Journal of Physical Science Research and Review Volume-1, Issue:1- September 2025

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Journal of Physical Science Research and Review

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INFLUENCING THE PHYSIO CHEMICAL PROPERTIES OF CASSAVA STARCH FILMS VIA OCIMUM SANCTUM LEAF EXTRACT

ASHA R[1], Dr. M. MEENA[2]

[1]Student, Department of Physics, S.T. Hindu College, Nagercoil.

[2]Associate Professor, Department of Physics, S.T. Hindu College, Nagercoil.

ARTICLE INFO

Received : 15.03.2025
Revised : 22.05.2025
Accepted : 13.08.2025
Published : 15.09.2025

Corresponding author:
ASHA R
asha13052003@gmail.com

Keywords:
Thin film
X-Ray Diffraction
FTIR
Antimicrobial and Antioxidant

ABSTRACT

Cassava starch films have gained significant attention in the field of biodegradable packaging materials due to their eco-friendly nature and potential to reduce plastic waste. These films are derived from cassava, a starchy root crop abundant in tropical regions. Cassava starch films exhibit desirable properties such as transparency, flexibility, and good barrier characteristics against oxygen and carbon dioxide. However, they often require modification to improve their mechanical strength and water resistance. The development of cassava starch films represents a promising avenue for sustainable packaging solutions, particularly in food and agricultural industries. Keeping this in view, we made an attempt to modify cassava starch film properties by adding ocimum sanctum leaf extract (Tulasi leaf extract), which is rich antioxidant in nature. The findings of this study suggest that the incorporation of tulasi leaf extract into cassava starch films has the potential to enhance their properties, making them suitable for various applications such as food packaging, agriculture, and biomedical applications.

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I.Introduction

Despite their renewable resources, biodegradability, and biocompatibility, biopolymer films are becoming more and more popular as a sustainable substitute for conventional plastics in a variety of applications, including food packaging and biomedical machines. Starch is the most important widely spread polysaccharide used for the synthesis of biopolymer film. Starch based films are flexible and strong, but free hydroxyl groups in starch structure make the film hydrophilic. Starch can be obtained from various resources, including cassava, wheat, potato, rice etc. Starch is widely used for food packaging materials due to its ability to produce films as well as its biodegradability and renewability. Cassava starch, extracted from the endosperm of cassava grains, has gained attention as a raw material for the production of biodegradable polymers. It is composed primarily of amylose and amylopectin, two polysaccharides that can be processed into films, coatings,

Active films based on biopolymers are promising materials for active packaging design. In addition to the functional properties promoted by the incorporation of active compounds, such as antimicrobial and antioxidant compounds, these film types are an alternative to synthetic packaging materials, as they produced from biodegradable, renewable, and environmentally friendly materials. Regarding functionality, a wide range of active compounds have been added to the bio polymeric matrix of the active films [1, 2], such as extracts from herbs and spices [3, 4] or from agricultural by-products [5, 6], essential oils (EO) [6, 7], and lipophilic compounds [8–9]. Antimicrobial and antioxidant agents are the most studied active components since the growth of pathogenic and/or spoilage microorganisms and the oxidative degradation are the main cause of food spoilage [2].

In our present study, Cassava starch films are casted via cost effective solution casting method, and we investigated the effect of ocimum sanctum leaf extract (Tulasi leaf extract), a rich antioxidant herb on the properties of cassava starch film.

II.Material and Methods

a) Preparation of Cassava Starch:

Cassava from local market was purchased and washed with water to remove soils and other debris. The central pith of the cassava root were cleaned properly and then cut into thin slices, then these slices were dried under sunlight for about a week. The highly dried slices were grinded well into starch flour. The grinded flour was sieved several times to remove any by-products. Thus collected starch powder was used for film casting.

b) Preparation of Tulasi leaf extract:

Fresh tulasi (Ocimum sanctum) leaves. Were collected from our locality and thoroughly wash the leaves to remove any dust or debris. Fresh cleaned leaves were crushed in mortar and then filtered through filter paper to collect the leave extract without any leave pieces. Collected Leaves and freshly prepared leave extract

c) Casting of pure and Tulasi added Cassava Starch Films

5g of as prepared starch powder was dissolved in 10 ml of distilled water under 50oC with constant stirring. Then it was mixed with glycerol under constant stirring .The transparent solution obtained was then cooled and poured into the petri dish to caste thin films by drying in room temperature .Similar procedure was followed for tulasi added cassava films. Before adding glycerol, 3ml of prepared tulasi extract was mixed with the solution. The casted films of pure and tulasi doped Cassava films were shown in Figure 1.

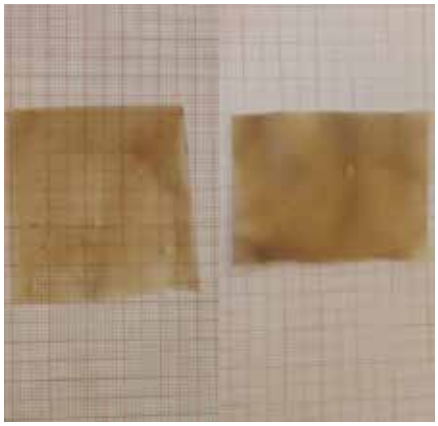


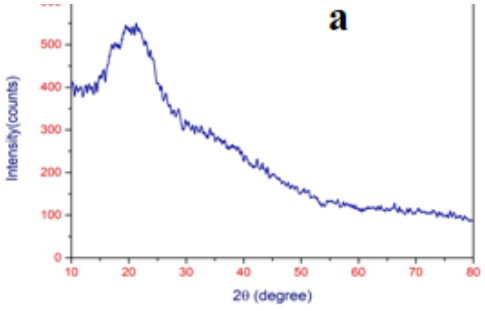
Figure 1: Photograph of casted films a) pure b) Tulasi added cassava film

d) Characterizations Made

The casted films were tested for its structural and functional properties using X-Ray diffraction (XRD), and Fourier transform Infrared spectroscopy (FTIR) analysis. Also casted films were investigated for its biodegradability and food packaging applications.

III.Results and Discussions

The XRD pattern obtained for pure and doped films are shown in Figure 2. (a and b). According to its main constituents, amylose and amylopectin, starch is a semi crystalline substance that possesses both crystalline and amorphous phases. Cassava starch showed diffraction at angles of (2θ) 15.2°, 20.1°, 23.1°, and a doublet at 17.2° and 18.1°. According to its main constituents, amylose and amylopectin, starch is a semi crystalline substance that possesses both crystalline and amorphous phases. Cassava starch showed diffraction at angles of (2θ) 15.2°, 20.1°, 23.1°, and a doublet at 17.2° and 18.1°



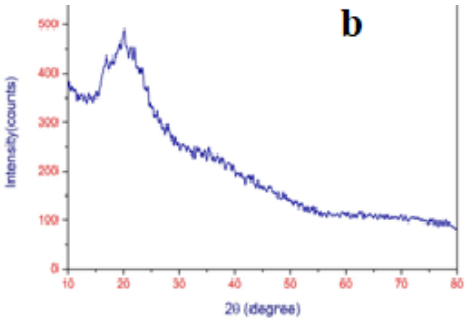


Figure 2: XRD pattern of pure and Tulsi added Cassava Film

FTIR spectra of casted films are shown in Figure 3. The newly induced peaks in FTIR confirms the addition of Tulasi in cassava matrix. While adding tulasi extract may produce change in hydrogen bonding, thus produce the shift as well as intensity of O-H bonding. In addition the photo chemicals present in tulasi may increase the intensity of C-H bonds

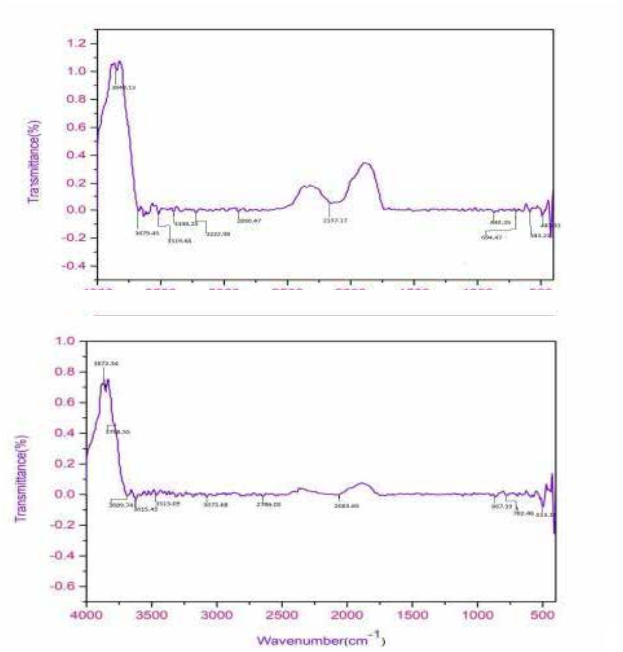


Figure 3: FTIR spectra of pure and Tulsi added Cassava Film

Measuring weight loss on buried samples were done on the interval of 6 days. Weight loss of 67.3 % and 34.6 % was detected for pure and tulasi added films after 6 days. After 12 days the weight loss of tulasi film was slightly increased and reached 44.63% whereas the pure film showed 10% weight loss. A weight loss of 99.35% was observed during the biodegradation of tulasi added cassava starch

based film after 24 days (figure 4). Thus tulasi addition increases the life span of cassava starch film which is a required parameter for food packaging applications.

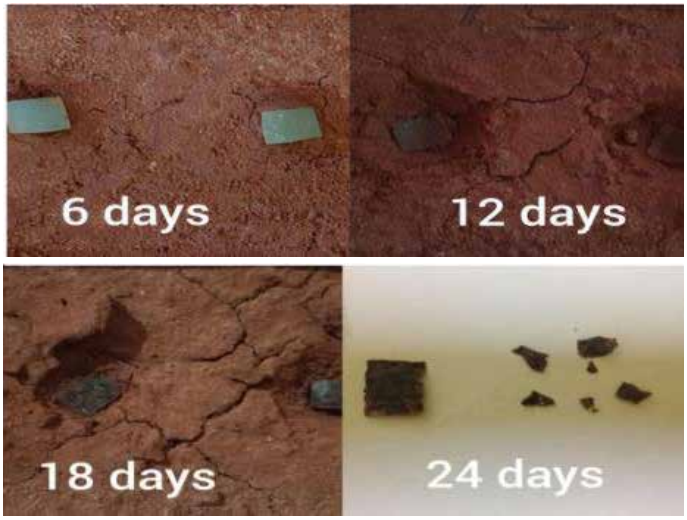
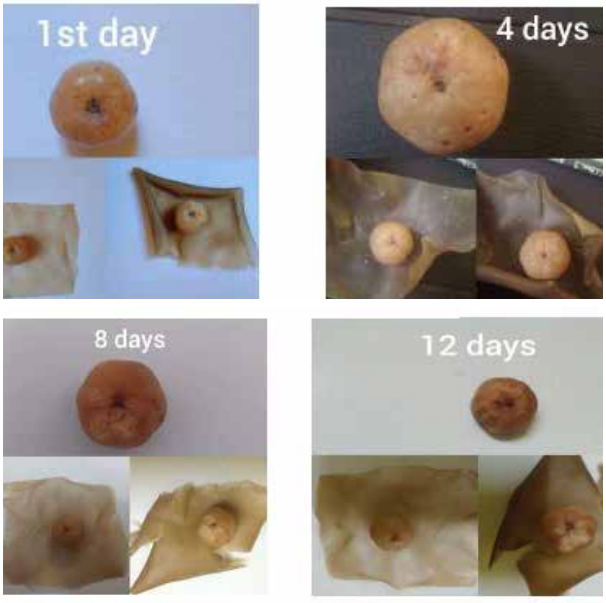


Figure 4: Photograph of casted films under soil burial test in different intervals

In order to find the application of proposed films, they were used in food packaging. We choosed Gooseberry as our test specimen. A freshly picked 2 gooseberry was covered separately with bare cassava film and tulasi doped cassava films. Then kept for observations or about 20 days. On the interval of 3 days the samples were taken out from the films and tested for its appearance and freshness. The photograph of the samples were displayed in Figure 4.5. The Gooseberry covered with tulasi doped film showed freshness even after 20 days. There will be no fungal or microbial presence in the appearance. Whereas the gooseberry covered with bare cassava film was fresh until 12 days thereafter it start rotten. Thus addition of tulsi enhance the antimicrobial activity of cassava starch films. (Figure 5)

Figure 5: Freshness Test on Gooseberry



IV.Conclusion

Cassava Starch, a bio polymer film and Tulasi added cassava starch films were casted using Solution casting technique. XRD results revealed that, cassava film was semi crystalline in nature, whereas Tulasi addition improves its crystalline nature. Also the functional groups of proposed films were confirmed through FTIR analysis. Addition of tulsi induce the shift in O-H bond and increase the intensity of C-H bonding. This changes in functional frequencies gives the evidence for addition of tulasi in starch matrix. Soil burial test evident that, tulasi addition improves the life span of cassava films with improved weight loss. Also freshness test confirms the antimicrobial active nature of tulasi modified cassava starch films. Thus the modified cassava film is the most suitable one for food packaging or for edible coating over vegetables or fruits to replace plastic films.

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