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Studies on Mechanical Properties and Biodegradation of Edible Food Wrapper from Banana Peel

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ABSTRACT: Edible Packaging are the most useful alternative for Secondary product packaging, reduces waste, easy disposal and to create novel applications for stability, quality, safety, variety, healthy and convenience of customers. Banana Peels are more nutritional rich than the flesh. The initial sections of this report begin with the history of plastics food packaging and edible wrappers followed by the whole banana powder producing process includes the steps, to obtain whole banana peel powder. The Powder is further processed to film formation. It will be used for edible packaging application Tea pack, Biscuit pack etc.

Keywords: Food wrapper; Banana; Mechanical; Biodegradation.

INTRODUCTION: Films fabricated from mixtures of pectin and starch[1] is the first edible film from fruits. It was produced from apple puree and different amounts of fatty acid, alcohol, bee wax and vegetable oil. It acted as an appropriate barrier against oxygen loss especially in relatively low or medium humidity.[2] Also it could reduce browning reaction, loss of moisture and maintained the flavor of sliced apple. It can be used for coating of walnut, almond and bakery products. The Prince of Songkla University, Thailand, in his paper[3] we will discusses the effects of the common types of plasticizers used and their effects on various properties like tensile strength, elongation at break and water vapour permeability of the Edible film.

The applications of Edible films, especially in the packaging industry by edible coating for light fruits and vegetables where biobased polymers used as a component in (food) packaging materials is considered, different strategies for improving barrier properties of biobased packaging and permeability values and mechanical properties of multi-layered biobased plastics are also discussed.[4] The pectin could provide a soft and shiny coat. It is also found that Pectin restricted loss of nutrient from fruits and vegetables and also pectin coating saves the volatile materials during storage and transport.[5] This study was performed for elderly consumers over 60 years and for grocery products.[6] The study was undertaken to find out the consumer preference for various packaging materials. The results of the study revealed that plastic was most preferred packaging material followed by glass packaging and then paper packaging. The metal packaging including tin, can, aluminum and foil packaging were less preferable. Angular shapes induces the feelings of energy, strength and toughness and are associated with masculinity whereas round shapes often induce feelings of friendliness, approachability and peace and harmony.[7] Proteins as Raw Materials for Films and Coatings along with the Definitions, Current Status, and Opportunities of Protein-Based Films and Coatings in NewYork.[8] Edible Coatings and Films in order to Improve the Food Quality and shell life of the packaged product in USA.[9] A massive study on Edible films which are made from gelatin and soluble starch and polyols. The edible films for Gelatin and starch made a big impact on the Pharmaceutical Industry, thus they are used for packing drugs and medicines until these days.[10] New technologies followed and proposed in food packaging fields with an Overview of Innovations method in food packaging.[11] Nutrient compositions of banana skins inspired by the presence of thick white fiber present between the banana skin and flesh.[12] Protein-based edible films and the characteristics and improvement of the film properties, in Structure and Function of Food Engineering.[13] Edible films from Milk Protein named Casein and further discussed the Tensile strength, thickness, oxygen permeability and other properties of characteristics of the film formed from Protein.[14] Influence of plasticizers on the properties of edible film from Mung bean protein[15] as the edible film formed from using Mung bean protein and then analyzing the property change of the

film due to addition of the plasticizers to the film. The Factors affecting the properties of edible film prepared from mung bean proteins[16] Influence of Plasticizers on the prosperities of edible film from Mung Bean Protein. He proposed the study on the results of the Edible film formed from Mung bean protein and analyzed the property affecting the edible film. Oxygen permeability and mechanical properties of banana films formed from Banana flesh.[17] The Study shows the Methods on preparation of Edible films from Banana and further discussed about the Oxygen permeability, thickness, sealability and the mechanical properties of the film formed with clear analysis and results.[18] Permeability properties edible films formed from fruit puree. In this study it is deeply and clearly discussed about the properties of the films like tensile strength, sealability, oxygen permeability, thickness of the film, degradability and other more properties, under the Journal of Food Science.[19] In United States and Japan Cooperative Program on Natural Resources, Tensile properties of fruit and vegetable edible films are discussed about the tensile strength and other tensile properties of the edible film formed from fruits and vegetables.[20] Apple wraps which is a novel method to improve the quality and extending the shelf-life of fresh-cut apples under Journal of Food Science.[21] The study shows the clear research on using or applying apple wraps on the fresh cut fruits. This study also shows the results on application of the wraps on the fresh cut fruits and about the extended shelf-life and quality of the fruits after the apple wraps on them.[22]

In this report, a brief economic study of edible food wrappers from Banana Peel with its applications has been performed.

MATERIALS AND METHODS: The material was purchased from Merck product, the material was used for this research work, Banana Peel, Glycerol and Distilled water.

Experimental: A 50g was taken the amount of banana paste while adding 13ml of aqueous banana solution and banana peel powder with 3ml of glycerol, film has formed and it was thick enough. The film did not decay. While adding 3ml glycerol in aqueous solution from banana peels powder with the good thickness. Film has formed, and it was much thinner than it has acquired a brown color and a sharp scent after 2 days it dried up when let to sunlight.

Tensile properties: The film was subject to tensile test as per ASTM D 882 using universal testing machine (UTM), LLOYD instrument ltd. UK. A cross head speed of 500 mm/min and gauge length of 50 mm was maintained for film making process.

Titration method of CO_2 determination (ASTM D 5338): The details of the biodegradation experiment are summarized below:

Sample detail: Banana peel film.

Conditions of reaction mixtures:

Origin of compost	: Municipal and vege table waste
Reaction Temperature	: 58^o C
Dry Solid (%)	: 52%
Air flow rate	: 100 ml/min
Test duration (day)	: 90 days
pH	: 7.4
Reference material	: Cellulose
Volume of reaction vessel	: 3000 ml

The preparation and ageing of the compost for biodegradation of film samples was carried out as per the standard. The PH value for all the samples, control and blank was maintained. Barium Hydroxide solution (0.024 N) was prepared by dissolving 4.0 g of anhydrous barium hydroxide in 1000ml of distilled water. The solution was filtered and the normality was determined by titrating against standard acid solution and stored in a sealed container as a clear solution to prevent absorption of CO_2 from air. About 5-20 L of 0.024 N barium hydroxide solutions was prepared at a time for running a series of tests. However, care was taken that a film of $BaCO_3$ does not form on the surface of the solution in the glass vessels, which would inhibit CO_2 diffusion into the absorbing medium.

Procedure: The composting vessels were incubated in diffuse light minimum for a period of 90 days & the temperature of the system was maintained at 58±2°C. The CO_2 & O_2 concentrations were checked in the outgoing air daily with a minimum time interval of 6 hrs after the first week. The air flow was adjusted to maintain a CO_2 concentration of at least 2% volume to allow accurate determination of CO_2 level in the exhaust air. Composting vessels were shaken weekly to prevent extensive channeling which could provide uniform attack of microbes on test specimen and provide an even distribution of moisture. The incubation time was fixed for 90 days.

Carbon dioxide analysis: The carbon dioxide (CO_2) produced in each vessel reacted with $Ba(OH)_2$ and was precipitated as barium carbonate ($BaCO_3$). The amount of carbon dioxide produced was determined by titrating the remaining barium hydroxide with 0.05 N hydrochloric acid to a phenolphthalein end point. Because of the static incubation, the barium carbonate built up on the surface of the liquid was broken up periodically by shaking the vessel gently to ensure continued absorption of the evolved carbon dioxide.

The hydroxide traps were removed and titrated before their capacity exceed. At the time of removal of the traps, the vessel was weighed to monitor moisture loss from the soil and allowed to sit open so that the air was refreshed before replacing fresh barium hydroxide and releasing the vessel. The carbon dioxide evolution rate reaches a plateau when all of the accessible carbon is oxidized. The test was terminated at this point. At the conclusion of the test, the pH and moisture and ash content of the soil is measured and recorded.

RESULTS AND DISCUSSION:

Tensile Properties: The tensile strength of Banana film is 11.15 N/mm^2, the increase of tensile strength is even for polyethylene due to the fiber material of banana peel with presence of inorganic nutrient. The inorganic nutrient improves the mechanical properties

Biodegradation Test (ASTMD 5338): Banana Peel film was subjected to the biotic exposure of the film as per ASTMD 5338 under controlled composting conditions. The percentage of biodegradation of banana film is fully biodegradation in 45 days. These films are easily accessible and consumable for composting part.

CONCLUSION: The results showed that the banana peels-based edible films are able to achieve the main grand challenge of increasing the industry's efficiency; also it supports the general economy in many other products that plastic wrapping plays a factor in the process of their manufacturing. These results suggest that banana film could be suitable as edible packaging for dried foods, instant water-soluble ingredients or applied as a wrap or coating on food products to provide nutrition and convenient use for consumers reducing food packaging waste.

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