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Pineapple: Sustainable Substitute to Plastic Food Packaging

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Abstract

Water resistance is a significant feature of fibrous packing paper for food, as are strength attributes. Several bio-coating solutions were put as coatings on pineapple leaf pulp paper to improve these qualities. In order to make biodegradable paper plates, the effects of beeswax, chitosan, shellac, and alginate/gellan gum, and beeswax–chitosan (1 percent chitosan+4 percent glycerol+30 percent beeswax) solutions on pineapple leaf pulp paper were investigated. On making the paper samples, the cooking duration (120–180 minutes) of chemical pulping and the dose of pulp by moist weight (200, 250, and 300 g) to a paper frame (40 x 40 cm2) were also investigated. Physical and mechanical qualities of the papers were examined. The best cooking duration and pulp dose by moist weight were found to be 180 minutes and 300 grammes per frame, respectively. The bio-coatings raised the average grammage and thickness of the paper, but decreased the density when compared to untreated paper. The longest absorbency time was achieved by coating paper with a beeswax–chitosan solution, which was followed by alginate/gellan gum, chitosan, beeswax, and shellac in that order. The paper coated with beeswax–chitosan solution before hot pressing had the highest tensile strength of 5.9 kN/m. When comparing the degradable duration of papers bio-coated before and after heat pressing, no difference was discovered with NaAlg/gellan coating, while a difference was detected with beeswax-chitosan coating. The results indicate that the beeswax–chitosan solution is the best option for coating paper to manufacture biodegradable plates out of the alternatives evaluated.

Keyword- biodegradable, water resistance

Introduction

Now a days, plastic food packaging is considered a source of environmental problem wastes, because it takes a very long time to decompose. Because of their quick decomposition durations and renewable nature, bio-materials have gotten a lot of interest as a solution to this

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problem. Cellulosic fibres are preferred over plastics in food packaging from this standpoint. India is the world's sixth largest pineapple producer and exporter.

After the harvest, a substantial amount of residual waste in the form of pineapple leaves with high cellulose fibre content remains. This garbage has the potential to be used as a raw material for producing environmentally friendly food packaging. The fibres are pulped first before being formed into paper, which is subsequently transformed to packaging. Cellulosic fibres, on the other hand, have a low water resistance, which makes them unsuitable for packaging. This aspect could be improved with the use of a suitable bio-coating. To improve water resistance, a variety of different bio-coating solutions were evaluated as coatings on fibrous paper. Some foods and fruits are packaged with emulsion-based edible films, which are waterproof and can extend the shelf life of the products. Paper cups could be waterproofed with sodium alginate and gellan gum coating. Because it is a natural commercial wax with high hydrophobicity and great moisture resistance, beeswax has been widely employed as a food grade addition in cosmetics, medicines, and foods. When the concentration of chitosan in solution was increased from 1.0 to 3.0 wt percent, the water vapour transfer rate fell from 171.6 to 52.8 g/m2/d, but the beeswax coating weight was similarly lowered (from 10.1 to 4.9 g/m2). When the shellac concentration was increased over 50% wt%, double coating with shellac/starch resulted in better water vapour barrier qualities. This research focuses on the effects of different bio-coating solutions such as beeswax, chitosan, shellac, alginate/gellan gum, and beeswax–chitosan (1 percent Before evaluating the coatings, the cooking periods (120–180 minutes) and pulp weights (200, 250, and 300 g) per paper frame (40 40 cm2) were tested. The effects of coating pineapple leaf pulp base paper on physical and mechanical qualities, as well as biodegradation, were researched in order to find the optimal coating for biodegradable plate production.chitosan+4 percent glycerol+30 percent beeswax) on the paper produced from pineapple leaves.

Pineapple leaves are washed and dried at room temperature to eliminate dirt and soil particles. The leaves are cut into little pieces of roughly 5 cm in length. Chemical pulping (soda pulping) is applied to chopped pineapple leaves in a 1 to 4 ratio of pineapple leaves (kg wet weight) to 10% sodium hydroxide solution. The pineapple leaves are cooked for 120, 150, or 180 minutes to determine the best period for the leaves to decompose into pulp. The pulp is then carefully rinsed under running water to eliminate any remaining chemicals. The

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pulp was then squeezed to remove water before being weighted into 200, 250, and 300 g dosages for paper production. Each pulp is pureed in a blender for 5 minutes with a 50 g/L starch solution. To manufacture a paper sheet, the mixed components are placed on a mesh frame of 40 x 40 cm.

The paper sheets are dried in a hot air oven at 65°C for 6 hours. The paper sheet is trimmed to a size of 20 x 20 cm to be used in a compression moulding machine with a temperature of 200°C and a pressure of 200 kg/cm2 for 10 minutes to test packaging forming; this stage is known as "hot pressing."

Beeswax, chitosan, shellac, alginate/gellan gum solution, and beeswax–chitosan emulsion are among the bio-coating solutions used to coat paper.

All coating solutions are applied to the paper samples using a wire rod coater at a constant forward speed to achieve a wet film thickness of 250m. Following that, the samples are dried for 24 hours in a 65°C oven. When using sodium alginate/gellan solution, the coated paper is sprayed with a 5% (w/v) calcium chloride (CaCl2) solution before being dried in the oven.Before compression, the pineapple leaf pulp paper is coated with a solution of 1% chitosan+4% glycerol+30% beeswax to make biodegradable plates. 750.01 g/m2, 1.24mm, 670.55 kg/m3 were the plate grammage, thickness, and density.

For 60 days, the biodegradation of 25 mm samples of each form of paper created from pineapple leaf pulp was studied. The average weight loss of paper after being buried in the soil for 15 days was used to characterise the deterioration. The uncoated paper dissolved the fastest, taking only 30 days to decompose completely. This could be due to the lack of a crosslinking agent or a film covering when pineapple leaf pulp was made into paper.When papers bio-coated before and after hot pressing were examined, there was no difference in degradation time for paper coated with NaAlg/gellan solution, but there was a difference for beeswax-chitosan coated instances. Paper coated with beeswax-chitosan after hot pressing degraded faster than paper coated before hot pressing. This is because the bio-coating solution only covered the paper surface after compression, whereas when coated before hot pressing, the solution was heated and crushed into the bulk paper, inducing cross linking and providing resistance to microbial digestion and degradation.

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