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DO RIO DE JANEIRO



**Diego Paul Martinez Eraso**

**Physical and Mechanical Properties  
of the Peach palm (*Bactris gasipaes Kunth*)  
as a Structural Composite Material**

**DISSERTAÇÃO DE MESTRADO**

Dissertation presented to the Programa de Pós-Graduação em Engenharia Civil of the Departamento de Engenharia Civil, PUC-Rio as partial fulfillment of the requirements for the degree of Master em Engenharia Civil.

Advisor: Khosrow Ghavami

Rio de Janeiro  
September de 2013



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This is for you, my mother, whom I miss and love. No words are sufficient to express the void you left when you parted forever from this world. This work is dedicated to you. Also in memory and tribute to Kenny Julian, cousin-brother, who died during my stay in Brazil.

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## Abstract

Martinez Eraso, Diego Paul; Ghavami, Khosrow (Advisor). **Physical and Mechanical Properties of Peach palm (*Bactris gasipaes kunth*) as a Structural Composite Material.** Rio de Janeiro, 2013. 75p. Msc. Dissertation - Departamento de Engenharia Civil, Pontifícia Universidade Católica do Rio de Janeiro.

To develop sustainable and structural materials, traditional construction techniques are evaluated in terms of engineering standards and methods of equivalent design are improved to optimize structural performance. However, the use of natural materials is limited by cultural traditions with little or no standardization, one example is the diversity of palms in the Latin American tropics, material of indigenous constructions and others uses. Therefore, this work presents results of “micro-structure”, “meso-structure” and “macro-structure” for two ages of palm stem *Bactris gasipaes Kunth* groups commonly known as "Peach Palm or Pupunha". Optical microscopy was performed for the micro structural analysis. Digital Image Processing was used to characterize the macrostructure, the variation of fiber volume fraction and the representative volume element (RVE). Furthermore, experimental research was carried out to determine basic physical properties (moisture and specific gravity) and mechanical properties to tension, flexion and torsion, generating as results the maximum tensile Strength (TS), the tensile modulus of elasticity (TMOE), bending modulus of elasticity (BMOE) and Modulus of Rigidity (MOR).

## Keywords

*Bactris gasipaes Kunth*; Natural composite material; Structural Composite Material; Non-Conventional materials and technologies.

## Resumo

Martinez Eraso, Diego Paul; Ghavami, Khosrow. **Propriedades físicas e mecânicas da pupunha (*Bactris Gasipae Kunth*) como material estrutural composto**. Rio de Janeiro, 2013. 75p. Dissertação de Mestrado - Departamento de Engenharia Civil, Pontifícia Universidade Católica do Rio de Janeiro.

Para desenvolver materiais sustentáveis e estruturais, as técnicas de construção tradicionais são avaliadas em termos de normas técnicas de engenharia e os métodos de construção equivalentes são melhorados para aperfeiçoar o desempenho estrutural. No entanto, o uso de materiais naturais é limitado pelas tradições culturais com pouca ou nenhuma padronização, um exemplo é a diversidade de palmeiras nos trópicos latino-americanos, material para construções indígenas e outros usos. Portanto, este trabalho apresenta resultados da "micro-estrutura", "meso- estrutura" e "macro-estrutura" para duas idades de troncos de palma *Bactris gasipaes Kunth* comumente conhecida como "Pupunha". A microscopia óptica digital foi usada para a análise micro-estrutural, e para caracterizar a macroestrutura foi utilizado o processamento digital de imagens encontrando-se a variação da fracção de volume de fibras e o elemento de volume representativo (RVE). Além disso, foi realizada uma análise experimental para determinar as propriedades físicas básicas (umidade e gravidade específica) e as propriedades mecânicas à tensão, flexão e torção, gerando como resultado a força máxima de tração (TS), o módulo de elasticidade de tração (TMO), o módulo de elasticidade de flexão (BMOE) e o módulo de rigidez (MOR).

## Palavras-chave

*Bactris gasipaes Kunth*; Materiais Compósitos Naturais; Tecnologias Não-Convencionais.

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