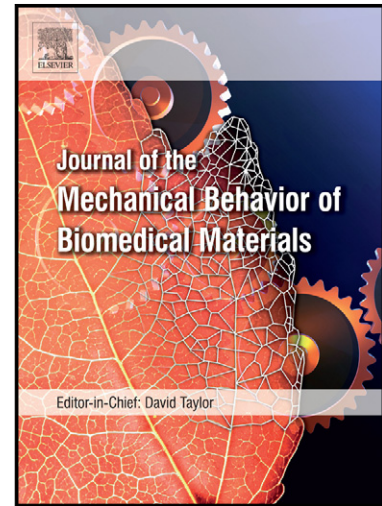


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Ultrasonic assessment of the elastic functional design of component tissues of *Phormium tenax* leaves.

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Abstract

Different tissues in *Phormium tenax* leaves present different morphologies and mechanical properties according to the different roles or functions that they play during the plant life. This is an example of what is known as functional design, a concept which is used in different scientific fields. Four different ultrasonic techniques comprising air-coupling and gel coupling, longitudinal and shear waves, normal and oblique incidence and low (0.2 MHz) and high frequencies (2.25 MHz) have been employed to study these leaves. By changing these experimental conditions it is possible to propagate longitudinal and shear waves in the different tissues present in these leaves (spongy mesophyll, chlorenchyma and sclerenchyma fibres) and in different directions so it is possible to determine their ultrasonic properties (velocity and attenuation) and hence their main elastic moduli. Additional analysis of microscopic images of the tissues permit to study the correlation between this elastic and ultrasonic tissues properties and main microscopic features like cell size and cell wall thickness, which are determined by the different function of these tissues.

1. Introduction

Functional Design is a concept used in engineering and software and refers to a simplified design approach for complex systems. It is based on the assumptions that the system can be divided into several parts, that each of these parts has only one function and that performs it with the minimum side effects on other parts. It is also used in biology where form and

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