Adriana Yumi Sato Duarte[1], Rayana Santiago de Queiroz[2,3], Regina Aparecida Sanches[2], Claudia Regina Garcia[2], Franco Giuseppe Dedini[1]

[1)]**Faculty of Mechanical Engineering State University of Campinas - UNICAMP**
Mendeleyev St, 200,13083-860 Campinas, SP, Brazil
E-mail: dri@fem.unicamp.br, dedini@fem.unicamp.br

[2)]**School of Arts Sciences and Humanities University of Sao Paulo - USP**
Arlindo Betio Ave, 1000, 03828-000 Sao Paulo, SP, Brazil
Email: rasanches@usp.br, claudiagarcia@usp.br

[3)]**Institute for Technological Research Center of Technical Textiles and Manufactures**
Professor Almeida Prado Av, 532, 05508-901 Sao Paulo, SP, Brazil
E-mail: rayanasq@gmail.com

Ethnobotany of Natural Fibres - *Bactris setosa* (tucum) in a Traditional Rural Community

Abstract
This work aimed to study the characteristics of the fibres of the species Bactris setosa ('tucum') used by close-knit social groups, located in Sorocaba – São Paulo - Brazil, in basket-making techniques, for possible applications in textile activity. Optical microscopy (NBR 13 538:1995) and Tensile Properties (ASTM D 3 822-2001) were used to assess properties such as the fibre structre, linear density, breaking force, elongation at break and breaking tenacity of each species. Bactris setosa showed a longitudinal view similar to that of sisal; an average linear density of 41.2 tex, a tenacity average of 11.96 cN/tex, closer to fiberglass, and an elongation ranging between 1.35 and 3.87%.It is important to clarify the delicacy and detail of the tests, and from this we highlight the importance of carrying out these studies, based on which science and technology must be linked with socio-environmental aspects.

Key words: *ethnobotany, natural cellulosic fibres, textile, Bactris setosa.*

Introduction

Ethnobotany consists in studying knowledge concerning plants in different sociocultural contexts. It studies the relation between man and plant, and it concerns, as the author describes, '(…) rescuing from human groups knowledge regarding the roles that plants play in several cultural environments and the meanings that social groups give them' [1].

Textile activity, just like agriculture, is one of the most ancient and traditional in mankind. Natural fibres have been used by men to produce fabric and clothing for millennia [2], and knowledge of vegetable fibres and techniques for textile production remain in many traditional cultures in Brazil and the world.

Considering this background and basing on the research on the definition of ethnobotanic, this work studied possible applications of fibrous plants in textile production, in which basketmaking techniques were rescued and tressing performed with the knowledge of such plants by traditional rural people in Sorocaba – Sao Paulo - Brazil. The proposal of this work was to create information and allow, in the future, the development of textile activity in the region through the improvement of such techniques (tressing and basketmaking) and greater technical knowledge of fibres.

Having as a foundation knowledge of these people and together with laboratory analysis, this work, in its more physical aspects, focused on the gathering and characterisation of the physical properties of textile fibres of *Bactris* to verify the potential of this plant regarding textile application: spinning and weaving. It is expected that from this work, knowledge of native natural fibres will be broader and allow the development of local textile activity in the future.

The introduction of alternative vegetable fibres from Brazil is a way of valuing the national product, as well as a means of preserving native raw material [3], not to mention its social contribution, being an alternative method of generating income for local and traditional communities [4].

The collection of the species selected was in a region of the Atlantic forest in the city of Tapiraí – Sao Paulo – Brazil, in a local neighbourhood known as the 'fishmen district'. ***Figures 1*** show a record of the collection.

The species *Bactris setosa* (***Figure 3***), known in Brazil by the names 'tucum-do-brejo, tucum-bravo, côco-de-tucum and ticum', belongs to the Palmae family and is found in the states of Espírito

Figures 1. *Bactris setosa – 'Tucum' collection.*

Figure 2. *Bactris setosa species.*

Sato Duarte A Y, Santiago de Queiroz R, Sanches R A, Garcia CR, Dedini FG. Ethnobotany of Natural Fibres - *Bactris setosa* (tucum) in a Traditional Rural Community. *FIBRES & TEXTILES in Eastern Europe* 2012; 20, 2(91): 18-20.

Santo, Rio de Janeiro and São Paulo, in the Atlantic forest.

The '*tucum* fibre is considered one of the most delicate and resistant that we know of' [5]. The author says that 'tucum' was widely used to produce hammocks, bowstrings, fishing lines, fabrics for several ornaments, among other uses, by the Brazilian indian tribes, prior to its 'discovery'.

The extraction of the fibre is through the same technique used by the ancient arboriginal of the country [5], which is similar to that used by the rural people involved in the present work.

'Once the palm tree leave is cut, the leaflets are separated one by one and handshaved using primitive utensils. Sometimes, they are gathered in groups and immersed in water for a certain time to macerate, before they are handshaved.' [5]

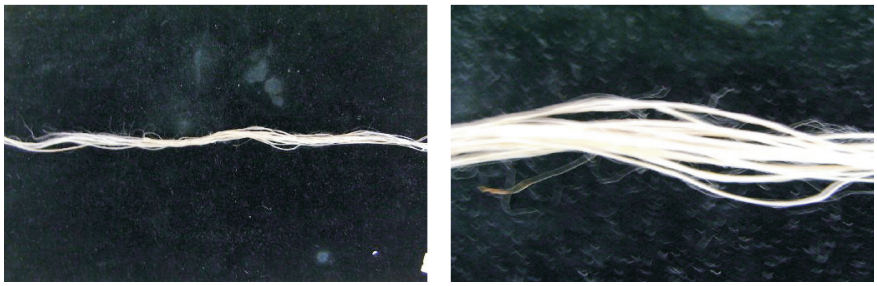
Previous studies with "tucum" fibres [5] offer some data about the properties thereof , where the average length of rupture is 38.6 km and the elasticity - 3.1%. In addition, some physical characteristics are presented in ***Table 1***, according to SI units, which will be used to start the discussion of the test results later.

Table 1. *Bactris setosa physical characteristics [adapted, 5].*

Sample	Parameter	Value		
		Minimum	Maximum	Average
Single fibre:	length, mm	1.0	3.6	1.9
	diameter, μm	2.9	7.2	4.9
	linear density, tex	169	15	36.8
Fibre bundle	width, mm	340	679	518
	thickness, mm	255	456	365
	number of single fibres in the bundle	27	113	61.2
	linear density, tex	168.8	112.1	512.4
	breaking force, cN	42.2	111.4	73.8

Table 2. *Linear density of the Bactris setosa.*

Sample	Mean length, m	Mean linear density, tex
T1	0.37	41.2



Figures 3. *Bactris setosa fibres.*

Methods

Method of the extraction of *Bactris setosa* fibres

The extraction of *Bactris setosa* ('tucum') fibres was done together with the people. Fibres of 'tucum' were removed from the leaves of the plants manually, which is an apparently simple technique, but it demands skill and experience. This reinforces the importance of the people's knowledge. The fibres obtained through this method correspond to sample T1.

T1 was the 'tucum' sample used for obtaining data. In this paper, specifically, those data are related to the final application: the textile industry, which explains why optical microscopy and tensile properties were chosen in order to give an initial perspective for the use of this fibre. In addition, few papers and studies regarding this subject have beeb found.

Tests of the characterisation of the fibres

The following tests were performed on samples of fibres T1 at the Fashion and Textile Laboratory of the Institute for Technological Research – IPT (São Paulo, Brazil).

Optical microscopy

A microscopy test was performed according to Standard NBR ISO 13 538:1995 [6]. Longitudinal and transversal views of the *Bactris setosa* fibres were analysed using 500× enlargement.

Tensile properties of the fibres

Tensile properties of the fibres were tested according toStandard ASTM D 3822-2001 [7] to determine those of single textile fibres, for which the following measurements were made: breaking force, elongation and tenacity.

A dynamometer - type CRE (*Constant-Rate-Elongation*) was used with a distance between the clamps of 25 mm and velocity thereof of 50 mm/min.

The standard recommends that the tensile property be tested for 20 test samples (corresponding to one single fibre); however, due to the small amount of *Bactris setosa* samples (T1), only 9 test samples were tested. Besides, because the extraction of the fibres was manual, fibre bundles and not single fibres were tested.

To calculate the tenacity, a test was previously performed to determine the linear density of fibers in accordance with ISO 1973:1995. The results are summarised in ***Table 2***.

Results and discussion

Bactris setosa fibres extraction

The *Bactris setosa* fibres obtained (T1) are thin, yellow-green and opaque (***Figures 3***). In terms of touch and appearance, they are softer and more delicate than other leaf fibres; however, they a little rough if compared to stem fibres. Moreover they are very long, with a length of about 370 mm.

Optical microscopy

were performed on the longitudinal section of the *Bactris setosa* fibres. Microphotographs of the fibres are shown in ***Figure 4.***

Bactris setosa fibre has a longitudinal section most similar to that of 'sisal' (***Figure 5***) and 'abacá'[1)] (***Figure 6***), which seems consistent to us since these three fibres are obtained from the leaves of dicots plants.

Table 3. Tensile properties of the Bactris setosa.

Sample	Breaking force		Elongation at break		Tenacity	
	Average, cN	Coefficient of variation, %	Average, %	Coefficient of variation, %	Average, cN/tex	Coefficient of variation, %
T1	246.27 ± 88.78	46.0	1.93 ± 0.58	39.5	11.96 ± 4.24	46.1

Tensile properties of the fibres

The ***Tables 2*** & ***3*** show the results of the linear density and tensile tests for samples T1.

Referring to the tensile test results for sample T1, when we compare the strength at break results to 246.27 cN with those published for the same fibres to 73.8 cN [5], it is noted that the first are significantly higher. However, it is known that the higher the linear density, the greater the force required to break it. As there are no data under this fibre [5], this comparison becomes questionable, in which case the tenacity value is more reliable as a parameter.

Based on data of the tenacity of the textile fibres, it is noticeable that the 'tucum' fibres were superior compared with other vegetable fibres, such as cotton and linen, as well as animal fibres, such as wool and silk [8]. While these have tenacity values ranging from 1 cN/tex (wool) to 5.5 cN/tex (linen), the 'tucum' showed a tenacity average of 11.96 cN/tex, close to those of glass fibres, within the range of 8.5 - 17.9 cN/tex. However, their values vary from 4.8 to 21.94 cN/tex, which justified the high coefficient of variation (46.1%), reducing the accuracy and reliability of results.

Figure 4. *Longitudinal section of the Bactris setosa fibre - 500×.*

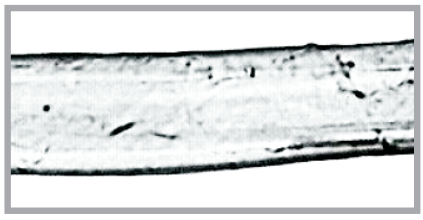


Figure 5. *Longitudinal section of the 'sisal' fibre - 500×.*

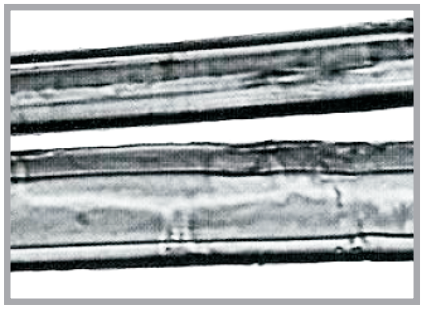


Figure 6. *Longitudinal section of the 'abacá' fibre - 500×.*

With regard to the values of elongation, it can be said that 'tucum' fibres are very similar to those of linen. While linen varies from 1.5 to 4%, 'tucum' ranged from 1.35 to 3.87%.

Final considerations

In terms of touch and appearance, the fibres that were obtained from "tucum" were softer and more delicate than other leaf fibres, which are also very long, about 370 mm in length. The laboratory test results showed that *Bactris setosa* ('tucum') presents a longitudinal view closer to that of sisal and 'abacá'. The breaking force of the fibres has an average of 246.27 cN, higher than the one found in the literature. Regarding the values of stretching, we can say that 'tucum' fibres are very close to those of linen. When compared with other vegetable fibers, 'Tucum' fibres are superior in terms of tenacity. *Bactris setosa* is similar to other vegetable textile fibres and demonstrates a good potential for application in textile activities.

This study represents the beginning of a project to rescue traditional knowledge, combined with the possibility of the introduction of a new textile fiber on the market. Therefore, for large-scale production, further studies regarding species management and analysis of the product life cycle will evaluate not only the economic viability but also social and environmental impact.

These results highlight the importance of carrying out such studies, bearing in mind that improvement in these techniques must be compatible with the reality of the rural people's lives. This can be a big challenge since the technological resources within these groups are often understood as 'limited'. However, it is up to us to understand the technical and technological improvement from a new perspective: that science and technology must be linked with socio-environmental and traditional knowledge.

Editorial note

1) The 'sisal' and 'abacá' refer to fibres obtained from the leaves of two vegetable species of *Bromeliaceaes*, very well known in Brazil.

References

1. Camargo, M. T. L. A. Etnofarmacobotânica: conceituação e metodologia de pesquisa. São Paulo: Humanitas/ FFLCH/USP: Terceira Margem, 2003, 30.
2. Ribeiro, L. G.; Andrade Filho, J. Introdução à Engenharia Têxtil, Rio de Janeiro: SENAI, 1987, I, II & III.
3. Pereira, O. J.; Rodrigues, E. A.; Pachecgo, F. A. M.; Tzechem, J. A Gestão Organizacional no Setor Têxtil: Limites e Desafios Diante dos Novos Paradigmas da Aldeia Global, VI SEMEAD, 2003, FEA – USP.
4. BNDES (Banco Nacional de Desenvolvimento Social) Relatorio Setorial: Fibras Artificiais e Sintéticas, 1995, Available at: <http://www.bndes.gov.br/conhecimento/ relato/fibras.pdf> [Accessed 7 september 2009]
5. Medina, J C. Plantas Fibrosas da Flora Mundial. Instituto Agronômico de Campinas, São Paulo, Brazil, 1959, 141.
6. ISO (International Organization for Standardization) ISO 1973:1995 Textile fibres - Determination of linear density - Gravimetric method and vibroscope method, Switzerland: ISO, 1995.
7. ASTM (American Society for Testing and Materials) ASTM D 3822, Standard Test Method for Tensile Properties of Single Textile Fibers, Pennsylvania: C ASTM International, 2001.
8. Maluf, E.; Kolbe, W. Dados Técnicos para a Indústria Têxtil, IPT- Instituto de Pesquisas Tecnológicas do Estado de São Paulo: ABIT – Associação Brasileira da Indústria Têxtil e de Confecção. São Paulo, Brazil, 2003.

Received 28.06.2011 Reviewed 02.11.2011