COCONUT FIBER AGRICULTURAL SUBSTRATE: A LITERATURE REVIEW

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ABSTRACT

Coconut (Cocos nucifera) is a fruit of high economic value, widely consumed throughout Brazil. Consequently, the consumption of these products results in the generation of waste, which is often inadequately disposed of, contributing to a significant environmental liability. This article proposes a literature review on ways to utilize and properly dispose of these residues generated by the coconut trade. Various alternatives for consumption and disposal of the husks are being developed, including commercial products such as mats and agricultural substrates made from coconut fiber degraded by microorganisms. The aim is to reduce the negative environmental impact generated by the inadequate disposal of coconut by-products, ensuring their proper disposal and utilization.

Keywords: Coconut fiber. Waste management. Sustainability. Agricultural Microbiology.

1 INTRODUCTION

Brazil recorded a considerable annual production of coconuts for commercialization in 2022, totaling an average of 1,829,612 thousand fruits.[1] This significant production quantity generates a proportionally high amount of waste, as about 80% to 85% of the coconut's weight corresponds to fiber, which is usually discarded. Such a scenario can overload the waste collection and disposal system, leading to the accumulation and improper disposal of this by-product.[2] The excessive accumulation of coconut waste poses logistical challenges for waste management, along with environmental concerns.

With the increase in industrial processes and the popularity of coconut water sales in supermarkets, there has been an identification in fruit production, resulting in a significant increase in the amount of waste generated.[3] To mitigate this environmental impact, recycling strategies are being studied, aiming to transform this fiber into sellable products. In addition to reducing the amount of waste sent to landfills, fiber recycling can contribute to the circular economy and promote sustainability in the coconut production chain.[4]

The rich composition of cellulose and lignin in coconut fiber makes it highly suitable for the production of agricultural substrates, especially during the plant's early development stages. Studies show that it can be slightly superior to other substrates available in the market, such as rice husk, sawdust, wood shavings, and rock wool. Its ability to retain water and nutrients, along with its porous structure, promotes an environment for root growth, contributing to plant development.[5]

The use of only crushed, washed, and decomposed coconut fiber for direct planting has also been tested. In this sense, it is necessary to subject the fiber to a composting process, which can take about 90 days to complete. This is because, even when crushed, the fiber still has a complex structure, which can slow down the decomposition process. Whole coconut fibers have an even slower degradation process due to their denser structure, which is less accessible to decomposing agents.[4]

To accelerate this process, the use of decomposing microorganisms, such as enzymes produced by some filamentous fungi, becomes a strategy. These microorganisms help break down the complex components of the fiber, turning them into nutrients available to plants more quickly.[5] Additionally, the addition of fiber to the soil has demonstrated the ability to increase voids and reduce settlement and compressibility. These results have a positive impact, especially for soils intended for agriculture. The presence of fiber promotes better soil structuring, increasing its porosity and allowing greater air and water circulation.[6]

2 MATERIAL & METHODS

This literature review is dedicated to exploring the diversity of applications of coconut fiber, highlighting its potential as a substrate for agricultural crops. In addition to searching through books, the research extended to articles available in important academic databases such as Google Scholar, Coordenação de Aperfeiçoamento de Pessoal de Nível Superior (CAPES), and Scientific Electronic Library Online (Scielo).

By employing a variety of terms related to coconut fiber, such as the use of microorganisms, plant substrates, and degradation and decomposition processes, the aim was to cover all relevant aspects for the study. The temporal breadth in the selection of

works, from older studies to the most recent ones, reflects the objective of gathering a significant range of information that can contribute to effective approaches in the treatment and management of waste from the coconut market. This methodology can be better understood in the scheme presented in Figure 1.

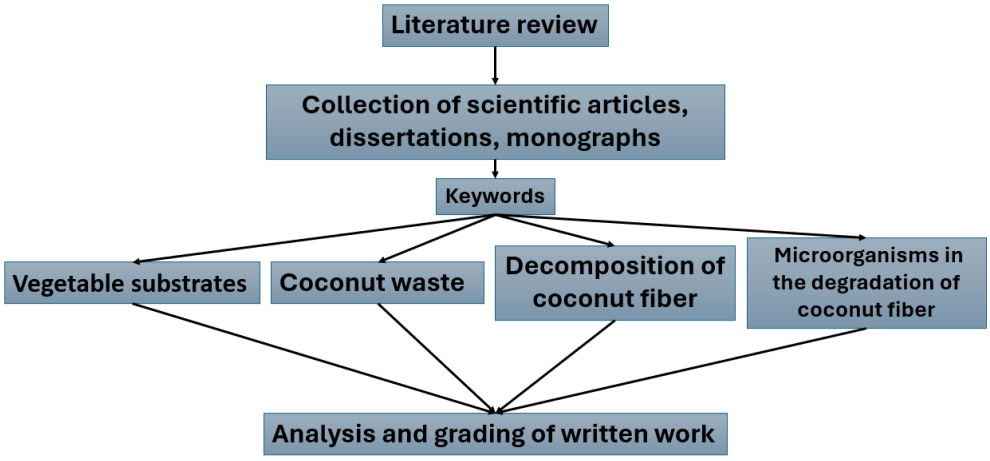

Figure 1 methodology applied in the development of the literature review.

3 RESULTS & DISCUSSION

A Crushed coconut fiber, on its own, is not suitable for use in planting due to the presence of potentially toxic levels of tannins, potassium chloride, and sodium chloride. Therefore, it is essential to wash it under running water to remove these substances. However, even after washing, coconut fiber still requires a decomposition process that can take up to 90 days to become fully suitable for planting. During this period, the action of decomposing agents is essential to break down lignin and transform the fiber into a safe substrate for plants.[4]

The temperature range for the decomposition of coconut fiber, without inoculation or additional treatments, varies approximately from 323.15 to 333.15 Kelvin degrees. Temperatures above this range can result in fiber damage, such as burning. On the other hand, at ambient temperatures, the decomposition process can be considerably slower. Therefore, for the industrial-scale production of compounds derived from the decomposition of coconut fiber, specialized machinery may be required.[7]

The use of enzyme-producing fungi capable of degrading lignin has emerged as a promising approach. Lignin is one of the main components of coconut fiber, responsible for its strength and durability. However, its complex and resistant structure makes the decomposition of coconut fiber a naturally slow process.[8]

Fungi, on the other hand, have the ability to secrete lignolytic enzymes, which can break down lignin bonds, facilitating its degradation. These enzymes efficiently act on the decomposition of coconut fiber, accelerating the process of transforming waste into simpler organic compounds.[5] This makes this approach a versatile and effective alternative for the treatment and recycling of coconut fiber waste, contributing to the reduction of environmental impact and the promotion of sustainability in the production chain.

In studies exploring the use of chemicals to accelerate the degradation of coconut fiber, a slight increase in the speed of the decomposition process was observed. However, it is important to note that the use of these chemicals may not be the most ecological strategy in the production of agricultural substrates.[9] In addition to the production of agricultural substrates, coconut fiber has shown promise in other areas, such as civil construction. One of the alternatives is its use to enhance the tensile strength of more fragile materials. Studies demonstrate that the addition of coconut fiber can reduce compressibility and increase the structural stability of construction materials, contributing to the development of more sustainable and efficient alternatives in civil engineering.[10]

4 CONCLUSION

A Proper management of waste generated by coconut production and consumption is essential to mitigate the negative environmental impacts associated with this process. The literature review highlighted several promising strategies for utilizing and properly disposing of coconut by-products, contributing to the sustainability of the production chain.

Recycling coconut fiber for the production of sellable products and agricultural substrates is a viable alternative that not only reduces the amount of waste sent to landfills but also promotes circular economy. Furthermore, the use of decomposing microorganisms, such as fungi, has proven to be an effective approach to accelerate the decomposition of coconut fiber, turning it into organic compounds beneficial for plants.

While the use of chemicals may also speed up the decomposition process, it is important to consider the potential risks to plants and the environment. Therefore, strategies based on decomposing microorganisms may be safer and more sustainable in the long run.

In summary, investing in waste management practices that valorize coconut by-products and promote environmental sustainability is crucial to ensure the responsible use of this natural resource.

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