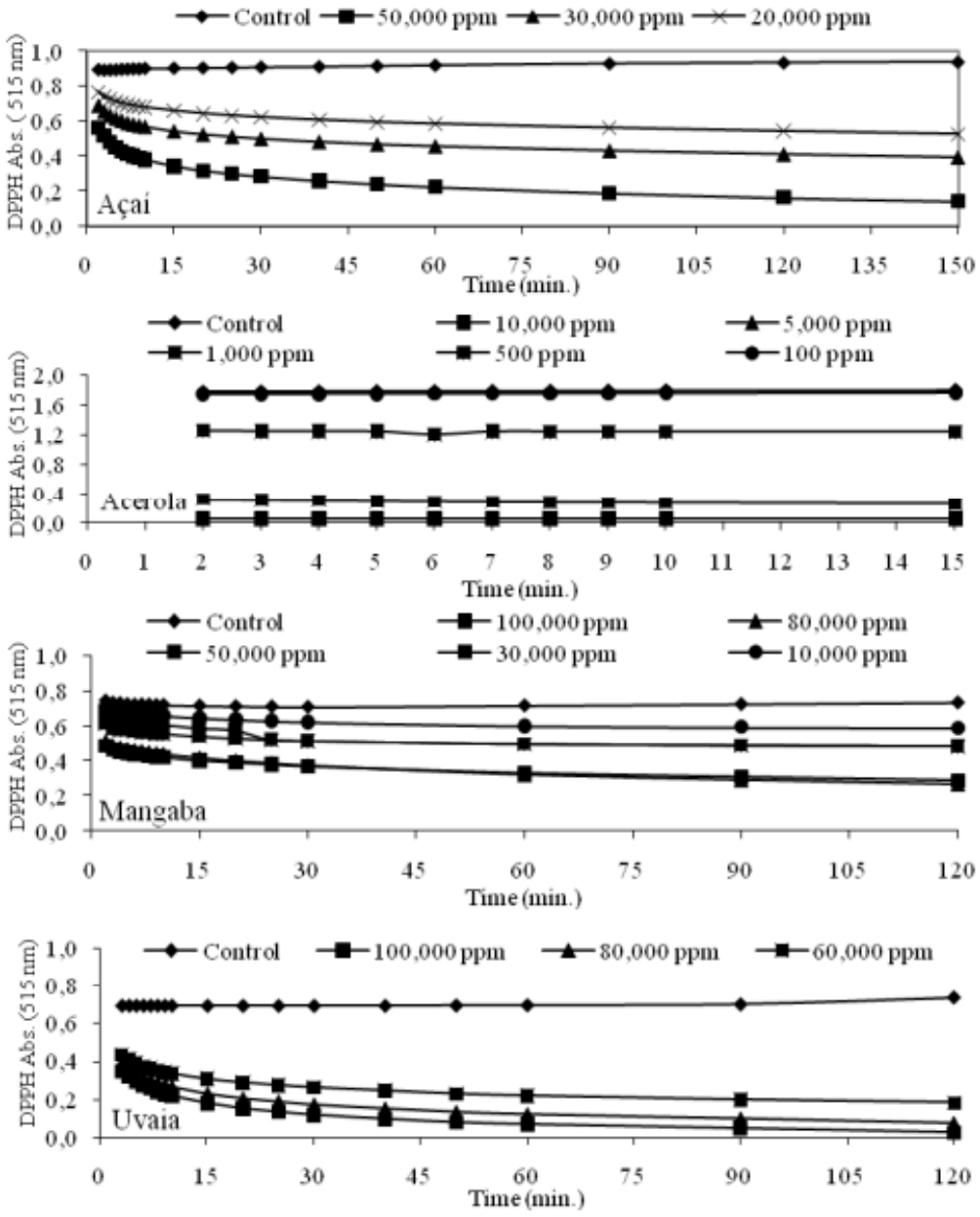

Fig. 1. Absorbance decrease and stabilization time of extracts from acerola, açaí, mangaba and uvaia fruits in the DPPH assay.

10

Quality, Bioactive Compound Content, and Antioxidant Activity in Fruits of Brazilian Acerola Clones

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Acerola is a fruit with a high nutritional value, not only due to its vitamin C content, but also to β-carotene and anthocyanins. The aim of this work was to evaluate the quality and the total antioxidant activity in fruits of six commercial acerola clones. Fruits were analyzed for total soluble solids (TSS), soluble sugars, total titrable acidity (TTA), pH, vitamin C, anthocyanins, yellow flavonoids, total carotenoids, total extractable polyphenols and total antioxidant activity by the DPPH, ABTS and FRAP methods. The 'II 47/1' clone had the highest vitamin C and anthocyanin contents among all the clones tested. Acerola fruits, evaluated by the DPPH method, had an average EC_{50} *of 697.1, with the clone II 47/1 having the highest value (461.5 g/g pulp). For the ABTS method, fruits from 'Cereja' and 'II47/1' had the highest values with 158.7 and 138.3 μM Trolox/g pulp, respectively. There was a significant difference among samples. For the FRAP method, the clone 'Sertaneja' showed the highest value of 306.9 μM* Fe_2SO_4 */g pulp.*

Regarding the quality of the acerola 'II47/1' clone, it had higher values of TA, TSS, soluble sugars, vitamin C, anthocyanins and TEP. The clones that had the most AA were 'II47/1' and 'Cereja'. The first one is a good source of vitamin C, total anthocyanins and TEP. And the second one is a good source of vitamin C and TEP, but principally, total carotenoids and yellow flavonoids.

Table 1. Total soluble solids (TSS - ºBrix), soluble sugar (SS - %), total titrable acidity (TTA - %), pH, TSS/TTA, total anthocyanins (TA – mg/100 g), yellow flavonoids (YF – mg/100 g) and total carotenoids (TC – mg/100 g) in fruits of different acerola clones.

	Bioactive compound content							
Clone	TSS	SS	TTA	pH	TSS/TTA	TA	YF	TC
Apodi	7.13 c	2.67 c	1.29 d	3.17 b	5.50 b	23.60 b	9.58 bc	1.07 c
Cereja	8.57 a	3.61 b	1.61 ab	3.02 c	5.33 b	22.60 b	13.44 a	3.06 a
Frutacor	7.90 b	3.98 b	1.41 c	3.21 ab	5.62 bc	9.48 d	8.36 cd	2.25 b
Roxinha	7.37bc	3.74 b	1.19 e	3.25 a	6.18 a	14.63 c	6.37 d	0.89 c
Sertaneja	7.50 bc	2.74 c	1.57 b	3.05 c	4.57 c	13.73 c	10.58 bc	1.07 c
II47/1	9.00 a	4.47 a	1.65 a	3.18 ab	5.45 b	34.55 a	10.91 b	0.56 d
mean	7.91	3.54	1.45	3.15	5.44	19.74	9.87	1.48

Means with different letters are significantly different according to Tukey's test ($P < 0.05$).

Table 2. Vitamin C (VC – mg/100g), total extractable polyphenols (TEP – mg/100g), antioxidant activity DPPH (EC_{50} - g/g pulp), ABTS (µmol Trolox/g pulp) and FRAP (µmol Fe_2SO_4/g pulp) in fruits of different acerola clones.

	Antioxidant activity assay				
Clone	VC	TEP	DPPH	ABTS	FRAP
Apodi	1177.78 c	478.16 d	688.40 b	97.04 c	289.22 ab
Cereja	1471.01 ab	822.03 b	667.98 b	158.72 a	187.66 c
Frutacor	1176.66 c	451.00 d	637.18 b	96.71 c	282.09 ab
Roxinha	1037.54 c	484.65 d	539.92 a	61.44 d	240.94 b
Sertaneja	1387.64 b	566.95 c	700.51 b	90.12 c	306.92 a
II47/1	1578.74 a	1104.79 a	461.53 a	138.27 b	244.19 b
mean	1304.90	651.26	615.92	107.08	258.51

Means with different letters are significantly different according to Tukey's test ($P < 0.05$).

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Quality for fresh consumption and processing of some non-traditional tropical fruits from Brazil

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Brazil is home to a great diversity of tropical, non-traditional fruit species with a potential for consumption in natura and agroindustrial processing. The objective of our study was to evaluate the quality of 18 non-traditional fruits from Brazil belonging to the families Anacardiaceae, Apocynaceae, Arecaceae, Clusiaceae, Malpighiaceae, Melastomataceae and Myrtaceae. Materials and methods. Samples were collected from areas of occurrence, commercial orchards and collections in Northern, Northeastern and Southeastern Brazil; they were tested for total soluble solids (TSS), soluble sugars (SS), reducing sugars (RS), total titratable acidity (TTA), pH, [TSS / TTA] ratio, starch, total pectin (TP) and soluble pectin (SP). Results and discussion. Parameters varied greatly among the species. Thus, TSS was 4.75–37.07 °Brix; SS, 1.26–17.74%; RS, 2.53–9.92%; TTA, 0.20–2.64%; pH, 2.56–5.38; [TSS /TTA], 3.26–107.70; starch, 0.12–12.65%; TP, 0.15–1.27%; and SP, 0.04–1.49%. Conclusion. Many of the 18 fruits evaluated in this study show potential for consumption in natura and agroindustrial processing.

Table II.
Composition of the 18 Brazilian tropical, non-traditional fruits included in a study aiming at assessing their quality for fresh consumption and processing (% = g of element·100 g^{-1} edible portion, average ± standard deviation, $n = 3$).

Fruit	Total soluble solids (TSS) (°Brix)	Soluble sugars (%)	Reducing sugars (%)	Total titratable acidity (TTA) (%)	pH	[TSS / TTA]	Starch (%)	Total pectin (%)	Soluble pectin (%)
Assai	6.02 ± 1.16	1.26 ± 0.34	Not detected	0.31 ± 0.06	5.38 ± 0.10	19.65 ± 1.13	5.94 ± 0.40	0.96 ± 0.08	0.34 ± 0.05
Acerola	7.60 ± 0.17	2.55 ± 0.03	Not detected	1.46 ± 0.02	3.19 ± 0.02	5.21 ± 0.08	0.58 ± 0.02	Not detected	not detected
Bacuri	14.00 ± 0.19	12.42 ± 0.26	4.77 ± 0.21	1.63 ± 0.01	2.68 ± 0.06	8.59 ± 0.13	4.19 ± 0.23	0.56 ± 0.09	0.82 ± 0.12
Cashew	11.83 ± 0.49	10.39 ± 0.51	Not detected	0.20 ± 0.03	4.37 ± 0.07	58.79 ± 10.35	0.69 ± 0.02	0.15 ± 0.01	Not detected
Camu-camu	7.18 ± 0.16	1.64 ± 0.05	Not detected	2.92 ± 0.09	2.56 ± 0.01	2.46 ± 0.02	0.93 ± 0.19	0.40 ± 0.03	0.04 ± 0.00
Carnaúba	37.07 ± 1.10	17.74 ± 0.80	Not detected	0.35 ± 0.03	4.93 ± 0.16	107.70 ± 12.49	12.65 ± 1.95	1.08 ± 0.10	1.49 ± 0.04
Gurguri	18.60 ± 2.79	11.49 ± 1.69	Not detected	0.48 ± 0.08	4.51 ± 0.06	39.19 ± 4.67	1.81 ± 0.22	0.44 ± 0.02	0.14 ± 0.00
Jaboticaba	11.22 ± 0.13	8.50 ± 0.17	6.88 ± 0.04	1.65 ± 0.07	3.18 ± 0.06	6.81 ± 0.31	0.89 ± 0.09	0.44 ± 0.01	0.06 ± 0.01
Java plum	12.13 ± 0.06	8.49 ± 0.07	Not detected	0.87 ± 0.03	3.53 ± 0.02	13.95 ± 0.55	1.28 ± 0.10	0.57 ± 0.01	0.72 ± 0.07
Jussara	4.75 ± 1.32	1.51 ± 0.36	2.53 ± 0.58	0.37 ± 0.02	4.66 ± 0.09	9.53 ± 0.44	4.82 ± 1.28	0.40 ± 0.08	1.19 ± 0.32
Mangaba	21.50 ± 0.53	13.55 ± 0.87	9.13 ± 0.45	0.72 ± 0.16	3.22 ± 0. 02	35.51 ± 5.50	0.76 ± 0.06	0.48 ± 0.04	0.37 ± 0.02
Murta	20.73 ± 0.45	15.22 ± 0.22	Not detected	0.64 ± 0.08	4.05 ± 0.00	32.60 ± 4.43	2.74 ± 0.10	0.67 ± 0.13	0.10 ± 0.01
Nance	22.13 ± 0.15	4.18 ± 0.12	Not detected	2.64 ± 0.14	3.48 ± 0.01	8.41 ± 0.50	7.01 ± 0.28	1.27 ± 0.00	0.46 ± 0.09
Puçá-coroa-de frade	26.13 ± 0.15	16.63 ± 0.60	9.81 ± 0.32	0.53 ± 0.03	4.42 ± 0.60	49.17 ± 2.02	2.73 ± 0.34	0.63 ± 0.03	0.22 ± 0.02
Puçá-preto	28.53 ± 0.47	15.69 ± 0.05	9.92 ± 0.26	0.38 ± 0.01	4.53 ± 0.07	75.98 ± 3.63	2.58 ± 0.26	0.59 ± 0.04	0.25 ± 0.03
Umbu	10.30 ± 0.46	4.51 ± 0.31	3.65 ± 0.18	2.17 ± 0.13	2.62 ± 0.01	4.75 ± 0.07	0.12 ± 0.04	0.51 ± 0.06	0.37 ± 0.07
Uvaia	7.53 ± 0.32	4.00 ± 0.09	2.77 ± 0.09	2.31 ± 0.08	2.77 ± 0.01	3.26 ± 0.03	0.35 ± 0.04	0.37 ± 0.02	0.17 ± 0.01
Yellow mombim	12.80 ± 0.89	7.80 ± 0.12	Not detected	1.09 ± 0.08	3.07 ± 0.06	11.71 ± 0.18	0.13 ± 0.03	0.46 ± 0.03	Not detected

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Temperature and packaging of minimally processed pumpkin (*Curcubita moschata*)

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The present work aimed to evaluate the efficiency of different storage temperatures and packing materials for pumpkin fresh cuts. Pumpkin cuts of 5 × 10 cm were packed in polystyrene trays covered with polivynilchloride film or in vacuum high density polyethylene bags. The trays and bags were kept at 5 and 10 °C for 12 days. Soluble solids, total titratable acidity, pH, vitamin C, and color of pumpkin cuts were evaluated every 3 days. The different temperatures did not affect the storage of the pumpkins. However, packaging with PVC film allowed a longer conservation by keeping the pumpkin quality attributes up to the 9th day, except for the color which undergone minor alterations when stored within a vacuum pack.

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Packing and refrigeration for atemoya preservation

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Despite the increasing commercial interest in atemoya in Brazil, this fruit has a very limited shelf-life. The present work intended to evaluate the storage of atemoya cv. Gefner under different packing systems and cold storage periods. A factorial of 3 × 5 completely randomized design was used (three packing systems: control (unpacked), individually packed with PVC films, and placed in polyester trays wrapped in PVC film for five different storage periods), with three replicates. Weight loss, skin and pulp color, Soluble Solids (SS), Total Tritable Acidity (TTA), vitamin C, pulp pH, and water activity at harvest were recorded every three days of storage. Modified atmosphere did not influence the skin color, but it preserved the pulp brightness and reduced weight loss of the unpacked fruits. SS and TTA levels increased during the storage of unpacked fruits as did the vitamin C contents. Cold storage was efficient for the atemoya preservation, which presented good appearance after 15 days of storage.

14

Incorporation of fruit pulp residue flour into cookies: an alternative to combat waste

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The residues originated from fruit processing contain many nutrients. As a way of preventing waste and minimizing the problem of malnutrition in underprivileged communities, this work involved a study concerning the composition of the dehydrated residues and their incorporation into cookies. The physical characteristics of the in natura residues and the proximate composition of the dried, ground residues were determined, and a sensory analysis for the acceptability of cookies with incorporation of the residue at percentages of 5, 10, 15 and 20% in substitution of the wheat flour, was carried out. The highest fibre contents were found in the guava (42.68 g.100 g–1) and passion fruit (47.00 g.100 g–1) residues and the major pectin contents in the umbu (13.7 %) and passion fruit (9.01%) residues, while the acerola residue showed a high carbohydrate content (70.83 g.100 g–1). For the four fruits studied, the best acceptance was obtained for the cookies with 10% residue incorporation, especially with respect to flavour, taste and texture. The most appreciated cookies, those of guava and passion fruit, were also the richest in fibres and those showing the lowest caloric values.

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Enzyme Synthesis of Oligosaccharides using Cashew Apple Juice as Substrate

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The use of agriculture substrates in industrial biotechnological processes has been increasing because of their low cost. In this work, the use of clarified cashew apple juice was investigated as substrate for enzyme synthesis of prebiotic oligosaccharide. The results showed that cashew apple juice is a good source of reducing sugars and can be used as substrate for the production of dextransucrase by Leuconostoc citreum B-742 for the synthesis of oligosaccharides using the crude enzyme. Optimal oligosaccharide yield (approximately 80%) was obtained for sucrose concentrations lower than 60 g/L and reducing sugar concentrations higher than 100 g/L.

The clarified cashew apple juice used in this study had 100.23 g L^{-1} of total reducing sugar (44 g L^{-1} of glucose and 56 g L^{-1} of fructose). Concentrated juice presented the same proportion of sugars. Cashew apple juice used herein presented a total sugar concentration of Experimental design and the results obtained are presented in Tables1 and 2. Some experimental runs presented very high dextran concentrations, presenting values higher than the maximum theoretical yield based on sucrose available (50 %). These results suggested that some reducing sugar might have been incorporated into the polysaccharide chain. The estimated effects of the independent variables on the evaluated responses are presented in tables 3 and 4

All effects were significant at the considered confidence interval, except sucrose quadratic effect and sucrose and reducing sugar interactions. Sucrose and reducing sugar linear effect were positive on oligosaccharide concentration. On dextran formation, sucrose linear effect also presented strong positive effect, as expected. Sucrose is a substrate for dextran formation and oligosaccharide synthesis. Reducing sugar acts as acceptor in the enzyme reaction. Thus, as expected, sucrose and reducing sugar presented positive effect on total consumed sugar, but only reducing sugar was positive and significant for reducing sugar consumption. Only the reducing sugar presented positive effect on oligosaccharides concentration and yield. Reducing sugar presented negative effect on dextran yield. Equations 3 to 7 are the fitted regression models obtained from the studied responses. ANOVA analysis of the given equations showed that all fitted regression models were statically significant at the considered confidence interval (95 %) because the calculated F-value was higher than the F-listed (Rodrigues et al., 2006). Good correlation coefficients (R^2 >0.95) were also obtained.

Figures 1 to 3 are the surface responses built using Equations 3,4 and 7. Oligosaccharides production was enhanced by increasing reducing sugar concentration in the reactor media. No substrate inhibition was observed at the considered experimental domain. As sucrose also takes part in oligosaccharide synthesis, the maximal oligosaccharide formation was found when high concentrations of sucrose (greater than 70 g/L) and reducing sugar (greater than 100 g/L) were applied (Figure 1). Reducing sugar caused a decrease in dextran formation. The results reported herein, except for dextran yield, are consistent with the acceptor mechanism proposed for dextrasucrase from *L. mesenteroides* B-512-F.

Table 1. Experimental design and obtained results (oligosaccharide and dextran yield) in *L. citreum* B-742 dextransucrase enzyme synthesis using cashew apple juice as substrate.

Run	Suc (g/L)l	RS (g/L)	Oligos (g/L)	Dextran (g/L)	Y_{OLIG} (%)	Y_{DXT} (%)
1	25.00	62.50	38.98	48.60 ± 2.19	44.51	55.49
2	25.00	125.00	107.00	32.03 ± 1.56	76.96	23.04
3	75.00	62.50	58.16	74.56 ± 3.26	43.82	56.18
4	75.00	125.00	134.47	53.15 ± 2.39	71.67	28.33
5	25.00	93.75	84.19	31.07 ± 1.26	73.04	26.96
6	75.00	93.75	103.99	52.32 ± 2.36	66.53	33.47
7	50.00	62.50	55.87	53.96 ± 2.57	50.87	49.13
8	50.00	125.00	127.15	46.52 ± 2.09	73.21	26.78
9	50.00	93.75	91.15	48.29 ± 2.15	65.37	34.63
10	50.00	93.75	93.44	47.64 ± 2.12	66.23	33.77
11	50.00	93.75	93.23	46.89 ± 2.09	66.53	33.47

Table 2. Experimental design; reducing and total sugars consumed in the enzyme synthesis of oligosaccharide in cashew apple juice.

Run	Suc (g/L)	RS (g/L)	RS_{cons} (g/L)	TS_{cons}(g/L)
1	25.00	62.50	62.578	87.578
2	25.00	125.00	114.020	139.020
3	75.00	62.50	57.722	132.722
4	75.00	125.00	112.616	187.616
5	25.00	93.75	90.259	115.259
6	75.00	93.75	81.307	156.307
7	50.00	62.50	59.828	109.828
8	50.00	125.00	123.674	173.674
9	50.00	93.75	89.440	139.440
10	50.00	93.75	91.078	141.078
11	50.00	93.75	90.122	140.122

Table 3. Estimated effects of independent variables on oligosaccharides, dextran concentration and yields.

	Oligosaccharides		Dextran		Y_{OLIGO}		Y_{DXT}	
Factor	Effect	S.E.	Effect	S.E.	Effect	S.E.	Effect	S.E.
Mean	94.36*	1.65*	45.98*	2.12*	67.42*	1.66*	32.58*	1.66*
Suc(L)	22.15*	2.62*	22.78*	3.37*	-4.17	2.64	4.17	2.64
Suc (Q)	-5.81	4.03	-3.67	5.19	0.60	4.06	-0.60	4.06
RS(L)	71.87*	2.62*	-15.14*	3.37*	27.55*	2.64*	-27.55*	2.64*
RS (Q)	-10.97*	4.03*	13.43*	5.19*	-14.89*	4.06*	14.89*	4.06*
Suc x RS	4.15	3.21	-2.42	4.13	-2.30	3.23	2.30	3.23

Table 4. Estimated effects of the independent variables on reducing and total consume sugars.

	RS_{cons}		TS_{cons}	
Fator	Effect	S.E.	Effect	S.E.
Média	90.34*	1.64*	140.34*	1.64*
Suc(L)	-5.07	2.60	44.93*	2.60*
Suc (Q)	-9.48	4.01	-9.48	4.01
RS(L)	56.73*	2.60*	56.73*	2.60*
RS (Q)	2.46	4.01	2.46	4.01
Suc x RS	1.73	3.19	1.73	3.19

Figures 1 to 3 are the surface responses. Oligosaccharides production was enhanced by increasing reducing sugar concentration in the reactor media. No substrate inhibition was observed at the considered experimental domain. As sucrose also takes part in oligosaccharide synthesis, the maximal oligosaccharide formation was found when high concentrations of sucrose (greater than 70 g/L) and reducing sugar (greater than 100 g/L) were applied (Figure 1). Reducing sugar caused a decrease in dextran formation. The results reported herein, except for dextran yield, are consistent with the acceptor mechanism proposed for dextrasucrase from *L. mesenteroides* B-512-F.

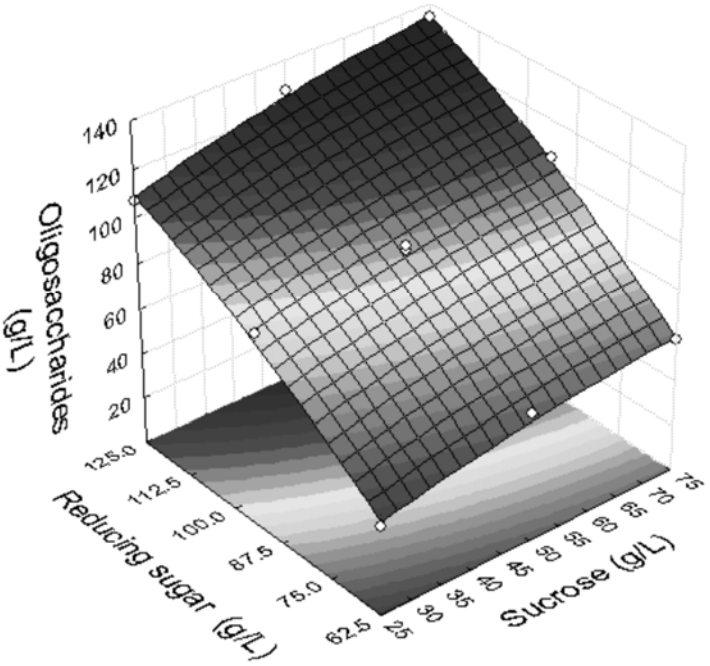

Figure 1.Surface graph of oligosaccharides formation as function of sucrose and reducing sugar concentration.

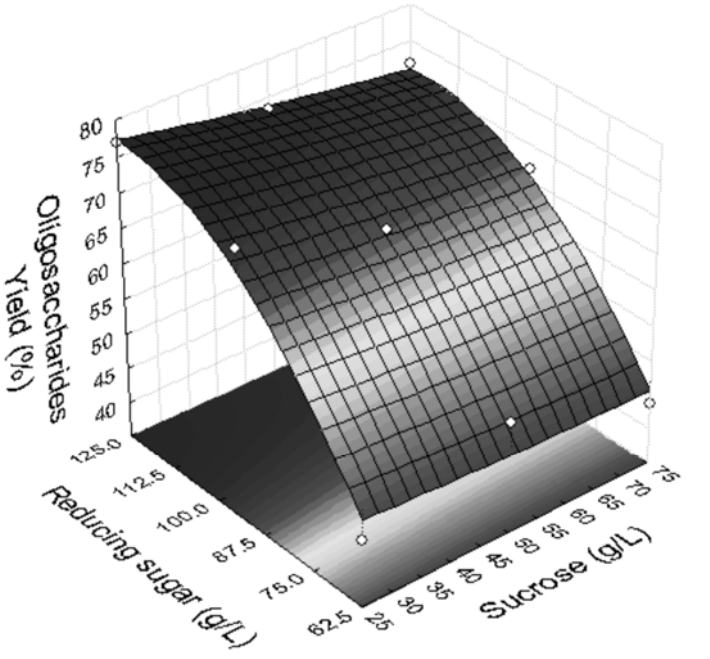

Figure 2. Surface graph of oligosaccharide yield as function of sucrose and reducing sugar concentration.

According to acceptor mechanisms, the increase on acceptor concentration causes de dextran synthesis suppression due to the deviation of glucosyl moieties to the acceptor chain producing oligosaccharides. Dextran formation was highly enhanced at high sucrose concentration and low reducing sugar concentration. Maximal dextran formation (75.56 g/L) was found when 75 g/L of sucrose and 62.50 g/L of reducing sugar were added to the crude enzyme fermented broth. As previously observed, dextran formation was higher than the maximal theoretical yield (50 %

of the available sucrose). Dextran obtained herein, was higher than the amount of sucrose available for the enzyme synthesis, suggesting that *L. citreum* B-742 dextransucrase is also able to polymerize the reducing sugar. However, the study of the polysaccharide production was outside the scope of the present work and it will be subject of future works.

Oligosaccharide yield is presented in Figure 2. Sucrose concentration did not significantly affect the oligosaccharide yield. However, reducing sugar concentration enhanced the oligosaccharide yield. The maximal oligosaccharide yield (approximately 80 %) was obtained for sucrose concentrations lower than 60 g/L and reducing sugar concentrations higher than 100 g/L (Figure 2).

The surface response graph of consumed reducing sugar is presented in Figure 3. Reducing sugars added to the crude enzyme (crude fermented broth), were almost totally consumed in 72 hours, showing that no substrate inhibition occurred at the studied concentration range and enzyme was not denaturalized at the synthesis conditions.

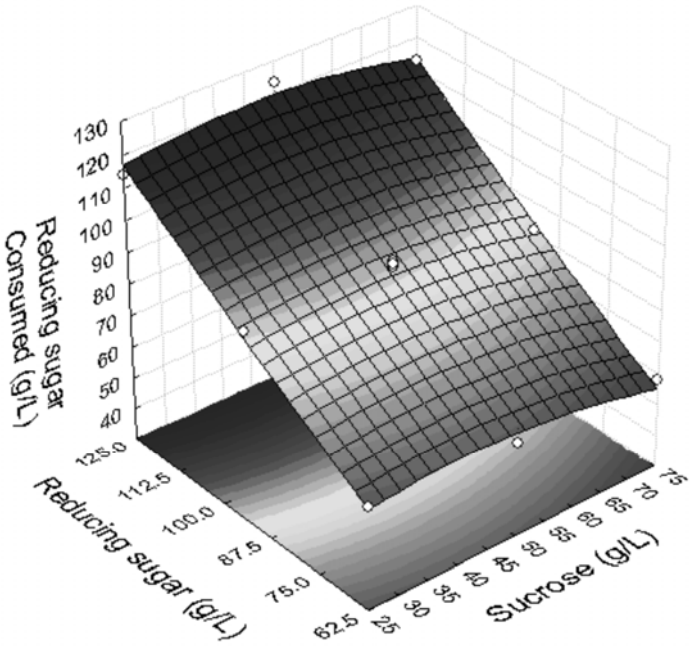

Figure 3. Surface graph total consumed reducing sugar as function of sucrose and reducing sugar concentration.

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Chemical and Sensorial Quality Parameters of Dehydrated Lemon Fruit

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Two varieties of lemon – lemon Taiti (Citrus latifolia) and Galician lemon (Citrus aurantifolia) fruits were dehydrated in the forms of entire lemon or their rinds. The main objective of the present work was to verify the presence of bitterness in the dehydrated product. The effect of fruit variety, maturation stage, concentration of salt solution used for brining, and the fruit and brine ratio were evaluated while dehydration was carried out in a cabin drier. Salt concentration varied from 10, 20, 30, 35 and 40% and contact period from 1, 2, 3 and 4 days while the proportion of fruit and brine solution was varied from 1:2, 1:3 and 1:4. The fruits were immersed in cold or hot water to remove the salt and dried later. Through detailed sensorial and visual tests, it was concluded that the Galician lemon fruits in the mature stage when treated with 30% salt solution for four days, having a fruit/brine ratio of 1:4 presented best results. The optimum dehydration temperature in a cabinet drier with forced air circulation was 60°C. The dehydrated product, triturated in the form of a powder, retained the characteristic aroma attributes of lemon and it could well serve as a condiment source.

Table 1 summarizes the data obtained on sensorial attributes of bitterness wherein parameters such as brine solution concentration and contact time were varied in both cultivars of lemon. The samples prepared with 10 and 20% of brine solution presented higher bitterness while the samples which were prepared with 30 and 35% of brine solution were supersaturated and these samples retained formation of crystals in lemon. However, the samples prepared with 30% of brine solution were selected for further studies as these possessed very little bitterness as reported by sensorial tests. In the evaluation of contact period with brine solution it was observed that the samples immersed for 4 days retained very little bitterness (Table 1).

As far as different proportions of fruit and brine solution tested in this study (Table 2), samples prepared with 1:4 proportions were found to be much more satisfactory according to the sensorial evaluation and better results were obtained with lemons having yellow rind. The color of ripe lemons cv. Taiti did not change. However, in both cultivars of green stage of ripening, the darker green color changed to green. In the samples submitted for water treatment at room temperature (26°C) after brine solution treatment, better results were obtained with both cultivars and for both the maturation stages studied.

Table 1. Effect of brine solution concentration and contact time according to bitterness notes in dehydrated product

Lemon cultivar	Brine solution concentration (%)	Bitterness evaluation based on contact time (days)			
		1	2	3	4
Galician	10	5	5	4	4
	20	5	5	4	4
	30	4	4	3	3
	35	Crystal formation			
Taiti	10	5	5	4	4
	20	5	5	4	4
	30	4	4	3	2
	35	Crystal formation			

Table 2. Bitterness notes of dehydrated lemons prepared with varying fruit/brine

Maturation stage	Fruit/brine solution proportion*		
	1:2	1:3	1:4
Galician lemon with green rind	4	4	3
Galician lemon with yellow rind	4	3	2

*Four days of contact time.

The samples which were treated with boiling water possessed lesser salty flavor; however, bitter flavor was intensified in these samples. All these tests demonstrated better results with the cultivar Galician for ripe fruits which possessed thinner rind, lesser bitter flavor and better aroma. The drying curves were prepared with the data on samples dehydrated at 60ºC, for both the cultivars of Taiti and Galician for ripe lemons and the results are represented in Figure 1. For the cultivar Taiti, the drying time was of 72 h while for Galician cultivar, it was only 60 h. The drying time being more for the cultivar Taiti was related to the fruit being bigger and its rind being thicker than that of the cultivar Galician which besides being rapid in drying, retained better lemon aroma. As far as the stage of maturity is related, both the cultivars needed lesser drying time for ripe fruits as compared to that of the green fruits.

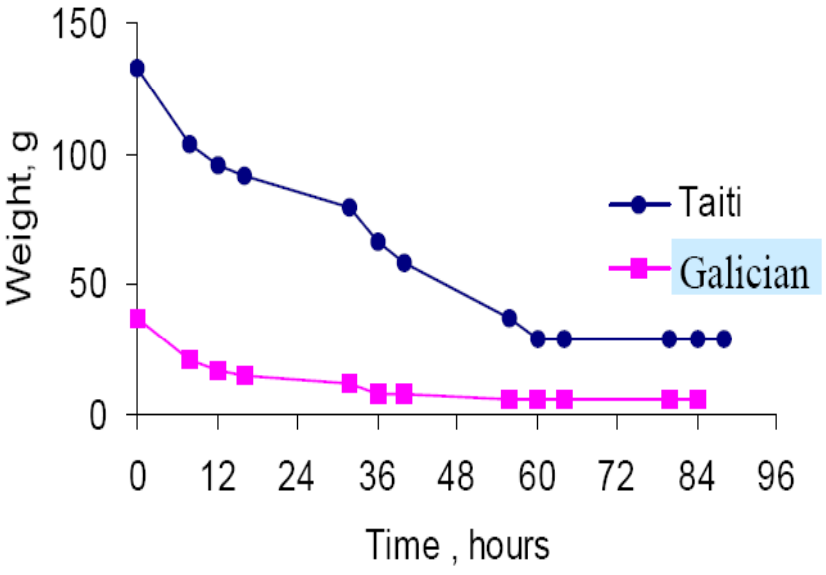

Figure 1. Drying curve for lemons of cultivars of Galician and Taiti

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Optimization of Processing Parameters for the Extraction of Essential Oil from Orange Rind

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The residues generated in the orange juice processing industries in Brazil are generally donated or sold at an extremely low price, and these are consequently used in animal feed or as organic fertilizer. For this reason, the present work was planned to give a better economic viability to these residues through the extraction of oil which could be used later in food and cosmetic industrial products. A 23 factorial with star design was utilized and the factors such as: solvent concentration, time and temperature of extraction were varied while the process yield was evaluated as response. The factors varied according to the planned experimental matrix and the models were evaluated by ANOVA while for optimization of parameters, response surface methodology (RSM) was employed. A unitary type extractor Foss Tecator of Soxtex was employed while various mixtures of alcohol and water were used as solvent. The extracts were incolored and possessed characteristic orange aroma. Through ANOVA analysis, a square model was adjusted to fit the results. The RSM analysis revealed the yield to be parabolic in nature between solvent concentration and time, and saddle point for temperature. The optimum regions for essential oil extraction pertained to the mean values of solvent concentration and of time but of minimum temperature for extraction. This work demonstrates that it is possible to aggregate value to these residues through the extraction of essential oils which could be used as subsidiary products and commercialized by industries.

The extracts obtained possessed characteristic orange aroma and these were incolor in appearance, which demonstrated that the properties of these essential oils were retained in the extracts. Table 1 presents the data on various experiments undertaken by selecting the values of *x1, x2* and *x3*. These results reveal the experimental values of extraction yields, obtained from each experimental design. These served as a base for finding regression by minimum square method and thus obtained the models with the objective of posterior evaluation of these by ANOVA methodology

Eq. 1, which is presented below, describes the optimum model for the evaluation of dependence on extraction yield (*Y*) under effects of factors of time (*t*) and temperature (*T*) of extraction. It is perceived that the dependence is of square type with both the factors.

$$Y=5.3300-0.0513CAlcohol+0.0756t-0.1076T-0.0654CAlcohol^2-0.2318t^2+0.1621T^2+0.0176\ CAlcohol.\ t+0.0174\ CAlcohol.T-0.0114\ t.T$$

The results presented in Table 2 were obtained by application of ANOVA for the optimum model. In these are presented the values of analysis of variance explainable, maximum explainable and multiple correlations (R2). How close these values be of 100 (1º and 2º) and 1.0 (3º), small will be the error accumulated in the model. It is perceived that the values obtained for these cited parameters fall within the expected. Thus from these concepts, we can conclude that the model presents low error values due to the (variances and R2) and low errors due to the methods employed in analysis.

Table 1. Planned matrix for experimental design

Assay	x_1	x_2	x_3	Y_{ex}	Y_{calc}
1	-1	-1	-1	5.3440	5.3018
2	1	-1	-1	5.1100	5.1292
3	-1	1	-1	5.4420	5.4406
4	1	1	-1	5.3940	5.3384
5	-1	-1	1	5.0560	5.0746
6	1	-1	1	5.0070	4.9716
7	-1	1	1	5.2240	5.1678
8	1	1	1	5.1300	5.1352
9	0	0	0	5.3260	5.33
10	0	0	0	5.3760	5.33
11	0	0	0	5.2970	5.33
12	-1.682	0	0	5.2010	5.2313
13	0	-1,682	0	4.5410	4.547
14	0	0	-1,682	5.9400	5.9696
15	1.682	0	0	5.0370	5.0587
16	0	1,682	0	4.7550	4.8014
17	0	0	1,682	5.5850	5.6076

The two last columns in the Table 2 present F test values, being that the first (Fcalc/Ftab) indicates that the model is significative, or the data calculated approximates to the experimental values while the second (Ftab/Fcalc) indicates that the data are adjusted and describes well the surface response. For the first test to be valid, it is necessary that the value of Fcalc should be four times the values of Ftab. This condition approximates the values thus demonstrating that the model is significant within the scope of this work. In the case of the second test, the condition is inversely proportional or Fcalc has to be four times lower than Ftab. However, for the model, we observe that Fcalc value is two times lower than the Ftab, which signifies that the data could not describe the surface, although the model being better adjusted to the process.

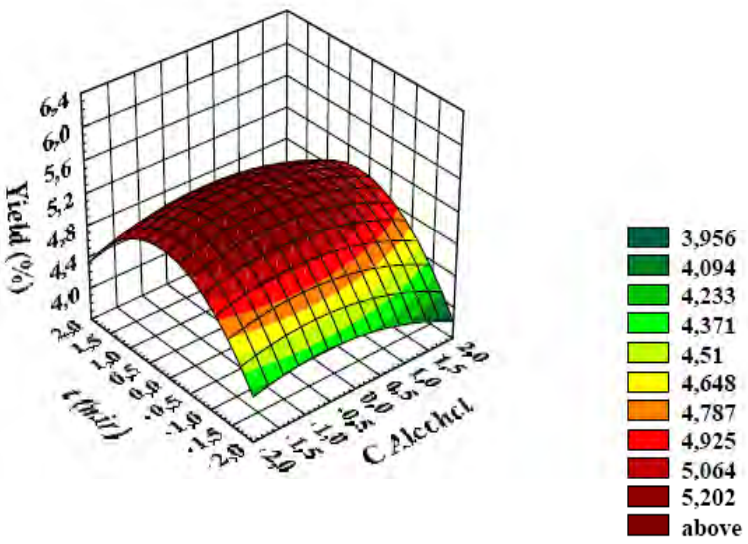

Figure 1. Effect of extraction time and solvent concentration on the extraction yield

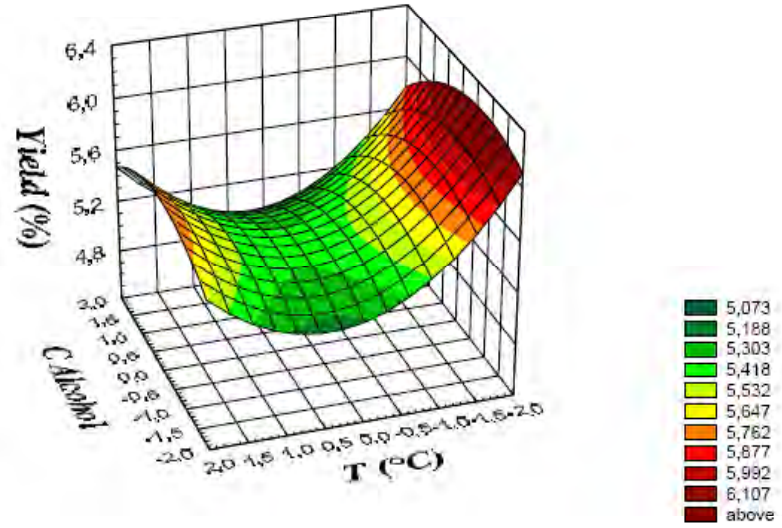

Figure 2. Effect of temperature and solvent concentration on the extraction yield

Table 2. Variance analysis for obtaining the optimum empirical model

Variation source	Square sum	Freedom degree	Square means	F_{calc}	F_{tab}
Regression	1.5782	9	0.1754		
Residual	0.0182	7	0.0026	67.397	3.68
Lack of fitting	0.0150	5	0.0030		
Error	0.0032	2	0.0016	1.881	19.3
Total	1.5916	16			
% variation explained			99.159		
% maximum variation explained			99.799		
Determining coefficient (R^2)			0.9916		

F_{cal} and F_{tab} are, respectively, the calculated and tabled Test F.

The product obtained had pleasing aroma, color and appearance characteristic to the essential oils from orange rinds, showing that the extraction method was efficient in the retention of principal characteristics of this product.

The solid-liquid extraction process of essential oils from orange rinds must be done under conditions of utilizing a mixture of 50% alcohol in water having a heat treatment at 175°C for 105 min so that the yield could be maximum and a quality product could be obtained.

This work shows that it is possible to aggregate value by utilizing residues from citrus juice processing industries, generating a new source of economic development which could improve the quality of life in agricultural producers, creation of new jobs and income for these communities.

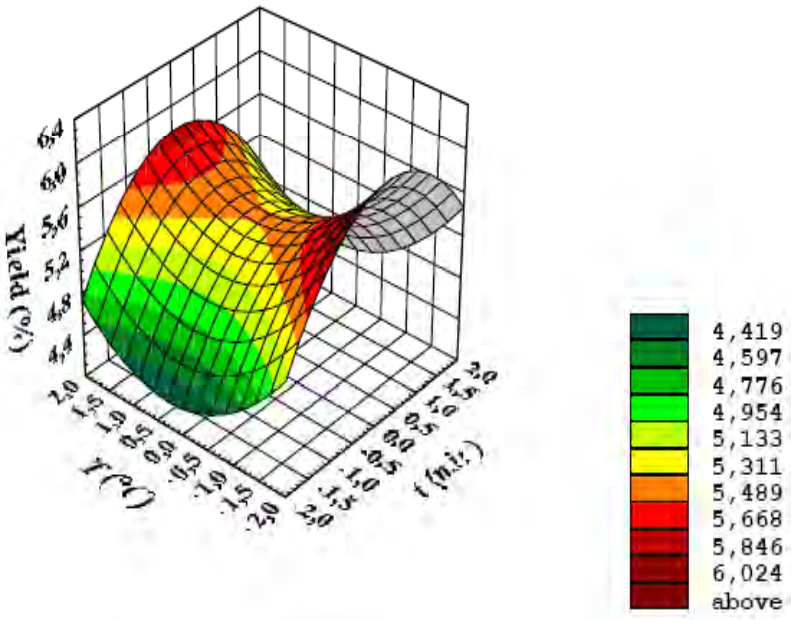

Figure 3. Effect of extraction time and of solvent concentration on extraction yield

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Ripening Behavior of Mangaba (*Hancornia speciosa*) Fruit Stored at Different Temperatures

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The ripening pattern of mangaba (Hancornia speciosa Gomes) fruit was studied during its post-harvest storage at different temperatures. Fruits which attained full development at half-ripe stage were harvested and initially stored at 6, 8, 10 and 12±1°C in chilled rooms for 4 days. After this period, the fruits were transferred to a room at 24±2°C and maintained for 5 days for monitoring of their ripening behavior. For control purposes, recently harvested fruits were stored at 24±2°C for 6 days. After storage of fruits at 24°C, all fruits were analyzed daily for vitamin C and soluble solids (°Brix) contents, titratable acidity, pH and firmness. In fruits stored directly at 24°C, there was a sharp fall in vitamin C and acid contents; however soluble solids increased after the second day of storage. Fruit firmness decreased, leading to the ripeness of the fruits and after 4 days of storage, the fruits turned totally ripe. The fruits which were initially maintained at 6 or 8°C did not show any significant difference in vitamin C, soluble solids and firmness levels up to 4 days. However, fruits stored at 10 and 12°C presented a sharp fall in firmness and an increase in soluble solids. These results indicate that fruits stored at 10 and 12°C did not retard the fruit ripening as it was verified in fruits initially stored at 6 and 8°C. It was further observed that independent of temperature, mangaba fruits ripen normally after removal from low-temperature storage.

After 2 days of storage, an increase in vitamin C content was observed in the fruits stored at 24±2ºC. After this period, the vitamin C contents fell by about 50% (Fig. 1). However, some citric fruits and vegetables may have a higher retention or increase in their vitamin C contents when stored. For 339 example, asparagus presents an increase in vitamin C content on 2 days after the harvest when stored at 4°C. Vitamin C also acts as an important antioxidant. Thus it could be suggested that an increase in vitamin C content observed in fruits stored at 24°C in the initial days of its storage (Fig. 1) could be related to its effect as an antioxidant in response to the advances in oxidative reactions which occur during the ripening.

Fruit maintained at 6, 8, 10 and 12ºC showed an increase in vitamin C contents during the refrigeration period. After removal of fruits from refrigerated storage, it was verified that the vitamin C content presented similar behavior as that of the fruits maintained at 24°C.

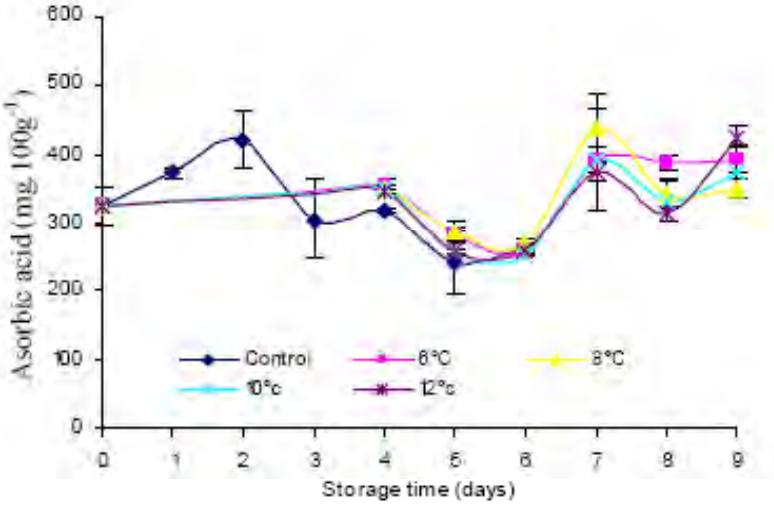

Figure 1. Ascorbic acid (Vitamin C) contents of mangaba fruits stored at 6, 8, 10, 12±1°C for an initial period of 4 days and later transferred to 24°C and stored 24±1°C (control). The bars represent the standard error values of the means.

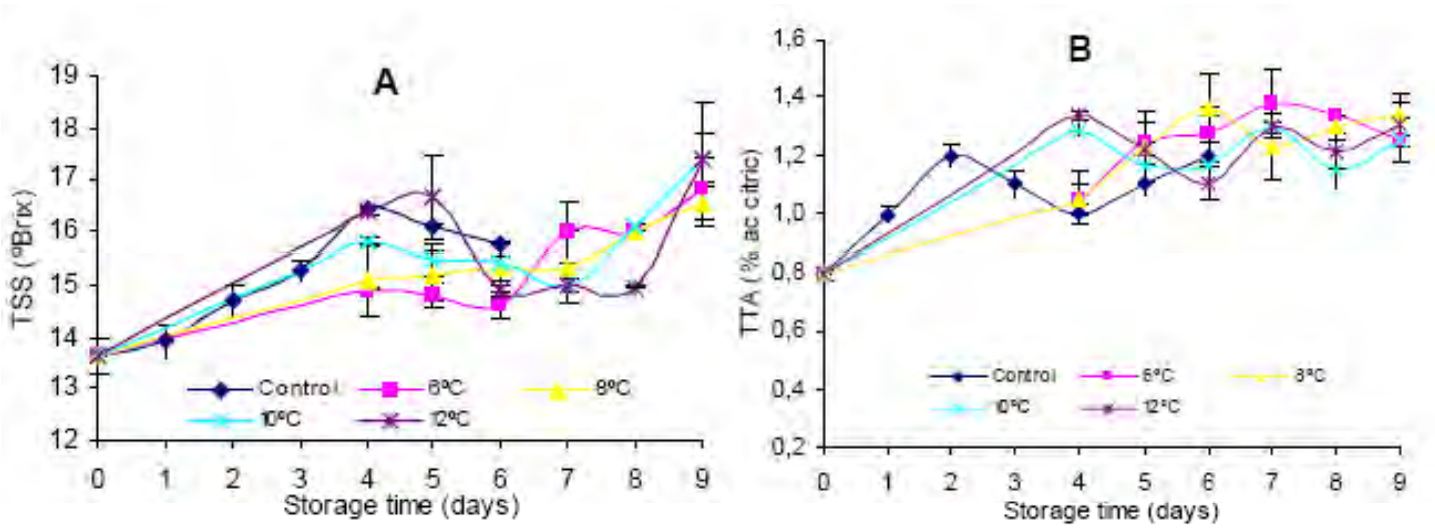

Figure 2. Total soluble solids (A) and total titratable acidity (B) of mangaba fruits stored at 6, 8, 10, 12±1°C for an initial period of 4 day, and later transferred to 24°C and stored 24±1°C (control). The bars represent the standard error values of the means.

These results indicate that the fruits maintained under refrigeration ripen normally after their removal from the cold atmosphere. However, there was no significative difference observed in the vitamin C contents among the fruits stored either at 6ºC or at 8ºC.

According to the results obtained in this study, mangaba fruits contain an elevated vitamin C content being approximately, 420 mg of vitamin C 100 g-1MF, when compared with other fruits, such as citric fruits, guava, mango and umbu-cajá.

These results show that mangaba can be considered as a fruit rich in vitamin C. It was also verified that mangaba fruits stored at 8 and 6°C presented maintenance of vitamin C contents during the refrigerated storage.

For all the temperatures studied, an increase in the total soluble solids (Fig. 2A)and total titratable acidity (Fig. 2B) contents in mangaba fruits was verified during their storage. Several researchers have demonstrated that increase in total soluble solids contents during the storage is related to the conversion of starch to sugars during the ripening process fruits.

The advance ripening could also cause a decrease in the total titratable acidity. However, for mangaba, this type of behavior was not observed.

For the fruits initially maintained at 24°C, an increase in the total soluble solids contents was verified until 4 days of storage which decreased after this period (Fig. 2A). The reduction in the total soluble solids contents is related to the degradation of the fruit with the progress in storage. There was no significant difference observed in the total soluble solids and total titratable acidity contents among the fruits initially maintained either at 6ºC or at 8ºC (Fig. 2A, B), indicating once more that these temperatures are efficient in maintaining the quality of the fruits, which presented better conservation when compared with the fruits stored at 10 and 12ºC.

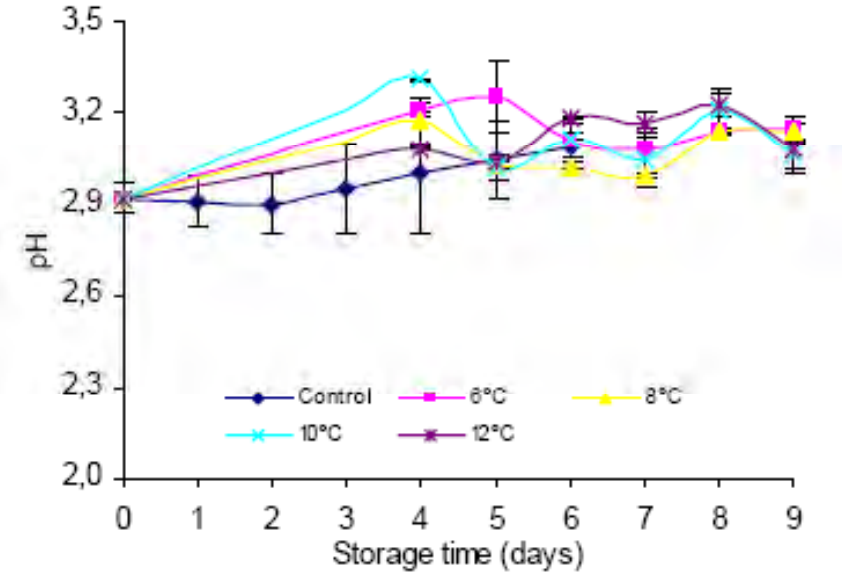

Figure 3. pH of mangaba fruits stored at 6, 8, 10, 12±1°C for an initial period of 4 day and later transferred to 24°C and stored 24±1°C (control). The bars represent the standard error values of the means

After removal of the fruits from refrigeration, an increase in the total soluble solids and total titratable acidity contents was observed which indicate that the fruits ripen normally. After 9 days of storage, the fruits which were maintained before at 6 and 8ºC presented soluble solids contents lesser than the fruits which were maintained at 10 and 12ºC (Fig. 2A). However, no significative difference was observed in total titratable acidity in the fruits removed from refrigerated storage.

Among all the treatments tried in this study, a significant increase in pH values during storage was observed (Fig. 3).]The fruit firmness which maintained initially at 24°C presented a sharp decrease from 5 to 1.89 kgf after 6 days of storage (Fig. 4). The loss in firmness is one of the general characteristics of ripening of mangaba. When the fruits were stored initially at 6 or 8ºC, the fruits maintained their firmness during the whole period of refrigerated storage. After their removal from refrigeration atmosphere, the firmness of the fruits maintained at 6 or 8°C decreased attaining the values verified for the fruits maintained initially at 24°C (Fig. 4), showing that the fruits ripen normally.

For the fruits stored at 10 or 12ºC, a fall of about 50% in its firmness was observed during the refrigeration, showing that these temperatures are not suitable for maintaining the fruit characteristics. These results indicate that fruits stored at 10 or 12°C did not retard the fruit ripening as was verified in fruits initially stored at 6 or 8°C. However, for the fruits maintained at 6°C, after 2 days of removal from refrigeration atmosphere chilling injury was observed such as formation of some soft pulpy areas, similar to other fruits stored at low temperatures.

For the fruits maintained at 8°C this effect was not observed, thus suggesting that the temperature of 8°C would be an optimum storage temperature for

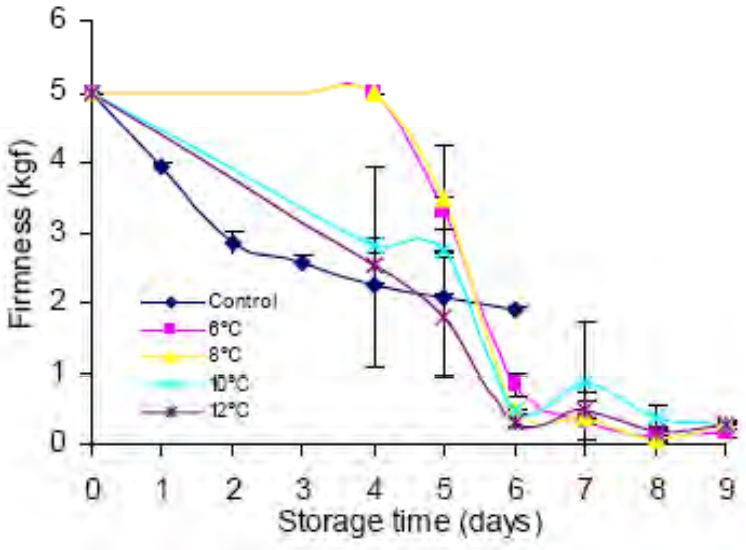

Figure 4. Firmness (kgf) of mangaba fruits stored at 6, 8, 10, 12±1°C for an initial period of 4 day and later transferred to 24°C and stored 24±1°C (control). The bars represent the standard error values of the means

For the fruits maintained at 8°C this effect was not observed, thus suggesting that the temperature of 8°C would be an optimum storage temperature for mangaba fruits storage. It was further observed that independent of temperature, mangaba fruits would ripen normally after removal from low-temperature storage.

The fruits maintained at 6 or 8±1ºC retarded by about 4 days its metabolism when compared with the fruits maintained at 10 or 12±1ºC for the same period. The mangaba fruits contain high ascorbic acid content, and thus it could be considered a fruit rich in vitamin C when compared with citric fruits. These results indicate that fruits stored at 10 or 12°C did not retard the fruit ripening as was verified in fruits initially stored at 6 or 8°C, being the optimum temperature of 8°C for the conservation of mangaba. It was further observed that independent of temperature, mangaba fruits would ripen normally after removal from low-temperature storage.

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Volatile Compounds in Caja-Umbu (*Spondias* sp.) Fruits

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The caja-umbu fruit belong to the genus Spondias and are considered to be a natural hybrid between cajá (Spondias mombim L.) and umbu (Spondias tuberosa) fruits. The fruits of caja-umbu (Spondias sp.) are native to the northeastern region of Brazil, and these are very much appreciated due to their refreshing aroma and sour flavor. Very little work has been done on the volatile aroma composition of these fruits and no work is yet reported on the identification of volatiles captured through the Purge & Trap technique. It was therefore the objective of this work to identify volatile compounds present in the pulp of caja-umbu fruits wherein volatiles a captured by two different techniques – Purge and Trap (P&T) and Simultaneous distillation and extraction technique, using Likens & Nickerson's apparatus (L&N). The volatiles in the pulp of caja-umbu fruits when captured through P&T technique revealed the presence of 70 components while a large number (152) of compounds were identified in the extract obtained by L&N. The major difference in two extracts was that the aldehydes represented a large area in the P&T capture of volatiles while this area was very small in L&N extract. One important fact was that very high concentration of terpenic compounds (23.14%) was detected in P&T capture while 10.52% of area pertained to this class in L&N extract. In the volatile profiles from the injection of the extracts obtained from the two techniques some notable changes were observed such as a very high concentration of 2-methyl butanal, 2- hexanol, β-caryophyllene, 2-ethyl furan, ethyl butyrate, o-xylene, β-cis-ocimene in the capture by P&T technique.

Out of a total number of 179 components separated in L&N extraction, 85 compounds were positively identified, 67 tentatively identified and 27 compounds could not be identified due to the lack of standard organic compounds. Among the identified compounds were 37 alcohols (18.27%), 28 esters (6.40%), 21 ketones (17.11%), 15 aromatics (12.03%), 12 aldehydes (5.45%), 10 terpenes (10.52%), 8 furans (4.02%), 6 sulfur compounds (9.63%) and 4 pyrazines (2.37%). The major components identified were 4-methyl-3-penten-2-one (7.00%), 2-acetyl-thiazone (6.83%), 2-nonanol (4.85%), β-caryophyllene (4.23%), ethyl benzene (4.07%), 2,2-dimethyl-4-octenal (3.70%) and 1-penten-3-one (3.30%).

The volatiles in the pulp of caja-umbu fruits when captured through P&T technique revealed the presence of 70 components out of which 45 were positively identified, 16 tentatively and 12 compounds could not be identified. Among the identified compounds, 12 pertained to the class of alcohols (20.74%), 13 of ketones (3.06%), 8 of esters (6.83%), 8 terpenes (23.14%), 6 aromatics (4.29%), 5 furans (10.04%) and 5 aldehydes (28.57%).

The alcohols and esters classes almost represented the same area in both methods. There were 43 compounds which were common and identified in the extracts obtained by both methods.

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From the table it can be observed that a large number (152) of compounds were identified in the extract obtained by L&N while in the volatile capture by P&T only 61 compounds could be identified. The major difference in two extracts was that the aldehydes represented a large area (28.57%) in the P&T capture of volatiles while this area was very small (5.45%) in L&N extract. The total area pertained to furans was so higher (10.04%) in P&T as compared to L&N extracts (4.02%). However, ketones represented a very higher area (17.10%) in L&N extracts as compared to only 3.06% in P&T captured. It was strange that no sulfur compounds detected in P&T capture while 9.63% of area in the chromatogram pertained in the extract of L&N.

One important fact was that very high concentration of terpenic compounds (23.14% of area) was detected in P&T capture while 10.52% of area pertained to this class in L&N extract.

In the volatile profiles from the injection of the extracts obtained from the two techniques some notable changes were observed such as a very high concentration of 2- methyl butanal (28.35%), 2-hexanol (14.95%), β-caryophyllene (14.08%), 2-ethyl furan (7.64%), ethyl butyrate (6.13%), *o*-xylene (3.12%), β-cis-ocimene (2.68%) in the capture by P&T technique. However, higher concentrations of 4-methyl-3-penten-3-one (7.00%), 2-acetyl thiazone (6.83%), 2-nonanol (4.85%), ethyl benzene (4.07%), 2,2-dimethyl-4-octenal (3.70%), 1-penten-3-one (3.30%), *p*-xylene (3.10%), α-ionone (2.73%), 1-nonanol (2.70%), toluene (2.10%), methyl pyrazine (1.93%), hexyl hexanoate (1.44%), 3-methylethyl-2-butanoate (1.40%) and 2-hexyl furan (1.40%).

Table 1. Volatile Compounds in Caja-umbu fruits

Class	Name	RI[a]	Area (%)	
			L&N	P&T
Alcohol				
	1-propanol	1034	0.11	ND[b]
	2-methyl 1-propanol[c]	1054	0.06	ND
	3-methyl 2-butanol	1092	0.14	0.03
	2-pentanol	1097	0.48	ND
	2-methyl 2-pentanol	1103	0.50	0.15
	3-pentanol	1111	ND	0.08
	3-methyl-2- pentanol[c]	1162	0.05	ND
	3-hexanol	1193	0.93	ND
	2-hexanol	1217	0.29	14.95
	3-methyl 3-buten-1-ol	1247	0.12	3.17
	2-methyl-1- pentanol	1296	0.70	ND
	4-penten-1-ol[c]	1299	ND	0.15
	Cyclopentanol	1301	0.06	ND
	1-hexanol	1346	0.14	0.58
	2,3-dimethyl 1-pentanol[c]	1348	0.10	0.17
	3-hexen-1-ol	1384	0.24	0.85
	3-octanol	1389	0.15	ND
	2-butoxy ethanol	1394	0.66	ND
	2-octanol	1407	1.16	ND
	1-heptanol	1443	0.19	0.05
	3-methyl-2-cyclopentanol[c]	1457	0.19	0.02
	2- nonanol	1515	4.85	ND
	2,3-butanediol	1542	0.41	ND
	1- octanol	1549	0.19	ND
	2,2-dimethyl 1-hexanol[c]	1619	0.28	ND
	2-decanol	1622	0.28	ND
	1-nonanol	1656	2.70	0.54
	(E)-2-nonenol[c]	1689	0.26	ND
	1,3-butane-diol	1749	0.20	ND
	1-decanol	1761	0.01	ND
	Methyl phenyl carbinol[c]	1763	0.02	ND
	3-cyclohexyl-1-propanol	1782	1.10	ND
	Benzyl alcohol	1844	0.03	ND
	1-undecanol	1876	0.01	ND
	1,4-butanediol	1925	0.01	ND
	Phenol[c]	1932	1.11	ND
	1-dodecanol	1966	0.01	ND
	2-ethyl phenol[c]	2025	0.33	ND
	1-iso eugenol[c]	2197	0.20	ND

Table 1. Volatile Compounds in Caja-umbu fruits

Class	Name	RI[a]	Area (%)	
			L&N	P&T
Aldehyde				
	2-methyl butanal	903	ND	28.35
	3-methyl butanal[c]	909	ND	0.02
	2-methyl pentanal	1009	0.43	ND
	(E) 2-butenal	1037	0.05	ND
	2- hexenal[c]	1061	0.14	ND
	1-hexanal	1064	0.21	0.03
	3-methyl 2-butenal[c]	1084	0.05	0.17
	2-methyl-2-pentenal[c]	1146	0.07	ND
	2,4-dodecadienal[c]	1429	0.15	ND
	(Z) 2-nonenal	1482	0.14	ND
	2,2-dimethyl-4-octenal[c]	1538	3.70	ND
	(E) 2-decenal[c]	1592	0.22	ND
	Dodecanal	1675	0.09	ND
	4-isopropyl-benzaldehyde	1746	0.20	ND
Alkane				
	2-methyl heptane	935	0.10	ND
	3,3-dimethyl hexane[c]	1058	0.11	ND
	Hexyl cyclohexane	1265	0.62	ND
	1-cloro- dodecane	1651	0.12	0.19
	1-undecene	1133	0.21	0.88
	1-methyl-4-(1-methyl)-1,3-cyclohexadiene	1178	ND	0.01
	2-methyl-1,5- hexadiene[c]	1379	0.08	ND
	4,4-dimethyl-cyclopentene[c]	1679	0.80	0.15
	1- heptadeceno	1755	0.03	ND
	3-bromo cyclohexeno[c]	1423	0.21	ND
Aromatic				
	Toluene	1030	2.10	ND
	Ethyl benzene	1112	4.07	ND
	p-xylene	1120	3.10	0.01
	m-xylene	1137	0.02	ND
	1,2-diethyl- benzene	1156	0.08	0.05
	m-xylene	1161	ND	0.03
	o-xylene	1167	1.30	3.12
	Propyl benzene	1189	0.10	ND
	1,3,5-trimethyl-benzene	1242	0.13	ND
	Isopropyl toluene	1306	0.14	ND
	1,2,3-trimethyl benzene	1318	0.33	ND
	1,2,3,4-tetramethyl benzene	1466	0.18	0.13
	Pentamethyl benzene[c]	1476	0.09	ND
	Naphthalene	1688	0.32	0.95
	1-methyl- naphtalene	1852	0.01	ND
	Dimethyl naphtalene	1979	0.06	ND

Table 1. Volatile Compounds in Caja-umbu fruits

Class	Name	RI[a]	Area (%)	
			L&N	P&T
Ester				
	Ethyl acetate	824	ND	0.04
	Isopropyl formate[c]	840	ND	0.20
	Isomethyl butanoate	916	ND	0.01
	Allyl formate[c]	958	0.32	ND
	Isopropyl propionate[c]	965	0.18	ND
	Propyl acetate	971	0.08	0.08
	Methyl butyrate	995	0.15	ND
	Ethyl butyrate	1022	0.90	6.13
	Butyl acetate	1068	0.04	0.23
	3-methylethyl-2-butanoate[c]	1150	1.40	ND
	3-methyl-2-butyrate	1153	ND	0.04
	Ethyl hexanoate	1223	0.34	ND
	Hexyl acetate	1258	ND	0.10
	Methyl octanoate	1377	0.13	ND
	Hexyl hexanoate[c]	1583	1.44	ND
	iso-citronelyl butyrate[c]	1704	0.10	ND
	nopyl acetate[c]	1778	0.04	ND
	n-citronely butyrate[c]	1790	0.02	ND
	Butyl benzoate[c]	1802	0.24	ND
	Hexyl octanoate[c]	1807	0.03	ND
	Propyl phenyl acetate[c]	1848	0.01	ND
	Benzyl butyrate[c]	1855	0.06	ND
	Geranyl butyrate[c]	1872	0.04	ND
	n-citronelyl valerate[c]	1880	0.02	ND
	Isoamyl benzoate[c]	1892	0.04	ND
	Amyl benzoate[c]	1943	0.03	ND
	Methyl cynamate[c]	2051	0.02	ND
	Furfuryl octanoate[c]	2077	0.02	ND
	Ethyl (E) cynamate[c]	2099	0.03	ND
	(Z)-3-hexenyl benzoate[c]	2122	0.16	ND
	Phenylethyl hexanoate[c]	2138	0.07	ND
	Hexyl phenylacetate[c]	2147	0.28	ND
	Iso-cinamyl valerate[c]	2271	0.21	ND
Furan				
	2,5 dimethyl furan	944	0.20	1.30
	2-ethyl furan	948	0.40	7.64
	2,4-dimethyl furan	954	0.11	0.02
	2-ethyl-5-methyl-furan[c]	1018	0.01	ND
	2-methyltetrahydro furan-3-one[c]	1268	0.14	ND
	2-hexyl furan[c]	1400	1.40	0.06
	2-acetyl-furan	1509	1.30	1.02
	2,5-diethyl tetrahydro furan[c]	1623	0.46	ND

Table 1. Volatile Compounds in Caja-umbu fruits

Class	Name	RI[a]	Area (%)	
			L&N	P&T
Ketone				
	2,3-butanedione[c]	952	0.25	ND
	2-pentanone	976	0.09	0.06
	2-methyl-3- pentanone	1000	0.55	ND
	1-penten-3-one	1013	3.30	0.05
	2,3-pentanedione	1046	0.08	ND
	3-hexanone	1074	0.29	0.02
	3-penten-2-one	1115	0.66	ND
	4-methyl-3-penten-2-one	1127	7.00	0.04
	5-methyl-2-hexanone	1148	ND	0.30
	1-methyl-4-(1-methyl)-1,3- cyclohexadiene[c]	1178	ND	0.01
	2-methyl cyclopentanone	1180	0.96	0.44
	4-hexen-3-one	1182	0.21	0.76
	3-methyl-3-buten-2-one[c]	1212	0.02	ND
	Cyclopentanone	1238	ND	0.62
	3-hexen-2-one[c]	1249	0.13	0.06
	3-hidroxy-2-butanone[c]	1278	ND	0.05
	2- cyclopenten-1-one	1340	0.14	ND
	3-nonanone	1350	0.20	ND
	3,5,5-trimethyl cyclohex-3-en-1-one[c]	1372	0.02	ND
	2- nonanone	1387	0.08	ND
	2-nonanone	1392	ND	0.06
	2-cyclohexen-1-one	1419	0.23	0.59
	2-decanone	1490	0.09	ND
	4-methylaceto-phenone	1766	0.02	ND
	a-ionone[c]	1822	2.73	ND
	b-ionone[c]	1924	0.06	ND
Pyrazine				
	Methyl pyrazine	1259	1.93	0.09
	2,5-dimethyl pyrazine	1311	0.03	ND
	2,3-dimethyl pyrazine	1336	0.26	ND
	2-acetyl-3-ethyl-pyrazine	1681	0.15	ND
Sulfur compounds				
	4-methyl-1,2,4-thiazole[c]	1239	0.49	ND
	2,4-dimethyl thiazole[c]	1271	0.17	ND
	5-methyl thiazole[c]	1288	0.25	ND
	2,4,5-trimethyl thiazole	1332	0.29	ND
	2-n-butyl thiophene[c]	1358	1.60	ND
	2-acetyl-thiazone[c]	1636	6.83	ND
Terpene				
	a-pinene	1005	0.04	0.70
	Camphene[c]	1049	0.05	1.85
	b-myrcene	1143	ND	0.09
	3-carene[c]	1148	0.01	0.60
	Limonene[c]	1176	0.31	ND
	b-cis-ocimene[c]	1221	0.50	2.68
	b-trans-ocimene[c]	1252	0.78	ND
	Linalool	1538	2.60	0.73
	b- caryophyllene[c]	1566	4.23	14.08
	a-caryophyllene[c]	1606	1.90	2.41
	S(+)-carvone	1717	0.10	ND

This work compares the volatiles profiles of ripe caja-umbu fruits, obtained by two different techniques of extraction being Purge and Trap (P&T) and Simultaneous distillation and extraction technique using Likens and Nickerson's (L&N) apparatus. Each technique showed some specific characteristics such as very few compounds could be identified by P&T while large number of compounds could be detected in the extracts obtained by L&N capture. Forty-three compounds were found to be common in the extracts obtained by both techniques. The major difference in two extracts was that the aldehydes represented a large area (28.57%) in the P&T capture of volatiles while this area was very small (5.45%) in L&N extract.

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Identification of Volatile Compounds in Mangaba (*Hancornia speciosa* Gomes) Fruit – a Preliminary Study

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Publication
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The ripe mangaba (Hancornia speciosa Gomes) fruit were harvested from an experimental Station situated in the city of João Pessoa, Brazil. Volatile compounds from the fruit pulp were extracted by using Likens and Nickerson's apparatus. Several extraction parameters such as weight of the pulp, dilution with water, solvent volume and extraction period were standardized to obtain highly characteristic fruit aroma extracts. The extracts were concentrated and analyzed for the identification of volatile compounds using a system of high resolution gas chromatograph coupled with mass spectrometer. Better separation was achieved in a polar capillary column. Compounds were positively identified when the mass spectrum and retention index data of the identified compound matched with that of the authentic standard run under identical analytical conditions. One hundred and ninety four compounds were separated out of which 38 compounds were positively identified and 23 were tentatively identified. The principal volatile compounds present in the pulp of ripe mangaba fruit were 3-hexanol (12.75%), isopropyl acetate (11.30%), 3-pentanol (9.93%), 3-methyl 3-buten-1-ol (4.98%), ethyl acetate (4.44%), δ-limonene (4.63%), ethanol (3.97%), dihydro actinidiolide (3.69%), (E)-2-pentenal (3.27%), amyl isobutyrate (2.62%), 2-phenylacetaldehyde (2.20%), β-cubebene (1.89%) and linalyl hexanoate (1.25%).

It is observed that in experiment number 5 (Table 1), number of peaks were much more (194) when compared to the number of peaks obtained in the chromatogram from other experiments. Although the number of the peaks in experiment 5 is much more, most of the peaks were relatively of minor concentrations and these peaks could not to be identified in this preliminary study. Thus based on these results, optimum conditions for the extraction of volatiles were established which were the usage of 150 g of pulp diluted with 150 ml of distilled water and extraction performed with 20 ml of pentane-ethyl ether (2:1) for 60 min.

A total of 61 compounds were identified out of which 38 compound were positively identified and 23 were tentatively identified (Table 2). The compounds were listed as tentatively identified since the standard organic compounds were not available to be run under identical conditions of chromatographic analysis.

The volatile compounds identified in the pulp of ripe mangaba fruit were 17 compounds belonging to the class of esters (23.54%), 13 alcohols (33.81%), 5 aldehydes (5.72%), 5 aromatics (2.89%), 4 terpenes (5.42%), 4 ketones (0.96%) and 2 sulfur compounds (0.23%).

When related to the area of the chromatogram the major compounds identified were 3-hexanol (12.75%), isopropyl acetate (11.30%), 3-pentanol (9.93%), 3-methyl 3-buten-1-ol (4.98%), ethyl acetate (4.44%), δ-limonene (4.63%), ethanol (3.97%), dihydro actinidiolide (3.69%), (*E*)-2-pentenal (3.27%), amyl isobutyrate (2.62%), 2-phenylacetaldehyde (2.20%), β-cubebene (1.89%) and linalyl hexanoate (1.25%).

It could be observed in the present preliminary study that alcohols, esters, aldehydes, aromatic and terpenes are the classes which represented most the volatile profile of ripe mangaba fruit.

Table 1. Extraction conditions for obtaining in volatile extracts from mangaba fruit

Experiment number	Pulp (g)	Water (ml)	Solvent (20 ml)	Extraction time (min)
1	100	200	n-Hexane	60
2	100	200	n-Hexane	80
3	100	200	Pentane-ethyl ether	80
4	100	300	Pentane-ethyl ether	80
5	150	150	Pentane-ethyl ether	80
6	200	150	Pentane-ethyl ether	80

Three lactones being α-angelica lactone, γ-valerolactone, and γ-undecalactone were also identified in this study. These compounds are known to posses peach like aroma and these may contribute partially to the overall aroma of mangaba fruit.

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Aumento da Vida Útil Pós Colheita de Pedúnculos de Cajueiro Anão Precoce pela Redução da Temperatura de Armazenamento

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Embrapa Tropical Agroindustry

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This work aimed to increase, through the reduction storage temperature, the post-harvest conservation time of the early dwarf cashew tree peduncle of clones CCP 76 and END 183. It was carried out in the Postharvest Physiology and Technology Laboratory of the Embrapa Agroindústria Tropical in Fortaleza (State of Ceará, Brazil) using a factorial scheme in a randomized design with three replications of the factors (clones and storage duration: 0, 5, 10, 15, 20, 25 and 30 days). The fruits evaluated were manually harvested in a farm located in the Municipality of Beberibe, State of Ceará, transported in plastic containers to the Laboratory and stored in extruded polystyrene trays at the temperature of 3,4 ± 0,6ºC and relative humidity 85 ± 11% under modified atmosphere. The parameters evaluated were weight loss; appearance; peel color; pulp firmness; total soluble solids (TSS); pH; total titratable acidity (TTA); TSS/TTA ratio; ascorbic acid; total soluble sugars; anthocyanins and phenolics. The analyses showed that the shelf life of the CCP 76 peduncle clone is 18 days while that of the END 183 clone is of 28 days, both with slight loss of mass, firmness and total anthocyanins.

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Optimization of Processing Conditions for Wine Production from Acerola (*Malpighia glabra* L.)

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In the present work, an attempt has been made to standardize the processing conditions for the manufacture of wine from acerola (Malpighia glabra L.) by RSM optimization. A central point design was used to evaluate the effect of soluble solids (°Brix) and the concentration of fruit pulp on sensorial quality attributes (color, flavor and aroma) of wine which were measured on hedonic scale. Saccharomyces cerevisiae yeast was used for fermentation. Acerola wines were found to be suave, sweet and 11°GL of alcohol concentration. Flavor and color of wines were characteristic of acerola fresh fruit. Sensorial analysis revealed that these were different among wines and optimization showed that wines produced with high °Brix and low fruit mass were the best products. This work supports the usage of acerola for obtaining high quality wines which possess pleasing aroma and shiny red color.

The wines obtained possessed clean appearance having the color and aroma characteristics pertaining acerola fruit, light and sweet flavor, showing that these characteristics of the fruit were retained to a great extent. Table 1 presents the data obtained after the analysis of acerola wine samples.

From the data it could be observed that total acidity was within the range established as Brazilian standard (lower than 130 meq/L) and practically all fermented samples did not characterize for any undesirable acidity which could be volatile, indicating resence of acetic acid or its derivatives. Such substances denature wine, modifying the aroma (pungent) and flavor of the same (bitter).

The reducing sugars content in wines varied from 5–20 g/L, which indicates relative stability that a small quantity of sugar could reduce or inhibit any perturbation which may occur in the physico-chemical properties of wines due to microbial action.

The dry matter content also was lower and hence it presented a clear appearance and low density due to the presence of non-volatile acids, superior alcohols, carbohydrates, inorganic minerals, tannins, etc.

The wine pH was in the range of 3.1 to 3.9 which is very much desired and it results in avoiding microbial contaminations or alterations in color, flavor and in oxireduction potential.

Table 1. Physico-chemical analysis of acerola wine

Characteristic	Average	Standard deviation (±)
Reducing sugars (g/L)	6.670	0.780
Total acidity (meq/ L)	5.798	0.780
Volatile acidity (meq/ L)	0.139	0.121
Density	0.985	0.008
pH	3.0	0.5
Total solids (%)	4.123	0.126
Alcohol content at 20°C (°GL)	11.0	0.5

The detailed observation for the data in Table 2 shows that majority of wines presented satisfactory results in their sensorial analysis, being close to 6. Figure 1 presents in the visual form the presentation of mean values of analysis sensorial of wines. This shows that in color practically there was no difference between the diluted or more concentrated wines leading to conclude that the weight of fruit mass did not alter the color significatively. It was also observed that there was a little diference between the samples in relation to wine aroma and to a little higher extent to flavor. However, the t Student test did not present any significant difference between the wines in both these sensorial attributes since the calculated T varied from 0.02 to 0.36 which is much lower than the T tabled (2.86). The value of T calculated must be at least four times lower than that of T tabled so that there may not be any significant differences between the samples.

The results obtained from the analysis of variance are presented in Table 3. The statistical parameters, multiple correlation and F test were utilized to evaluate the adjustment to models. As is known and from the data presented in table that however close the unit will be to the value of R2, more adjusted will be the data for the model. The test F1Calc/F1Tab evaluated the statistical significance of the models, while the test F2tab/F2calc evaluates the adjustment of data to the model and that it requires their values should be greater than 4. Thus, it could be stated that the

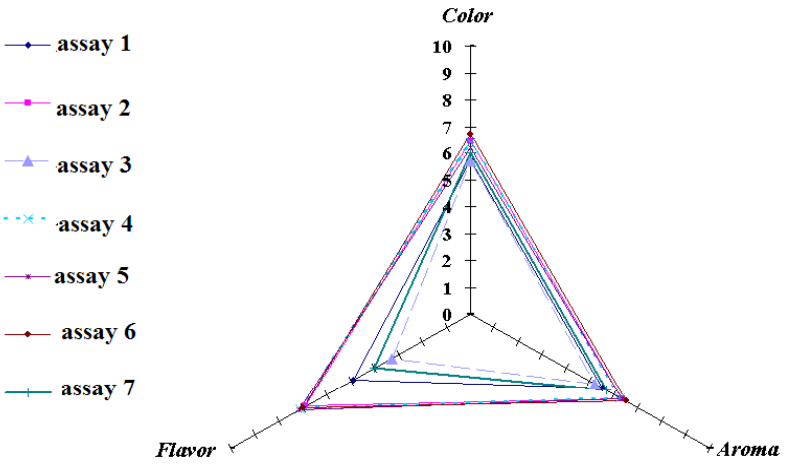

Figure 1. Sensorial attributes for acerola wine

Mass (4)

Flavor = 5.9029 + 1.3218 °Brix - 0.2953 Mass (5)

Table 2. Planning matrix for experimental design for acerola wine

Assay	Factors		Coded variables		Responses		
	°Brix	% Mass	x_1	x_2	Color	Aroma	Flavor
1	22	1/6	-1	-1	5.74	5.428	4.86
2	26	1/6	1	-1	6.46	6.34	7.261
3	22	1/3	-1	1	5.653	5.16	4.027
4	26	1/3	1	1	6.38	6.22	6.913
5	24	1/4	0	0	6.2	5.907	6.324
6	24	1/4	0	0	6.189	5.95	6.176
7	24	1/4	0	0	6.02	5.66	5.759

The results obtained from the analysis of variance are presented in Table 3. The statistical parameters, multiple correlation and F test were utilized to evaluate the adjustment to models. As is known and from the data presented in table that however close the unit will be to the value of R2, more adjusted will be the data for the model. The test F1Calc/F1Tab evaluated the statistical significance of the models, while the test F2tab/F2calc evaluates the adjustment of data to the model and that it requires their values should be greater than 4. Thus, it could be stated that the empirical models are statistically significative and are adjusted. The equations of the models which were better adjusted are presented as follows:

Color = 6.097 + 0.3618 °Brix - 0.0417 Mass (3)

Aroma = 5.8093 + 0.4930 °Brix - 0.0970 Mass (4)

Flavor = 5.9029 + 1.3218 °Brix - 0.2953 Mass (5)

Observing the Eq. 3, 4 and 5, it is perceived that the dependence for both responses was linear with the factors and that the influence of °Brix on the sensorial quality was much more than that of the pulp mass.

Figures 2, 3 and 4 demonstrate the response surfaces generated to optimize the production process of acerola wines under the conditions studied in this work. A general analysis of these figures shows that with the increase in initial °Brix of must, the wine obtained characterized better acceptance in all sensorial attributes studied. It is also perceived that practically there is no inclination in the curve in relation to the pulp mass, which indicates that its influence decreases the quality of final product, which was also perceived on comparison of model for the parameters.

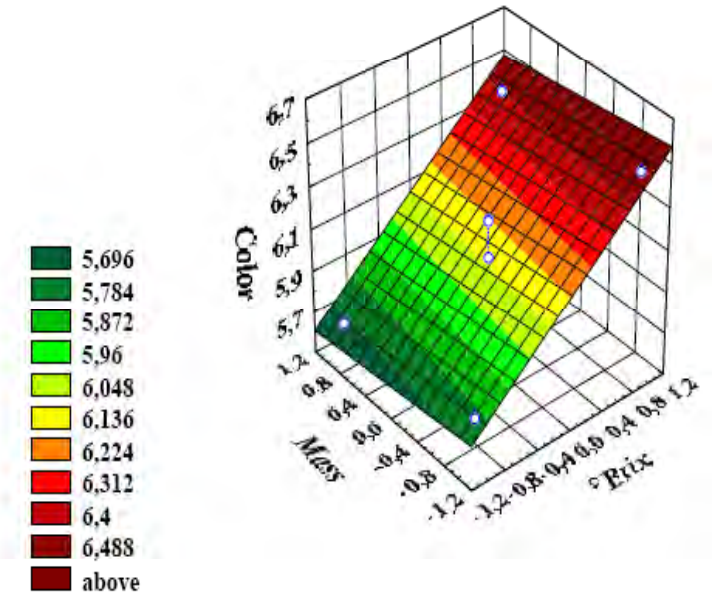

Figure 2 - Response surface for wine color optimization.

Table 3. Variance analysis for obtaining the optimum empirical model

Analysis	Color	Aroma	Flavor	Table
F_1 Test	34.210	34.175	36.037	6.94
F_2 Test	0.524	0.206	1.372	19.00
Multiple correlation R^2	0.9454	0.9447	0.9475	1.00

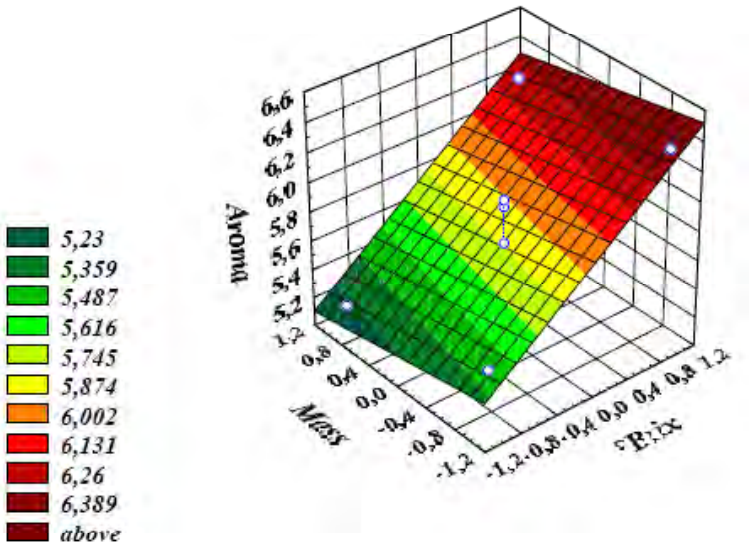

Figure 3 - Response surface for wine aroma optimization.

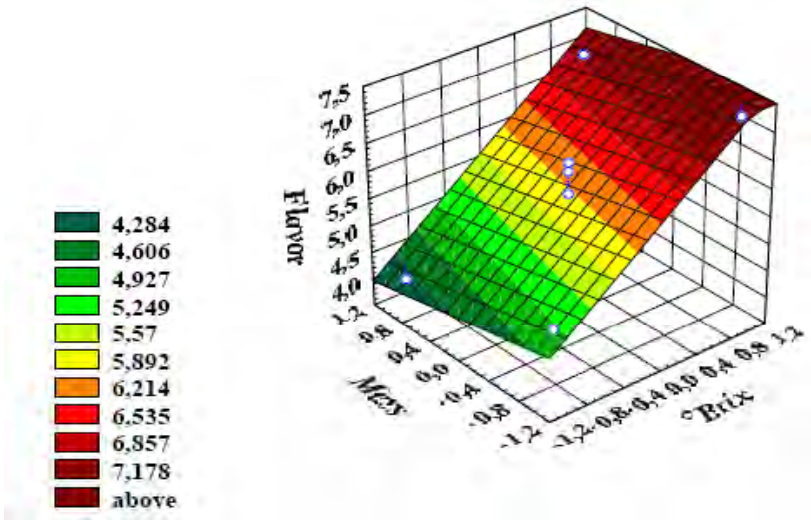

Figure 4 - Response surface for wine flavor optimization.

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Physico-Chemical Quality Changes in Mangaba (*Hancornia speciosa* Gomes) Fruit Stored at Different Temperatures

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The physical-chemical quality changes in mangaba fruit were studied. The fruit which attained full development at half-ripe stage were harvested and initially stored at 6, 8, 10 and 12±1ºC for four days. After this period, the fruit were transferred to an acclimatized room (24±2ºC) and maintained for five days. For control purposes, recently harvested fruit were stored directly in an acclimatized room (24±2ºC) for six days. After the transfer and storage at 24ºC, fruit were analyzed daily for their vitamin-C, soluble solids (oBrix), titratable acidity, pH and firmness contents. In fruit directly stored at 24 ºC, there was a sharp fall in vitamin C and acid contents. The fruit firmness decrease, after four days of storage, and they turned totally ripe. The fruit which were initially maintained at 6 or 8 ºC did not show any significative difference in physical-chemical quality during the storage.

Table 1 presents the data on fruit firmness on all the fruit which were initially maintained at lower temperatures for four days and the control which did not have this initial storage. The fruit (Control) stored directly at 24°C presented a sharp decrease from 49 to 1 N after five days of storage.

The loss in firmness is one of the general characteristics of ripening of mangaba. When the fruits were stored initially at 6 or 8ºC, the fruits maintained their firmness during all the period of refrigerated storage. After their removal from refrigeration atmosphere, the firmness of the fruits maintained at 6 or 8°C decreased attaining the values similar to the fruits maintained initially at 24°C (Table 1), showing that the fruits ripened normally. For the fruits stored at 10 or 12ºC, a fall of about 50% in its firmness was observed during the refrigeration, showing that these temperatures was not suitable for maintaining the fruit characteristics.

These results indicated that fruit stored at 10 or 12 ºC did not retard the fruit ripening as was observed in fruits initially stored at 6 or 8ºC. For the fruit maintained at 8°C this effect was not observed, thus suggesting that the temperature of 8°C, would be an optimum storage temperature for mangaba fruit. It was further observed that independent of temperature, mangaba fruits would ripen normally after removal from low-temperature storage. Figure 1 presents the changes in vitamin C content during storage of mangaba fruits.

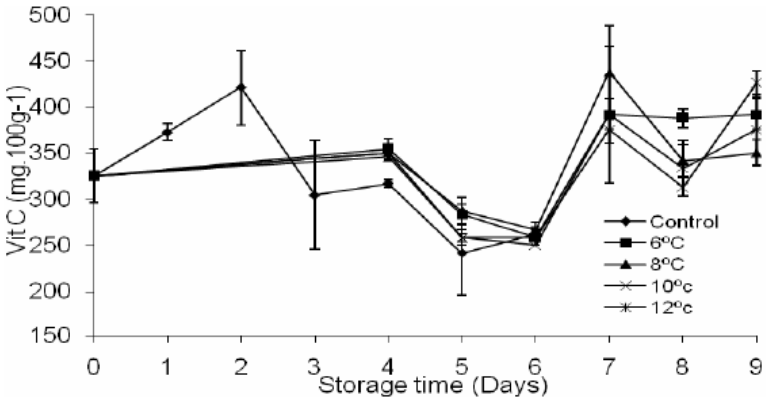

Figure 1 Vitamin C contents of mangaba fruit stored at 6, 8, 10, 12±1ºC for an initial period of 4 days and later transferred to 24°C and stored 24±1ºC(control). The bars represent the standard error values of the means (n=5)

Table 1. Physico-chemical analysis of acerola wine

Storage	Storage time (Days)					
Temperature	4+0	4+1	4+2	4+3	4+4	4+5
Control*	49±0.1 aA	39±3.3 aB	28±1.4 aC	2±1.0 aD	1±1.0 aD	1±0.0 aD
6°C	49±0.1 aA	32±4.0 bB	8±2.8 bC	3±0.6 aD	1±1.2 aD	1±0.0 aD
8°C	49±0.1 aA	27±0.7 cB	5±0.1 bcC	5±2.3 aC	1±1.1 aC	2±0.0 aC
10°C	27±1.7 bA	27± 0.1cA	5.±0.3bcB	4±2.3 aB	4±2.7 aB	3±0.3 aB
12°C	25± 0.1bA	24± 2.9cA	3±1.4 cB	3±0.3 aB	2±1.4 aB	2±0.7 aB

After two days of storage, an increase in vitamin C content was observed in the fruit stored at 24 ±2ºC. After this period, the vitamin C contents fell by about 50%. Vitamin C also acts as an important antioxidant. Thus, it could be suggested that an increase in vitamin C content observed in fruit stored at 24°C in the initial days of its storage (Fig.1) could be related to its effect as an antioxidant in response to the advances in oxidative reactions which occur during the ripening.

Fruit maintained at 6, 8, 10 and 12ºC showed a slight increase in vitamin C contents during the refrigeration period. After removal of fruits from refrigerated storage, it was observed that the vitamin C content presented similar behavior as that of the fruits maintained directly at 24°C. These results indicated that the fruit maintained under refrigeration ripen normally after their removal from the cold atmosphere. However, there was no significative difference observed in the vitamin C contents between the fruit stored at 6 and 8ºC. According to the results obtained in this study, mangaba fruit contained an elevated vitamin C content being approximately, 420 mg of vitamin C in 100g-1 whole fruit.

These results showed that mangaba could be considered as a fruit rich in vitamin C. It was also observed that mangaba fruit stored at 6 or at 8°C retained the vitamin C contents during the refrigerated storage.

For all the temperatures studied, an increase in the total soluble solids (Fig. 2A) and total titratable acidity (Fig. 2B) contents in mangaba fruit was observed during their storage. For mangaba, this type of behavior was not observed.

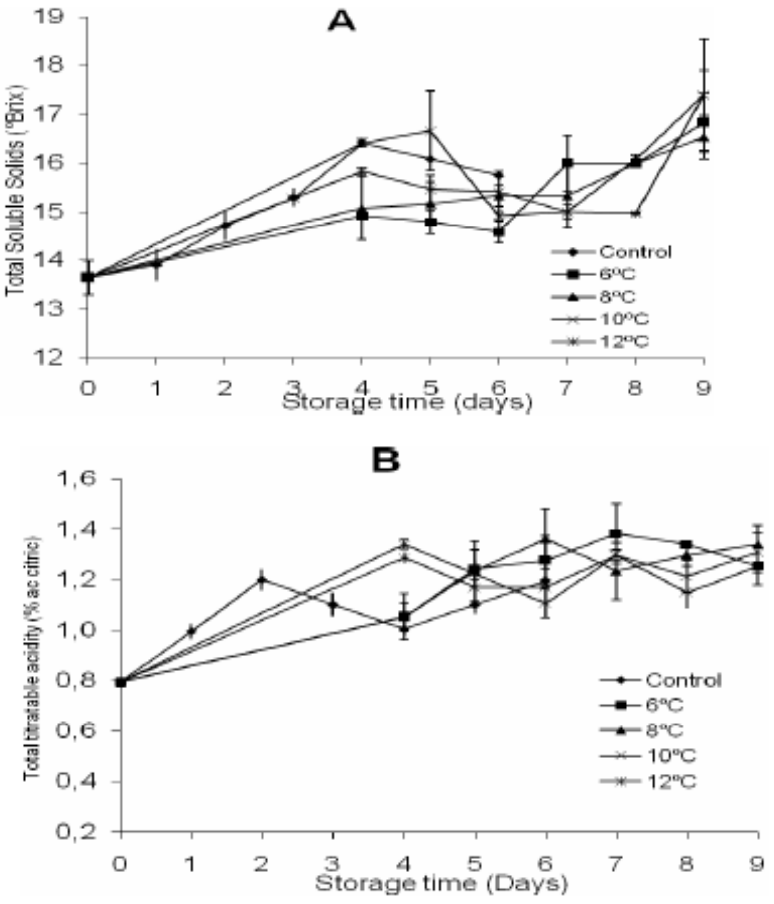

Figure 2. Total soluble solids (A) and total titratable acidity (B) of mangaba fruit stored at 6, 8, 10, 12±1ºC for an initial period of 4 day, and later transferred to 24°C and stored 24±1ºC(control). The bars represent the standard error values of the means (n=5).

For the fruit initially maintained at 24°C, an increase in the total soluble solids contents was observed until four days of storage where after it decreased (Fig. 2A). The reduction in the total soluble solids contents was related to the degradation of the fruit with the prolonged storage. There was no significative difference observed in the total soluble solids and total titratable acidity contents among the fruit initially maintained either at 6 or at 8ºC (Fig. 2A and 2B), indicating again that these temperatures were efficient in maintaining the quality of the fruit, which presented better conservation when compared with the fruits stored at either 10 or at 12ºC. After the removal of the fruit from refrigeration, an increase in the total soluble solids and total titratable acidity contents was observed which indicated that the fruit ripened normally. After nine days of storage, the fruit which were maintained initially at 6 and 8ºC presented soluble solids contents lower than the fruit which were maintained either at 10 or at 12ºC (Fig. 2A). However, no significative difference was observed in their total titratable acidity.

Among all the treatments tried in this study, a significative increase in pH values during storage was observed (Fig. 3).

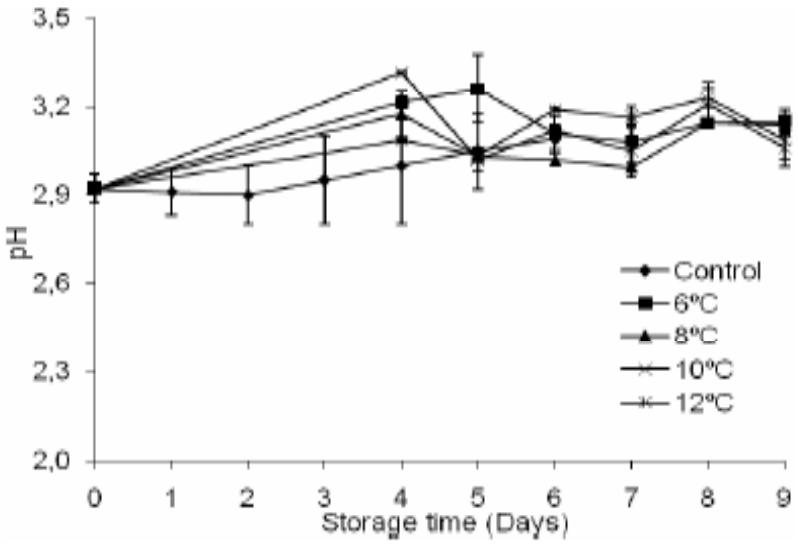

Figure 3. pH of mangaba fruit stored at 6, 8, 10, 12±1ºC for an initial period of 4 day and later transferred to 24°C and stored 24±1ºC (control). The bars represent the standard error values of the means (n=5).

24 Conference Communications

Symposium on Biotechnology for Fuels and Chemicals - USA

ARAUJO, S. M.; SILVA, C. F.; MOREIRA, J. J. S.; NARENDRA, N..

Biotechnological process for obtaining new fermented products derived from cashew apple fruit by *Saccharomyces cerevisiae* strains.

Bangalore IndiaBio - INDIA

ARAUJO, S. M.; SILVA, C. F.; MOREIRA, J. J. S.; NARENDRA, N..

Biotechnological process optimization for obtaining wines from exotic tropical fruits.

International Symposium on Medicinal and Nutraceutical Plants - INDIA

ALMEIDA, J.V.; SILVEIRA, J.J.M.; NARAIN, N.

Functional properties of cajá-umbu fruit.

Brazilian Congress of Physiology - BRAZIL

OLIVEIRA, L. S. ; MIRANDA, M. R. A.

Influences of conservation process of pulp of Acai (*Euterpe oleraceae*) on its antioxidant capacity

OLIVEIRA, L. S. ; OLIVEIRA, A. B. ; RABÊLO, M. C. ; MIRANDA, M. R. A.

Comparative analysis of antioxidant enzymes activity in frozen Açaí pulp and Açaí powder.

RABÊLO, M. C. ; SILVA, A. B. ; MIRANDA, M. R. A.

Antioxidant enzymes in clones of cashew peduncles (*Anacardium occidentale*) at different stages of development.

Latin American Food Science and Technology Symposium – BRAZIL

NARENDRA, N..

Talk on “Fruit Flavors”

COELHO, R. M. D. ; OLIVEIRA, V. S. ; COSTA, J. M. C. ; FELIPE, É. M. F.

Mineral composition of Mamey sapote (*Achras sapota* L.) in natura and powder obtained by freeze-drying process.

SANTOS, R. C. A.; SANTANA, K. L.; LEAL, A. L. J.; MOREIRA, J. J. S.; NARAIN, N.

Volatile compounds profile and physicochemical characterization of fermented beverages of pineapple

COELHO, J.C. ; ALBUQUERQUE, T.L. ; RODRIGUES, S.

Influence of storage under refrigeration in the viability of *Lactobacillus casei* in orange juice.

COELHO, J.C. ; ALBUQUERQUE, T.L. ; RODRIGUES, S.

Growth of *Lactobacillus casei* NRRL B-442 in submerged fermentation using concentrated orange juice.

OLIVEIRA, V. S. ; COELHO, R. M. D. ; COSTA, J. M. C. ; BATISTA, E. N.

Physicochemical characterization of murici (*Byrsonima crassifolia* L., malpighiacea) in natura and powder obtained by freeze-drying process.

OLIVEIRA, F.I.P. ; FERNANDES, F. A. N. ; RODRIGUES, S.

Dehydration of jambo (*Syzygium malaccense*) with pre-treatment by ultrasound.

OLIVEIRA, F.I.P. ; FERNANDES, F. A. N. ; RODRIGUES, S.

Dehydration of carambola (*Averrhoa carambola*) with pre-treatment by ultrasound.

OLIVEIRA, V. S. ; COELHO, R. M. D. ; COSTA, J. M. C. ; BATISTA, E. N. .

Evaluation of mineral parameters of murici (*Byrsonima crassifolia* L., Malpighiaceae) in natura and powder obtained by freeze-drying process.

National Bioprocess Symposium - BRAZIL

AQUINO, A. C. ; BRITO, E. S. ; FIGUEIREDO, R. W. ; PINTO, G. A. S.

Characterization of bacuri pulp (*Platonia insignis* Mart.) macerated by an enzymatic preparation of commercial Viscozyme L.

AQUINO, A. C. ; GARRUTI, D. S. ; FIGUEIREDO, R. W. ; SOUZA NETO, M. A. ; PINTO, G. A. S.

Sensory Evaluation and chromatographic of bacuri products (*Platonia insignis* Mart) macerated enzymatically.

BARBOSA, M. M. ; PINTO, G. A. S. ; BRITO, E. S. ; RODRIGUES, R. D. P. .

Obtaining carotenoids compounds extracted from cashew apple bagasse with aid of a pectinolitic enzyme complex.

COELHO, J.C. ; ALBUQUERQUE, T.L. ; RODRIGUES, S.

Evaluation of the Growth and viability of *Lactobacillus casei f*ermented in orange juice.

COELHO, J.C. ; ALBUQUERQUE, T.L. ; RODRIGUES, S.

Growth and viability of *Lactobacillus casei* fermented in orange juice stored under refrigeration.

RABELO, M. C. ; Fontes, C.P.M.L. ; RODRIGUES, S.

Enzymatic synthesis and characterization of prebiotics oligosaccharides produced in cashew apple juice.

RODRIGUES, R. D. P. ; BARBOSA, M. M. ; PINTO, G. A. S. ; BRITO, E. S.

Evaluation of the effect of adding commercial enzymes on the cashew apple bagasse extract.

VIEIRA, J. M. M. ; PINTO, G. A. S.

Definition of initial parameters for maceration of edible film of caja (*Spondias mombin* L.).

Regional Meeting of the Brazilian Society of Biochemistry and Molecular Biology - BRAZIL

OLIVEIRA, L. S. ; CARVALHO, W. M. ; RODRIGUES, D. C. ; MOURA, C. F. H. ; RUFINO, M. S. F.; ALVES, R. E. ; BRASIL, I. M. ; MIRANDA, M. R. A.

Effect of processing and storage on the antioxidant capacity of pulp acerola clones.

I Symposium in Food Science and Technology – BRAZIL

SANTOS, R. D. S.; MOREIRA, J. J. S.; FONTES, A.S.

Physico-chemical and chromatographic profile of volatile compounds in umbu fruit at different stages of maturity.

SANTANA, K. L.; MOREIRA, J. J. S.; NARAIN, N.; FONTES, A.S. ; LEAL, A. L. J.

Study on volatile constituents of pulp and fermented beverages obtained from pineapple fruit.

II Symposium in Food Science and Technology and I Congress of the INCT-FT – BRAZIL

ARAGÃO, C. T., SANTANA, K. L.,; LEAL, A. L. J.; ARAÚJO, S. M., NARAIN, N.

Sensory evaluation of fermented drinks produced from tropical fruits – pineapple, umbu, mangaba, pinha e ciriguela.

ARAÚJO, S. M., FERRAZ, C., MOREIRA, J. J. S., SILVA, A. V. F., EUZÉBIO, M. A., NARAIN, N.

Sensory evaluation of fermented beverages obtained from cajá-umbu and cashew apple.

ARAÚJO, S. M., FERRAZ, C., MOREIRA, J. J. S., SOUZA, R. R., EUZÉBIO, M. A., NARAIN, N.

Performance evaluation of the various fermentation strains of *Saccharomyces cerevisiae* as fermented beverages prepared using cajá-umbu

AZEREDO, H. M. C. ; MATTOSO, L.H.C. ; AVENA-BUSTILLOS, R.J. ; McHUGH, T.H.

Mango puree edible films reinforced with cellulose nanofibers.

BARBOSA, M.M.; RODRIGUES, R.D.R.; PINTO, G.A.S.; BRITO, E.S. de

Evaluation of thermal stability of cashew apple bagasse extract

BARBOSA, M. M.; RODRIGUES, R.D.R.; PINTO, G.A.S.; BRITO, E.S. de; SOUSA, V.M.

Application of pectinolitic enzymes on the fiber of cashew apple bagasse to obtain carotenoids

BARREIROS, M. L., GALVÃO, M. S., SANDES, T. S., NARAIN, N.

Volatile components of pulp of the fruit of cajá-umbu (*Spondias* sp.) captured by dynamic headspeace

BARREIROS, M. L., JESUS, R. A., SANDES, T. S., BARREIROS, A. L. B. S., NARAIN, N.

Phenolic totals and antioxidant activity of five Northeastern tropical fruit : caja-umbu, umbu, siriguela, mangaba e graviola

BASTOS, V. S., SANTOS, J. C., MENESES, Y. B. S., OLIVEIRA, S. C., NARAIN, N., OLIVEIRA JÚNIOR, A. M.

Study on the kinetics of freeze sliced cashew "in natura"

BASTOS, V. S., COSTA, R.A., SANTOS, J. C., MARQUES, A.M., OLIVEIRA JR, A. M. NARAIN, N.

Osmotic dehydration as a pre-treatment for freeze-drying of cashew apple sliced

CAVALCANTE, J.M.; MAGALHÃES, H.C.R.; BRITO, E.S. de

Modifications in the profile of metabolites of melon juice subjected to pasteurization

COELHO, J.C. ; ALBUQUERQUE, T.L. ; RODRIGUES, S.

Stability of ascorbic acid in orange juice fermentation throughout fermentation and storage.

COELHO, J.C. ; ALBUQUERQUE, T.L. ; GARRUTI, D.S.; RODRIGUES, S.

Sensory evaluation of orange juice fermented by *Lactobacillus casei*.

COSTA, M. G. M. ; FONTELES, T.V. ; RODRIGUES, S.; JESUS, A.L.T. ;

PEREIRA, A. L. F.

Study of the growth of *Lactobacillus casei* in pineapple juice

FONTES, C.P.M.L.; RABELO, M.C.; RODRIGUES, S.

Use of melon juice for synthesis of prebiotics oligossacharides.

FONTES, C.P.M.L.; RABELO, M.C.; RODRIGUES, S.

Synthesis of prebiotics oligosaccharides in pineapple juice

FONTES, C.P.M.L.; RABELO, M.C.; RODRIGUES, S.

Obtaining oligosaccharides prebiotics in orange juice.

FONTELES, T.V. ; COSTA, M. G. M. ; JESUS, A.L.T. ; PEREIRA, A. L. F. ;

RODRIGUES, S.

Production of fermented melon juice by *Lactobacillus casei*

LEAL, A. L. J., SANTANA, K. L., GALVÃO, M. S., FONTES, A. S., SANTOS, R.D.S.,

NARAIN, N.

Quality evaluation of lyophilized mangaba powder

LIMA, J.R. ; GALLÃO, M. I.

Effect of osmotic dehydration and frying in physico-chemical and cellular structure of cashew apple peduncles .

LOPES, M. M. A.; ENÉAS FILHO, J.; MOURA, C. F. H.; ALVES, R. E.

Quality analysis in peduncles of early dwarf cashew tree clones CCP 09 and CCP 76 at various stages of ripening.

LOPES, M. M. A.; SILVA, M. S.; CARDOSO, T. G..; MOURA, C. F. H. ; ENÉAS FILHO, J.

Quality analysis in peduncles of early dwarf cashew tree clones BRS 189 and BRS 265 at various stages of ripening.

LOPES, M. M. A.; MOURA, C. F. H.; SILVA, M. S.; CARDOSO, T. G.; ENÉAS FILHO, J.

Quality analysis in orange peduncles of early dwarf cashew tree clones CCP 09 and CCP 76 at various stages of ripening.

MIRANDA, K.W.E.; DE MOURA, M.R.; AZEREDO, H.M.C.

Characterization of edible films based on acerola puree.

OLIVEIRA, F. I. P. ; RODRIGUES, S. ; FERNANDES, F. A. N.

Dehydration of Jambo (*Syzygium malaccense*) with pre-treatment by ultrasound.

OLIVEIRA, F. I. P. ; RODRIGUES, S. ; FERNANDES, F. A. N.

Dried papaya Formosa (*Carica papaya* L.) with pre-treatment in ultrasound

OLIVEIRA, L. C., SANTOS, J. A. B., NARAIN, N.

Aroma extracts obtained from residues of pineapple processing.

OLIVEIRA, S. C., BASTOS, V. S., SOUZA, A., BARREIRO, M. L., BARREIROS, A. L. B. S., NARAIN, N.

Comparative analysis of total antioxidant activity in tropical fruits: açaí, caju and cupuaçu

OLIVEIRA, S.L.R. ; MACIEL, T.C. ; RODRIGUES, S.

Effect of pretreatment of green coconut husk powder (*Cocus nucifera*) in the production of fungi cellulase.

OLIVEIRA, V. S. ; BATISTA, E. N. ; COSTA, J. M. C. ; ROCHA, E. M. F. F.

Characterization of integral Mamey sapote pulp and dried powder obtained by spray-drying

PINTO, P.L.; COSTA, J. M. C. ; RODRIGUES, S.; AFONSO, M. R. A. ; LIMA, B. ; NETO, L.G.M.

Use of spray-dryer in drying of mango added with malto-dextrin

RABELO, M.C. ; GALLÃO, M. I. ; MIRANDA, M.R.A

Evaluation of histology and antioxidant metabolism during refrigerated storage peduncles of two clones of cashew apple.

RABELO, M.C. ; MIRANDA, M. R. A.

Antioxidant enzymes and lipidic peroxidation in cashew apples clones in different stages of development.

REBOUCAS, J. L. ; BATISTA, E. N. ; COSTA, J. M. C. ; AFONSO, M. R. A. ; NETO, L. G. M.

Evaluation of the external appearance of papaya (*Carica papaya* L) under refrigeration and modified atmosphere.

REBOUCAS, J. L. ; COSTA, J. M. C. ; BATISTA, E. N. ; AFONSO, M. R. A. ;
NETO, L. G. M.
Loss in mass of papaya var. formosa.

RIBEIRO, A. R. C. ; SOUZA, A; N. NARAIN
Chemical composition of essential oil of mature umbu in natura and pulp.

ROCHA, E.M.F.F. ; CORREIA, C.J.M.; RODRIGUES, S.; AFONSO, M. R. A. ;
NETO, L.G.M. ; CANUTO, H.
Prediction of mango pulp drying

SANTANA , K. L., ALEXANDRE, M. R., LEAL, A. L. J., BARRETO, S. O., NARAIN, N.
SPME-GC-MS analysis of aroma of fruit of the Anonaceae family: influence of extraction temperature

SANTANA, K. L., SOUZA, A., ALEXANDRE, M. R., GALVÃO, M. S., NARAIN, N.
SPME-GC-MS analysis of aroma of soursop (*Annona muricata* l.)

SANTOS, A. F., SANTANA, K. L., LEAL, A. L. J., SANTOS, R. A. R. , SANTOS, R. D. S., NARAIN, N.
Profile of aroma retention onto bread prepared by use of umbu pulp

SANTOS, J. C., SANTANA, K. L., BASTOS, V. S., NARAIN, N., CASTRO, A. A., MARQUES, L. G.
Assessment of the physico-chemical quality of cajá-umbu processed by osmotic dehydration

SANTOS, J. C., SANTANA, K. L., NARAIN, N., OLIVEIRA JUNIOR, A. M., MARQUES, E. L. G.

Dehydration of umbú-cajá as a pre-treatment of drying

SANTOS, R. D. S., LEAL, A. L. J., FONTES, A. S., SANTOS, A., MOREIRA, J. J. S., NARAIN, N.

Aroma characterization of mangaba pulp in three stages of maturity from Sergipe

SANTOS, R. D. S., SANTANA, K. L., RIBEIRO, R. A. S., ARAÚJO, S. M., SANTOS, J. C., NARAIN, N.

Physicochemical characterization of pulp from mangaba, umbu, ciriguela e cajá-umbu native to the Northeastern region of Brazil

SANTOS, R. A. R., COSTA, J. A. M., NARAIN, N.

Influence the content of pectin in acceptance of cajá-umbu jam

SILVA, I.M. ; RABELO, M.C. ; RODRIGUES, S.

Enzymatic synthesis of prebiotic oligosaccharides in cashew apple juice

SILVA, J.L.A. ; RABELO, M.C.; RODRIGUES, S.

Dextran-sacharase enzyme stability in cajá, jambo e sapoti juice

SILVEIRA, M. S. ; FONTES, C.P.M.L.; GUILHERME, A.A.; FERNANDES, F.A.N.; RODRIGUES, S.

Evaluation of the sources of nitrogen sources containing clarified cashew apple juice for lactic acid production by *Leuconostoc casei* B-442

ZILIOTTO, P. M., MOREIRA, J. J. S., NARAIN, N., ARAÚJO, S. M., BARREIROS, M. L., ALMEIDA, J. V.

Comparative study of titration and chromatographic methods (CLAE) for determination of vitamin C on tropical fruits

Brazilian Symposium in Essential Oils - BRAZIL

MOREIRA, J. J. S.; SANTOS, R.D.S.; ALMEIDA, J. V.; SOUZA, A.; NARENDRA, N.

Volatile compounds profile of essential oils extracted from whole fruits of umbu (*Spondias tuberosa*) and cajá-umbu (*Spondias sp*.) and the physico-chemical characteristics of their pulps.

25 Masters & Doctorate

Masters Degree - Concluded

Francisca Imilena Pereira de Oliveira

Dehydration of malay apples using ultrasound pre-treatment.

Masters in Chemical Engineering - Federal University of Ceará

Supervisor: Fabiano André Narciso Fernandes

Isabel Moreira da Silva

Cashew juice containing prebiotic oligosaccharides

Masters in Food Science and Technology - Federal University of Ceará

Supervisor: Sueli Rodrigues

Janaina Maria Martins Vieira

Enzymatic maceration of the edible peel of cajá (*Spondias mombin* L.) for the extraction of carotenoids.

Masters in Chemical Engineering - Federal University of Ceará

Supervisor: Gustavo A. S. Pinto

Doctorate Degree

Ana Lucia Fernandes Pereira

Production of pro-biotic cajá juice.

Doctorate in Food Science and Technology - Federal University of Ceará

Supervisor: Sueli Rodrigues

Ana Elisa Oliveira dos Santos

Creation, adaptation and validation of post-harvest technologies for grapescultivated in the Brazilian Northeast.

Doctorate in Phytotechny – Federal Rural University of the Drylands

Supervisor: Ebenezer de Oliveira Silva

Ana Maria de Abreu Siqueira

Antioxidant fibers and pectin from cashew apple bagasse.

Doctorate in Biotechnology - State University of Ceará

Supervisor: Edy S. Brito

Claudia Patricia Mourão Lima Fontes

Production of pre-biotic oligossacharides using fruit juices as substrate

Doctorate in Biotechnology - Federal University of Ceará

Supervisor: Sueli Rodrigues

Érica Milô de Freitas Felipe Rocha.

Production of food powders from cashew apple juice by the process of spray-drying and freeze-drying: physical, physicochemical, morphological and hygroscopic characterization.

Doctorate in Food Science and Technology - Federal University of Ceará

Supervisor: José Maria Correia da Costa

Francisca Imilena Pereira de Oliveira

Dehydration of fruits using ultrasound technology.

Doctorate in Chemical Engineering - Federal University of Ceará

Supervisor: Fabiano André Narciso Fernandes

Jonas Luiz Almada da Silva

Production of fruit juices pre-biotic oligossacharides

Doctorate in Food Science and Technology - Federal University of Ceará

Supervisor: Sueli Rodrigues

Leirson Rodrigues da Silva

Physical, physicochemical and total antioxidant activity characteristics of noni fruit (*Morinda citrifolia*) under developtment.

Doctorate in Phytotechny – Federal Rural University of the Drylands

Supervisor: Ebenezer de Oliveira Silva

Maria Edileuza de L. Andrade

Post-harvest quality evaluation of "Tommy Atkins" mango subjected to pulsed ultraviolet radiation.

Doctorate in Phytotechny – Federal Rural University of the Drylands

Supervisor: Ebenezer de Oliveira Silva

Masu Capistrano Camurça Portela

Production of functional died ice cream from goat milk with pro-biotic oligossacharides obtained from tropical fruit juices.

Doctorate in Biotechnology - Federal University of Ceará

Supervisor: Sueli Rodrigues

Mércia de Sousa Galvão

Biotechnological process development in obtaining aromas from fruit processing residues

Doctorate in Biotechnology - Federal University of Sergipe

Supervisor: Narendra Narain

Williams Pereira Batista

Use of vegetal waxes, specially carnaúba wax, as a source for long chain alcohols.

Doctorate in Biotechnology - State University of Ceará

Supervisor: Edy S. Brito

Masters Degree

Albertina de Oliveira Costa

Effect of the pasteurization process on the amount of natural antioxidants in tropical fruit pulps - acerola, cashew apple and guava.

Masters in Food Science and Technology - Federal University of Sergipe

Supervisor: Narendra Narain

Holivania Maria Pereira Canuto.

Freeze-dried papaya: physical, physicochemical, morphological and hygroscopic characterization.

Masters in Food Science and Technology - Federal University of Ceará

Supervisor: José Maria Correia da Costa

Joice Correia dos Santos

Evaluation of the quality of graviola (Annona Muricata L.) dehydrated by the freeze-drying process.

Masters in Food Science and Technology - Federal University of Sergipe

Supervisor: Narendra Narain

Josália Liberato Rebouças.

Evaluaton of post-harvest shelf life of papaya var. formosa "TAINUNG 01" under refrigeration and modified atmosphere.

Masters in Food Science and Technology - Federal University of Ceará

Supervisor: José Maria Correia da Costa

Josenice Silva dos Santos

Use of antioxidants in conservation of minimally processed. mango (*Mangifera indica*).

Masters in Food Science and Technology - Federal University of Sergipe

Supervisor: Marcelo Augusto G. Carnelossi

Karen Letícia de Santana

Study of the physical, physico-chemical characteristics and profile of volatile compounds of soursop and seriguela fruits.

Masters in Food Science and Technology - Federal University of Sergipe

Supervisor: Narendra Narain

Laiane Torres Silva

Application of edible coatins based on sodium alginate and mango pulp for the conservation of aroma in minimal processed mangoes.

Masters in Phytotechny – Federal Rural University of the Drylands

Supervisor: Ebenezer

Lilia Calheiros de Oliveira

Extraction and characterization of flavors from process residues of pineapple, passion fruit and orange.

Masters in Food Science and Technology - Federal University of Sergipe

Supervisor: Narendra Narain

Luis Carlos Alencar da Silva

Inactivation of vegetal enzymes by ultrasound application.

Masters in Chemical Engineering - Federal University of Ceará

Supervisor: Sueli Rodrigues

Luis Gomes de Moura Neto

Applicaton of spray-drying on the obtaintion of cajá powder: physical, physicochemical, morphological and hygroscopic characterization.

Masters in Food Science and Technology - Federal University of Ceará

Supervisor: José Maria Correia da Costa

Mayra Garcia Maia Costa

Production of pro-biotic pineapple juice.

Masters in Food Science and Technology - Federal University of Ceará

Supervisor: Sueli Rodrigues

Priscila Ximenes Moreira.

Evaluaton of post-harvest shelf life of papaya produced in the Chapada do Apodi under refrigeration and modified atmosphere.

Masters in Food Science and Technology - Federal University of Ceará

Supervisor: José Maria Correia da Costa

Raquel Anne Ribeiro dos Santos

Development and characterization of jams from caja-umbu (*Spondias sp*.) and mangaba (*Hancornia speciosa* Gomes) fruits.

Masters in Food Science and Technology - Federal University of Sergipe

Supervisor: Narendra Narain

Sheila Cristina de Oliveira

Study of the volatile compounds of açai (*Euterpe oleracea* Mart.)and cupuassu (*Theobrama grandiflorum* Schum.) pulps.

Masters in Food Science and Technology - Federal University of Sergipe

Supervisor: Narendra Narain

Suzane Macêdo Araújo

Process optimization for elaboration of fermented beverages from cashew apple juice.

Masters in Food Science and Technology - Federal University of Sergipe

Supervisor: Narendra Narain

Thatyane Vidal Fonteles

Production of pro-biotic melon juice.

Masters in Food Science and Technology - Federal University of Ceará

Supervisor: Sueli Rodrigues

Valdeci Silva Bastos

Cashew juice (*Anacardium occidentale* L.) powder obtained by combined dehydration processes of osmotic dehydration followed by lyophilization

Masters in Food Science and Technology - Federal University of Sergipe

Supervisor: Narendra Narain

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Facilities

1 Laboratory of Chromatographic Analysis and of Flavors

Federal University of Sergipe

Funding
INCT/CNPq

The Laboratory of Chromatographic analysis and flavors (LAF) currently possesses equipments and apparatus necessary for flavors isolation, analysis and characterization besides common physico-chemical analysis of fruits. Among these some principal equipments are listed below:

Figure 1. HPLC

Flavor extracts isolation:

The principal equipments used to obtain aroma fractions (volatile extracts) belong to the conventional techniques of hydrodistillation including Clevenger apparatus, Likens-Nickerson simultaneous distillation and extraction assembly and a prototype device that simulates the extraction conditions used in the industrial process for obtaining extracts of aromatic fractions. For characterization and identification of aroma fraction of tropical fruits, other extraction and volatiles capture techniques such as Headspace (static and dynamic modes of operation), solid phase microextraction (SPME) procedures using various different fibers and Teledyne Tekmar Stratum Purge and Trap in combination with Varian Purge and Trap autosampler, coupled to gas chromatograph.

Figure 2. Gas Chromatograph

Chromatographic Equipments available :

Gas chromatographs (GC) coupled with various detectors such as FID (Flame Ionization Detector), ECD (Electron Capture Detector) and TCD (Thermal Conductivity Detector) of Brand Varian models CP-3380 and CP-3800 of GC

Gas chromatograph coupled with mass spectrometer (Varian model GC 3800/MS4000) online with purge and trap concentrator (Teledyne Tekmar Stratum Purge & Trap) and autosampler

Gas chromatograph coupled with mass spectrometer (Varian model GC 3380/Saturn 2100T) equipped with ion trap analyzer working with electron impact ionization and of chemical ionization;

Ultra Fast Liquid Chromatograph (UFLC) with diode array detector (SPD-20A) and refractive index detector,

Figure 3. Pressurized Flavor Extractor Prototype

Other equipments:

Fourier Transform Infrared spectrophotometer (FT-IR)

UV-Vis spectrophotometer Apparatus make Shimadzu, model UVMini-1240

Lyophilizer, Terroni, model LS6000

Texture analyzer.

Figure 4. Jam Products

2 Biotechnology Lab

Federal University of Ceará

Funding
INCT/CNPq
CAPES
BNB

The lab works with biotechnological processes and has 100 m^2 distributed into three labs.

The lab is equipped with basic scientific equipment, bioreactor, HPLC, oven dryer, thermostatized centrifuge, UV-visible spectrometer, BOD, optical microscope, fluorescence microscope, colorimeter, water activity detector, orbital shaker, autoclave, vacuum pump, rotary dryer, micro plate reader.

Grant from INCT project allowed the construction of 50 m^2 of lab area.

Figure 1. Lab overview

Figure 2. Lab Overview

3 Process Analysis & Development Lab

Federal University of Ceará

Funding
INCT/CNPq
CAPES
FUNCAP

The main research field of the lab is related to drying, ultrasound technology and chemical reactions.

The lab is equipped with basic scientific equipment, 4 chemical reactors, gas chromatograph, probe ultrasound, 2 bath ultrasound, texturometer, tray dryer, infrared dryer, oven dryer.

Grant from INCT project allowed the acquisition of a probe ultrasound and a texturometer..

The new equipment will allow studies on:

Effect of ultrasound power on fruit processing

Effect of ultrasound power on chemical reactions

Effect of processing on fruit texture

Processing of fruit juices in ultrasound

Extraction of pigments

Extraction of phenolic content

Cell disruption and extraction of intracellular compounds

4 Plant Cell Biology Lab and Enzyme Lab

Federal University of Ceará

Funding
INCT/CNPq

The main research field of these labs are related to plant physiology, plant morphology and enzyme characterization.

The plant cell biology lab is equipped with basic scientific equipment, microtome, optical microscope.

The enzyme lab is equipped with basic scientific equipment, centrifuge, freeze-dryier.

Grant from INCT project allowed the acquisition of an optical microscope and basic scientific equipment.

The new equipment will allow studies on:

Changes in cell structure provoked by processing.

Cell morphology.

Cell physiology.

Enzyme characterization.

Enzyme activity.

Figure 1. Plant Cell Biology Lab

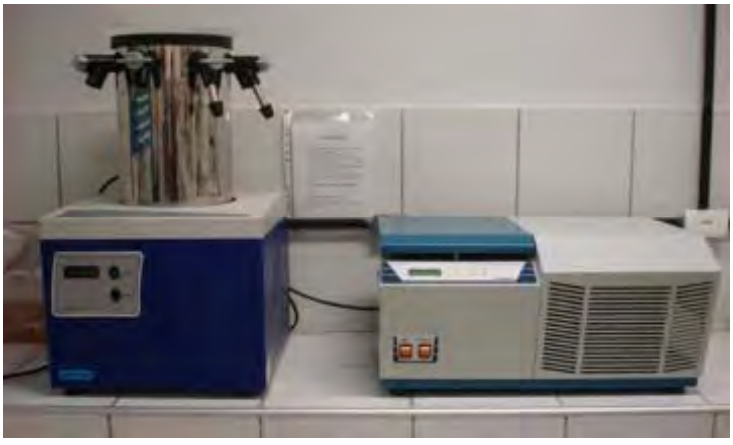

Figure 2. Enzyme Lab

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Workshop

1 I Congress of the INCT-FT & II Symposium of Food Science and Technology

The INCT-FT and the Brazilian Society of Food Science and Technology have organized the I Congress of the INCT-FT and the II Symposium on Food Science and Technology, which was held in Aracaju – SE in 18 to 21st of April of 2010.

The theme of the congress was Advances in Food Technology and aimed to present innovative research of national interest, focusing mainly in the innovations toward the North and Northeastern regions. The symposium has presented and discussed innovative technologies developed for the food industry.

The event has gathered food professionals reinforcing the relation between researchers and private companies, as well as under grad and post grad students.

The event had 439 participants that came from all parts of Brazil. A total of 533 researches were presented, from which 54 researches were from the INCT-FT.

Companies, such as SINC, Varian and Analítica, have presented their equipments for the food industry and Marata has sponsored the event.


18 a 21 de abril de 2010 - Aracaju - Centro de Convenções de Sergipe
II SIMPÓSIO EM CIÊNCIA E TECNOLOGIA DE ALIMENTOS
I CONGRESSO DO INSTITUTO NACIONAL DE FRUTOS TROPICAIS
APRESENTAÇÃO
COMISSÕES
PROGRAMAÇÃO
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INSCRIÇÕES
ENVIO DE RESUMOS
LOCAL / COMO CHEGAR
HOSPEDAGEM
AGÊNCIA OFICIAL
FALE CONOSCO
ACESSO RESTRITO
APRESENTAÇÃO
Atenção: Comunicamos que apesar das fortes chuvas que têm caído sobre o estado de Sergipe e sobre a sua capital Aracaju (conforme destaque na mídia nacional), o II Simpósio em Ciência e Tecnologia de Alimentos e o I Congresso do Instituto Nacional de Frutos Tropicais transcorrerão de forma tranqüila e sem problemas, tendo-se fácil acesso aos hotéis bem como ao local do evento.
Aguardamos todos vocês em Aracaju!
Atenção: Veja aqui a data da apresentação do seu banner.
Prezados Congressistas,
A SBCTA-SERGIPE, encontra-se sediada junto ao Núcleo de Pós-Graduação em Ciência e Tecnologia de Alimentos – NUCTA da Universidade Federal de Sergipe, onde vem congregando acadêmicos, pesquisadores, empresários, técnicos e demais profissionais vinculados ao setor agroindustrial do Estado. Dando continuidade às atividades, a cada ano, das Regionais da SBCTA, na realização de Simpósios, a Secretaria Executiva da SBCTA-SE e de conformidade com as diretrizes do Programa do Instituto Nacional de Ciência e Tecnologia - INCT promoverão o "II SIMPÓSIO DE CIÊNCIA E TECNOLOGIA DE ALIMENTOS" e o "I CONGRESSO DO INSTITUTO NACIONAL DE FRUTOS TROPICAIS", respectivamente, a serem realizados, conjuntamente, no Centro de Convenções de Sergipe, na cidade de Aracaju, no período de 18 a 21 de abril de 2010.

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Media

1 Stand at the Symposium on Food Science and Technology

The INCT-FT and the Brazilian Society of Food Science and Technology have organized the I Congress of the INCT-FT and the II Symposium on Food Science and Technology, which was held in Aracaju – SE in 18 to 21th of April of 2010.

A stand of the INCT-FT has displayed information regarding the proposal of the INCT-FT, its current researches and the products developed by the INCT-FT.

A large amount of persons have visited the stand.

2 Homepage www.frutostropicais.com.br

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- Frutas
- Valor Nutricional
- Safra

INCT Frutos Tropicais

Neste site você encontrará informações sobre o Instituto Nacional de Frutos Tropicais e informações sobre frutas tropicais.

Notícias

Simpósio em Ciência e Tecnologia de Alimentos
e
Congresso do Instituto Nacional de Frutos Tropicais

Aracaju - Abril / 2010

Read more Oct 02, 2009

3 News in the Internet and Newspapers

Pesquisas com frutas tropicais ganham impulso com criação de Instituto

http://www.agronline.com.br/agronoticias/noticia.php?id=5426

Avançar no desenvolvimento de tecnologias voltadas para o processamento de frutos tropicais e colocar o Brasil em lugar de destaque no cenário exportador mundial. Com esses objetivos foi criado o Instituto Nacional de Ciência e Tecnologia – Frutas Tropicais (INCT-FT), uma iniciativa do Ministério da Ciência e Tecnologia e que integra o Programa Institutos Nacionais de Ciência e Tecnologia. Compõem o Comitê Gestor do Instituto a Universidade Federal de Sergipe, a Universidade Federal do Ceará e a Embrapa Agroindústria Tropical (Fortaleza/CE), Unidade da Empresa Brasileira de Pesquisa Agropecuária, vinculada ao Ministério da Agricultura, Pecuária e Abastecimento.

De acordo com o presidente do Comitê Gestor e professor da Universidade Federal de Sergipe, Narendra Narain, o Instituto foi criado para desenvolver know-how tecnológico "por meio da agregação de recursos humanos especializados nas diferentes áreas de estudos em ciência e tecnologia de frutos tropicais, de diferentes instituições de ensino e pesquisa". Estão previstos recursos de R$ 4,5 milhões para os próximos três anos, que serão destinados para a compra de equipamentos, contratação de bolsistas e realização de simpósios e workshops.

O INCT-FT vai focar sua atuação no desenvolvimento de produtos promissores utilizando frutas tropicais e subtropicais de larga produção (abacaxi, mamão, caju, manga e acerola), de escala produtiva média (cajá, umbu, sapoti, mangaba, açaí e cupuaçu) e de frutas exóticas de pequena escala de produção (guajuru, pulsar, seriguela, jambo e cajarana) na Região Nordeste. O alvo é a exportação de produtos de alto valor agregado.

Segundo o Prof. Narain, o Brasil possui um enorme potencial de comercialização de frutas, mas está vendendo esses produtos na forma, principalmente, de polpa congelada, de forma que não agrega o valor correto. Ele adianta que o foco principal dos planos de trabalho a serem desenvolvidos pelo INCT-FT será em desidratação de frutas, notadamente a padronização de condições de processamento para obter produtos desidratados de frutas tropicais.

"O custo de transporte das nossas frutas poderá diminuir consideravelmente na forma de produtos desidratados. Isso porque a maioria das frutas tropicais tem entre 80% a 95% de umidade. Significa dizer que estamos pagando caro para exportar água", explica Narain.

Outras linhas de pesquisa trabalhadas pelos integrantes do Instituto serão sucos prontos para beber, sucos em pó, frutas minimamente processadas, frutas in natura revestidas com biofilmes, e essências de frutas. A expectativa do Comitê Gestor é que, em 18 meses, cinco produtos sejam lançados e, no caso de tecnologias estratégicas, o Instituto vai acompanhar a obtenção de patentes. A idéia é apresentar esses produtos nos

simpósios e workshops que serão realizados com os recursos do INCT-FT.

Programa

O Programa Institutos Nacionais de Ciência e Tecnologia tem como metas mobilizar e agregar, de forma articulada, os melhores grupos de pesquisa em áreas de fronteira da ciência e em áreas estratégicas para o desenvolvimento sustentável do país; impulsionar a pesquisa científica básica e fundamental; estimular o desenvolvimento de pesquisa científica e tecnológica de ponta, associada a aplicações para promover a inovação e o espírito empreendedor, em estreita articulação com empresas inovadoras.

Data: 22-06-2009
Fonte: Embrapa (http://www.embrapa.br)

UFS compõe dois projetos para institutos nacionais de C&T

Data 17/12/2008 09:32:56 | **Assunto:** Últimas Notícias

Através de dois projetos a UFS faz parte dos 101 novos Institutos Nacionais de Ciência e Tecnologia (INCTs), criados pelo Ministério da Ciência e Tecnologia (MCT) em julho deste ano. As propostas foram aprovadas através de edital lançado pelo Conselho Nacional de Desenvolvimento Científico e Tecnológico (CNPq) que, junto com mais oito instituições, investirá cerca de R$ 600 milhões no desenvolvimento e apoio à pesquisa no país.

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O INCT de Frutos Tropicais, encabeçado pelo professor Narendra Narain, coordenador do Núcleo de Pós-Graduação em Ciência e Tecnologia de Alimentos (Nucta), em parceria com Universidade Federal do Ceará (UFC) e a Embrapa, receberá mais de R$ 4 milhões em recursos nos próximos cinco anos. O propósito da pesquisa é desenvolver produtos nobres e de alta qualidade para fins de exportação. A matéria-prima constitui-se de frutas tropicais brasileiras.

No Instituto Nacional de Ciência e Tecnologia para Engenharia de Software (Ines), liderado pelo Centro de Informática da Universidade Federal de Pernambuco (UFPE), a UFS entra como parceira, através do Departamento de Computação (DCOMP) representado pela professora Leila Maciel de Almeida, junto com mais sete instituições. As principais linhas de pesquisa focam o reúso, a verificação e a validação de software e engenharia de software experimental.

De acordo com a professora, a inserção da universidade contribui para consolidar o nível em que se encontra a pesquisa na instituição, principalmente quando se trata de Engenharia de Software. "Esta área é basilar para os avanços do setor de Tecnologia da Informação no país, um setor reconhecidamente estratégico e cuja importância cresce consideravelmente a cada ano, já que a área de Computação é também área meio para o desenvolvimento tecnológico de inúmeras outras áreas do conhecimento", ressalta.

Os institutos selecionados começam a atuar ainda este ano e formarão uma rede com instituições por todo o país, ocupando posição estratégica no Sistema Nacional de Ciência e Tecnologia. Com isso a UFS se posiciona no terceiro dos cinco níveis para constituição das Instituições Federais de Ciência & Tecnologia.

Fonte: Ascom/UFS

Itaporahoje
ANO IV .com
A notícia hoje será história amanhã

01/07/2009 - 15:23:02

Pesquisas ganham impulso com criação de Instituto

Avançar no desenvolvimento de tecnologias voltadas para o processamento de frutos tropicais e colocar o Brasil em lugar de destaque no cenário exportador mundial.

Com esses objetivos foi criado o Instituto Nacional de Ciência e Tecnologia – Frutas Tropicais (INCT-FT), uma iniciativa do Ministério da Ciência e Tecnologia e que integra o Programa Institutos Nacionais de Ciência e Tecnologia. Compõem o Comitê Gestor do Instituto a Universidade Federal de Sergipe, a Universidade Federal do Ceará e a Embrapa Agroindústria Tropical.

De acordo com o presidente do Comitê Gestor e professor da Universidade Federal de Sergipe, Narendra Narain, o Instituto foi criado para desenvolver know-how tecnológico "por meio da agregação de recursos humanos especializados nas diferentes áreas de estudos em ciência e tecnologia de frutos tropicais, de diferentes instituições de ensino e pesquisa".

Estão previstos recursos de R$ 4,5 milhões para os próximos três anos, que serão destinados para a compra de equipamentos, contratação de bolsistas e realização de simpósios e workshops.

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Segundo o Prof. Narain, o Brasil possui um enorme potencial de comercialização de frutas, mas está vendendo esses produtos na forma, principalmente, de polpa congelada, de forma que não agrega o valor correto.

Ele adianta que o foco principal dos planos de trabalho a serem desenvolvidos pelo INCT-FT será em desidratação de frutas, notadamente a padronização de condições de processamento para obter produtos desidratados de frutas tropicais.

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A expectativa do Comitê Gestor é que, em 18 meses, cinco produtos sejam lançados e, no caso de tecnologias estratégicas, o Instituto vai acompanhar a obtenção de patentes. A idéia é apresentar esses produtos nos simpósios e workshops que serão realizados com os recursos do INCT-FT.

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<!--[if !supportLineBreakNewLine]-->
<!--[endif]-->
Fonte: Dourados Agora

Imprimir

Outras Notícias

Quinta-feira, 22 de Julho de 2010

[11:37:01] - Geral
Abastecimento de água será suspenso amanhã em Dourados

[11:04:40] - Geral
Rodovia BR-262 ficará interditada para passagem de carga

[10:31:11] - Geral
Depois briga por Mega-Sena, pai e filho fazem acordo

[10:20:52] - Geral
Pirataria e informalidade movimentaram R$ 578 bilhões em 2009

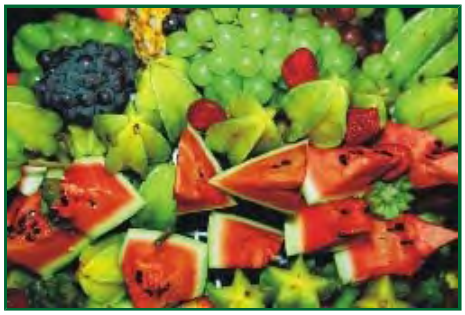
[09:03:07] - Inverno
Frio mata ao menos 2 mil cabeças de gado no Paraguai

22/06/2009 16:18

Pesquisas com frutas tropicais ganham impulso com criação de Instituto

O Instituto foi criado para desenvolver know-how tecnológico

EMBRAPA AGROINDÚSTRIA TROPICAL



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URL: www.portaldoagronegocio.com.br/conteudo.php?id=30401

Resumo Agroindustrial

NOTÍCIAS AGROINDUSTRIAIS

Quem sou eu

RESUMO AGROINDUSTRIAL
JUNDIAÍ, RN, BRAZIL
Blog referente ao curso de Agroindústria da Escola Agrícola de Jundiaí, aqui você encontrará um resumo de todos os fatos e acontecimentos mundiais referentes a área agroindustrial!

Visualizar meu perfil completo

SEXTA-FEIRA, 26 DE FEVEREIRO DE 2010

Simpósio e Congresso em Aracajú

Com o Tema central “Avanços em Tecnologia de Alimentos” o evento objetiva apresentar inovações tecnológicas de interesse nacional, mais precisamente focado, na região norte /nordeste, discutir e difundir tecnologias inovadoras geradas para a indústria de alimentos a nível nacional e para os Arranjos Produtivos Locais – APLs, em especial do Estado de Sergipe. Acreditamos que o evento permitirá congregar os mais diversos profissionais da área de alimentos, estreitando as relações de conhecimento entre os pesquisadores e a iniciativa privada do Brasil, bem como, com estudantes de graduação e de Pós-Graduação, contribuindo assim na difusão do conhecimento das pesquisas geradas em Ciência e Tecnologia de Alimentos, especialmente, no que concerne a Frutos tropicais.

Pela abrangência do tema proposto e por Aracaju ainda não ter sediado eventos desta natureza, espera-se um número superior a 500 congressistas. Portanto, é com grata satisfação que os convidamos a participar do mesmo.

Dando continuidade às atividades, a cada ano, das Regionais da SBCTA, na realização de Simpósios, a Secretaria Executiva da SBCTA-SE e de conformidade com as diretrizes do Programa do Instituto Nacional de Ciência e Tecnologia - INCT promoverão o **"II SIMPÓSIO DE CIÊNCIA E TECNOLOGIA DE**

ALIMENTOS" e o **"I CONGRESSO DO INSTITUTO NACIONAL DE FRUTOS TROPICAIS"**, respectivamente, a serem realizados, conjuntamente, no **Centro de Convenções de Sergipe, na cidade de Aracaju, no período de 18 a 21 de abril de 2010.**

A programação conta com mesas redondas, palestras, mini-cursos, Apresentação de Posters.

Normas para Envio de Resumos Expandidos

1) Envio do trabalho

Podem ser submetidos resumos de trabalhos científicos escritos em português, que sejam relacionados às áreas de Ciência, Tecnologia e Engenharia de Alimentos, Alimentação e Nutrição, Biotecnologia, desenvolvido por acadêmicos ou profissionais de instituições do Brasil ou do exterior. Pelo menos um dos autores deverá estar inscrito no Evento.

2) Autores

No máximo 6 (seis) autores poderão constar no trabalho (incluindo co-autor, orientador e outros).

3) Resumo Expandido

O resumo expandido deverá ser enviado via internet, respeitando-se o prazo de inscrição no evento.

3.1) Prazo para envio do resumo expandido – de 04 de novembro de 2009 até 08 de março de 2010;

3.2) O resumo expandido não poderá ser enviado mais de uma vez (por autores diferentes), pois isto bloqueará o trabalho. É obrigatório que todos os autores e principalmente o orientador, tenham conhecimento do conteúdo do resumo e do envio para o evento;

3.3) Cada resumo expandido será analisado pela comissão técnico-científica do evento e poderá ser aceito ou não. A resposta (incluindo o parecer de recusa, se for o caso) seguirá por e-mail ao autor que enviou o trabalho, até 19 de março de 2010;

3.4) O pôster deverá ser elaborado e apresentado de acordo com as normas publicadas neste site. É proibida a apresentação do pôster por terceiros, ou seja, não autores;

3.5) Cada inscrição só dará direito a apresentação de 2 trabalhos.

3.6) Será entregue no final da apresentação do pôster, o certificado de apresentação do trabalho com o nome de todos os autores cadastrados no envio do resumo;

GRANDE/RN
25 minutos atrás

Grande Ponto
Poluição do rio Piranhas-Assu afeta a pesca de mariscos em Macau
1 hora atrás

Diário de uma Professorinha
Frase do Dia:
12 horas atrás

Apicultura no RN
Congresso Ibero-Latino americano de apicultura - Natal/RN - Brasil 2010
17 horas atrás

Blog do Cara
1 dia atrás

Portal Búzios
Prefeita Goreti faz visita às comunidades Rurais do município de Apodi.
2 dias atrás

Cultura Nordestina
Poesia: Provocação de vizinha (Daudeth Bandeira)
4 dias atrás

Embolando Palavras
A oração de Borges
1 semana atrás

Agricola e Pecuaria
Normas para zoneamento agrícola do abacaxi são publicadas no Diário Oficial
1 semana atrás

Historiador do cotidiano
Frase do dia
2 semanas atrás

AGRONOMIA 1981 - BAGÉ, RS.
DIA DO FISCAL FEDERAL AGROPECUÁRIO (30.junho)
3 semanas atrás

Terra - RSS - Terra Magazine
Sarney prefere não remexer história de dossiê contra Roseana
5 semanas atrás

Robson Coelho
Você já pensou que a IDÉIA surgisse assim?
9 meses atrás

FENATA - Federação Nacional dos Técnicos Agrícolas

3.7) Serão certificados apenas os trabalhos efetivamente apresentados no evento, nas Sessões de Pôsteres, por pelo menos um dos autores.

Análise e elaboração do resumo expandido

1) Não serão aceitos:

a) Trabalho já publicado anteriormente;
b) Simples descrição de projeto, intenção de trabalho, trabalho só com resultado preliminar;
c) Resumo da revisão bibliográfica;
d) Trabalho que não se caracterize como pesquisa científica ou desenvolvimento de processos/produtos.

2) Formatação

a) Digitar o resumo expandido no Word 2003 for Windows;
b) Configuração da página - deve ser A4 (210 x 297 mm);
c) Tamanho do documento – 3 a 4 páginas, incluindo: título, autores e siglas das instituições, resumo, introdução, metodologia, resultados e discussão, conclusões e referencias, agradecimentos (quando houver);
d) Margens - 2,5 cm para as margens: superior, inferior, direita e esquerda; Espaçamento: simples;
e) Fonte - tipo Arial (exceções aos símbolos, fórmulas e letras gregas); utilizar tamanho 12 (exceto título, autores e instituições);
f) Título do trabalho - deve ser digitado em letras maiúsculas, negrito, fonte Arial tamanho 14;
g) Autores, emails e endereços institucionais– devem ser digitados fonte Arial, negrito, tamanho 10;
h) E-mail - colocar o e-mail do autor que irá apresentar o trabalho ou para quem a correspondência deve ser enviada ;
i) Palavras-chave: 3 a 5 palavras-chave separadas por vírgulas, em ordem alfabética.

3) Corpo do resumo expandido

O texto do resumo deve ser em parágrafo único, sem tabulação ou espaço com no mínimo 150 e no máximo 250 palavras.
Introdução: Visão geral sobre o assunto com definição dos objetivos do trabalho, indicando a relevância da pesquisa.
Metodologia: Como o trabalho foi realizado (procedimentos/estratégias; os sujeitos/participantes/documentos; equipamentos/ambientes; etc).
Resultados e Discussão: Os resultados obtidos deverão ser discutidos preferencialmente fazendo referência a medidas e cálculos estatísticos aplicados.

Conclusões: a conclusão do trabalho deverá contemplar o item proposto no objetivo da pesquisa.

4) Critérios para recusa do trabalho

Antes de enviar o resumo expandido ao II de Simpósio de Ciência e Tecnologia de Alimentos e I Congresso do INFT, é obrigatório que os autores façam rigorosa revisão gramatical, ortográfica, de digitação e de conteúdo em todos os dados do resumo expandido; a falta de cuidados e o excesso de erros podem justificar a recusa do trabalho. O trabalho recusado não poderá ser alterado pelos autores para reavaliação.

5) O resumo expandido

O resumo expandido poderá conter além do texto, tabelas, gráficos, fotos, esquemas químicos ou fórmulas os quais também poderão ser inseridos no pôster. Após o aceite final do trabalho, o mesmo será publicado sem correções posteriores.

6) Áreas de Trabalho

1 - Análise de Alimentos (AL)
2 - Avaliação sensorial de Alimentos (AS)
3 - Microbiologia e toxicologia de Alimentos (MT)
4 - Nutrição, saúde e Alimentação (NA)
5 - Química e Bioquímica de Alimentos (QB)
6 - Tecnologia de produtos de origem animal (TA)
7 - Tecnologia de produtos de origem vegetal (TO)
8 - Diversas (DV)

Postado por Resumo Agroindustrial às 11:46 0 comentários

Marcadores: Blog Indica

Resumo Geral

Muito boa tarde a todos,
Primeiramente pedimos desculpas pela demora na atualização do blog.
Voltaremos normalmente com as publicações.

Informamos que as aulas na Escola Agrícola de Jundiaí já recomeçaram

normalmente.

Equipe de Edição

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Marcadores: Aconteceu na EAJ , Blog Indica

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COTAÇÕES

TEMPO

11:59

22/07/2010

PESQUISAS COM FRUTAS TROPICAIS GANHAM IMPULSO COM CRIAÇÃO DE INSTITUTO

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Avançar no desenvolvimento de tecnologias voltadas para o processamento de frutos tropicais e colocar o Brasil em lugar de destaque no cenário exportador mundial. Com esses objetivos foi criado o Instituto Nacional de Ciência e Tecnologia – Frutas Tropicais (INCT-FT), uma iniciativa do Ministério da Ciência e Tecnologia e que integra o Programa Institutos Nacionais de Ciência e Tecnologia. Compõem o Comitê Gestor do Instituto a Universidade Federal de Sergipe, a Universidade Federal do Ceará e a Embrapa Agroindústria Tropical (Fortaleza/CE), Unidade da Empresa Brasileira de Pesquisa Agropecuária, vinculada ao Ministério da Agricultura, Pecuária e Abastecimento.

De acordo com o presidente do Comitê Gestor e professor da Universidade Federal de Sergipe, Narendra Narain, o Instituto foi criado para desenvolver know-how tecnológico "por meio da agregação de recursos humanos especializados nas diferentes áreas de estudos em ciência e tecnologia de frutos tropicais, de diferentes instituições de ensino e pesquisa". Estão previstos recursos de R$ 4,5 milhões para os próximos três anos, que serão destinados para a compra de equipamentos, contratação de bolsistas e realização de simpósios e workshops.

O INCT-FT vai focar sua atuação no desenvolvimento de produtos promissores utilizando frutas tropicais e subtropicais de larga produção (abacaxi, mamão, caju, manga e acerola), de escala produtiva média (cajá, umbu, sapoti, mangaba, açaí e cupuaçu) e de frutas exóticas de pequena escala de produção (guajuru, pulsar, seriguela, jambo e cajarana) na Região Nordeste. O alvo é a exportação de produtos de alto valor agregado.

Segundo o Prof. Narain, o Brasil possui um enorme potencial de comercialização de frutas, mas está vendendo esses produtos na forma, principalmente, de polpa congelada, de forma que não agrega o valor correto. Ele adianta que o foco principal dos planos de trabalho a serem desenvolvidos pelo INCT-FT será em desidratação de frutas, notadamente a padronização de condições de processamento para obter produtos desidratados de frutas tropicais.

"O custo de transporte das nossas frutas poderá diminuir consideravelmente na forma de produtos desidratados. Isso porque a maioria das frutas tropicais tem entre 80% a 95% de umidade. Significa dizer que estamos pagando caro para exportar água", explica Narain.Outras linhas de pesquisa trabalhadas pelos integrantes do Instituto serão sucos prontos para beber, sucos em pó, frutas minimamente processadas, frutas in natura revestidas com biofilmes, e essências de frutas. A expectativa do Comitê Gestor é que, em 18 meses, cinco produtos sejam lançados e, no caso de tecnologias estratégicas, o Instituto vai acompanhar a obtenção de patentes. A idéia é apresentar esses produtos nos simpósios e workshops que serão realizados com os recursos do INCT-FT.

Programa

O Programa Institutos Nacionais de Ciência e Tecnologia tem como metas mobilizar e agregar, de forma articulada, os melhores grupos de pesquisa em áreas de fronteira da ciência e em áreas estratégicas para o desenvolvimento sustentável do país; impulsionar a pesquisa científica básica e fundamental; estimular o desenvolvimento de pesquisa científica e tecnológica de ponta, associada a aplicações para promover a inovação e o espírito empreendedor, em estreita articulação com empresas inovadoras.

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