Analysis of the Sustainable Use of Fibrous Hemp Stems and Blends With Binders For the Food Industry

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Relevance and Scientific Problem

Sticks for edible ice cream and disposable stirrers for hot drinks are usually made from various types of wood, such as birch, beech, linden, or other tree species. Growing trees take many years and they play an important role in increasing oxygen and reducing CO_2 in the environment. Therefore, it would be reasonable to consider using alternative annual plants, such as fibrous hemp, for the production of such food-contact products.

However, there is currently a lack of knowledge on how to develop mixtures based on fibrous hemp biomass and binding agents that are suitable for use in food-contact products intended for the food industry.

Using Fiber Hemp for Alternative Uses

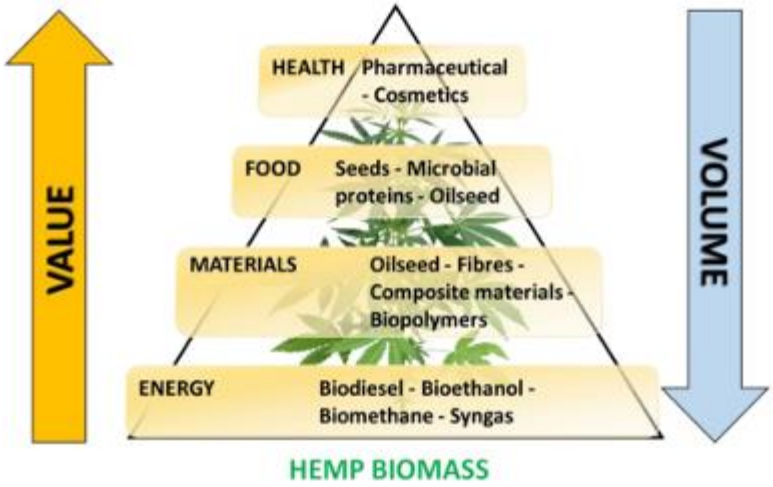

Figure 1. Multifunctional purpose of hemp biomass components

Figure 1 illustrates the potential uses of hemp biomass, ranked by added value and volume. The lowest value but highest volume application is for energy, while the highest value is in health and cosmetics. Intermediate levels include materials and food uses.

Materials Used for the Production of Ice Cream Sticks

Wood. Wood is one of the most traditional and widely used materials for ice cream sticks.

Bamboo. This is a fast-growing and sustainable resource, known for its strength and durability.

Plastic. Plastic ice cream sticks are less common due to environmental concerns, but they are still used in some cases.

Cardboard. In some instances, paper or cardboard is used for ice cream sticks. These materials can be coated or treated to resist moisture, though they may not be as durable as wood.

Recycled materials. To promote sustainability, there is growing interest in using recycled materials for ice cream sticks. Recycled wood, bamboo, or other biodegradable materials can be used to reduce the environmental impact of production (Jittra Rukijkanpanich et al., 2022).

Materials Used for Beverage Stirrers

!!Chemical migration into beverages. Wooden stirrers do not impart any off-flavors in hot drinks. Plastic stirrers may release harmful chemicals such as styrene or benzene. These substances can alter the taste of the beverage and pose risks to human health. The World Health Organization (WHO) has classified styrene as a possible human carcinogen. Studies have shown that the level of styrene migration depends on temperature — higher temperatures result in greater release (Wang J., et al., 2023; Coles R., Kirwan M., 2011).

	Time (min)		
Temperature (°C)	10	30	60
20	0.0	0.48 ± 0.02	1.02 ± 0.03
60	3.24 ± 0.05	3.22 ± 0.09	3.88 ± 0.06
100	6.04 ± 0.07	6.25 ± 0.02	6.85 ± 0.04

Figure 2. Contents of migration of styrene monomer from HIPS cups (µg/l) into hot tea in different temperatures and time periods.

New Materials Used for Ice cream sticks and Beverage Stirrers

Ice cream sticks and hot beverage stirrers could be developed using hemp fiber combined with food-contact-safe binding agents.

One of the typical natural polymers is **starch**, which is used as a binder due to its ability to harden and reinforce structures (Pilla, S., 2011).

In the production of sticks from hemp fiber, other potential binders include **soy flour**, **millet flour**, and **sunflower oil**.

Soy flour is frequently used as a binder in biocomposites because of its high protein content, which contributes to structural strength when bonding with cellulose fibers (Carter C. L., Gadhia P.S, 2008; Papadopoulou E., Moutousidis D., Kountouras S., et al., 2024).
Millet flour can also be used as a binding component, but to improve the mechanical properties of the composite, it is advisable to use **vegetable oil** (e.g., **sunflower oil**), which has good adhesive and cohesive properties, helps shape the material, and increases its moisture resistance (Norris, M. R., Laks, P., 2010; Mohanty, A. K., Misra, M., 2002).

Research objective

To generate new knowledge necessary for the production of high-quality ice cream sticks and hot beverage stirrers using preforms made from hemp biomass and binding agents.

Research tasks:

1) prepare different compositions from fibrous hemp and binding materials that would meet the requirements for food contact products
2) investigate the physical and mechanical properties of the created preforms.
3) analyze the environmental assessment of new product formulations.


THANK YOU FOR YOUR ATTENTION

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