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GREEN TEA BASED EDIBLE BIO PACKAGING FILM : DEVELOPMENT OF EDIBLE PACKAGING FILM AND ITS EVALUATION

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ABSTRACT

In today's world edible films have gained a lot of importance as they are the solution to the environmental problems. Persistent polymers generate environmental pollution which harms the Mother Earth as they are dispersed in nature.

The food industry has at its disposal a wide range of biodegradable protein and polysaccharide based edible films that can serve as packaging material.The common polymers used in film formulation are protein(gelatin ,casein, wheat gluten), polysaccharide (starch ,chitosan) and lipids (waxes ,paraffin).

Using wheat gluten as the prime ingredient can be an advantage as gluten gives strength, elasticity to the films along with improved water vapour barrier and mechanical properties.

In the present study ,a biopolymer based edible film with gluten and green tea as an antioxidant was developed and evaluated.

Green tea is a source of polyphenolic compounds like gallates ,epicatechins and flavanols which have antioxidant ,anti inflammatory and anti radiation biochemical effects.

Film with Green tea had improved solubility in water and lower surface hydrophobicity as compared to film of gluten which showed better surface hydrophobicity.

Edible films play an important role in packaging . Increasing health and environmental awareness and food safety concerns are driving growth in edible packaging market.Future research can be done to improve film properties by enzymatic and chemical protein treatment.

Key words :Edible film,biodegradable,wheat gluten ,green tea

INTRODUCTION

Edible film can be defined as thin, unbroken sheets made up of edible substances [1][2].They are good alternatives to plastic or biodegradable plastic in various industries .Edible films are applied on food products in so that a barrier is formed against water vapor ,gases and solutes transmission, providing mechanical resistance .[3]] They prevent oxygen absorption ,offer physical protection and eliminate plastics from being used in wrapping material .To make it more user friendly ,antioxidant and flavors can be added to the preparation of edible film.[4]Edible films are prepared by using edible compounds derived from diverse renewable sources. Polysaccharides , protein, or lipid materials are used in different forms (simple or composite material ,single layer or multilayer films)to prepare edible films .Due to their low affinity with water ,lipids are considered as the most effective moisture barrier .But due to their non- polymeric characteristic ,they are opaque and present poor mechanical properties [5]

Wheat Gluten

When wheat flour is washed with water to remove non-starchy polysaccharides, starch and water-soluble constituents, a rubbery mass is left which is called gluten. Gluten consists of 80–85% protein and 5% lipids; most of the remainder is non- starch carbohydrates and starch [6][7] .Gluten is cohesive and elastic which gives integrity to wheat dough and helps in the formation of the film. Wheat gluten contains a low proportion of charged amino acids (histidine, lysine , arginine) and a huge proportion of non-polar amino acids which due to hydrophobic interactions combine easily [8].

Cellulose

The most abundant biomass resource on earth is cellulose. Cellulose is the insoluble material found in plant cell walls of vegetables and fruits .It is present in the leaves trunks and barks of bigger plants as a structural component .Cellulose derivatives are polysaccharides having linear chains of β (1–4) glucosidic units with methyl, carboxyl or hydroxypropyl functional groups. It is insoluble in water due to its crystalline structure and polymer chains.[9]

LIPID FILMS:

Lipids are generally combined with other materials like proteins or polysaccharides in order to improve water vapor permeability[10].The ability of lipids to form films depend on the features of lipid component like its physical state ,degree of saturation or chain length of fatty acids.[11][12]Triglycerides are the esters of fatty acids with an addition glycerol,having increased polarity , insoluble in water but will spread at the surface to form a stable mono-layer. The hydrophobicity depends on their structure. Above a certain concentration, they form aggregates which is similar to micelles. [13]

ANTIOXIDANT USED IN EDIBLE FILMS :

Adding antioxidants to packaging material has become important because oxidation affects the safety properties and food quality . Antioxidants consists of substances that can protect materials against oxidation irrespective of the action mechanism [14]. Antioxidants can be classified as natural or synthetic. Synthetic antioxidants that are regarded safe for use in foods includes propyl gallate (PG) butylated hydroxyanisole (BHA), butylated hydroxytoluene (BHT), octyl gallate, ascorbylpalmitate, and tertiary butyl hydroquinone (TBHQ) [15].

METHODOLOGY

A film forming solution was prepared using wheat gluten,cellulose,glycerine and glycerol,ethanol,distilled water along with sorbic acid ,pH was adjusted using 6N sodium hydroxide to adjust pH at 11.

Green tea was added at a concentration of 4ml to the antioxidant film.

All components of both the films were mixed on magnetic stirrer. When sodium hydroxide was used to adjust the pH the solution was heated in a water bath and stirred until its temperature reached 70^0 .Finally the film forming solution was poured and spread evenly onto a glass petri dish and dried at ambient temperature for 20 h (modified method from Gontard et al.1993)

PHYSICAL ASSESSMENT:

- **Solubility in water**

  Solubility test was done using film samples of 3X2 cm in size .samples were dried at 105^o C for 24 hours and weighed(W_1).Each sample was then inserted into a 50ml centrifuge tube containing 10ml of distilled water.Samples were stored for 24 hours at room temperature and stirred slowly on a periodic basis using a shaker.The solution was filtered,and the residues remained on the filter paper were dried in an oven at 105^0 C for 24 hours

- **Film swelling**

Film swelling in the presence of water was measured as a function of time over a 24hour period .5g of each film sample was taken and its initial mass was recorded.Each film sample was immersed in a separate petri dish containing 30ml of water.After 24 hours ,two film samples were removed from water,air dried for one minute and weighed.

- **Contact angle**

Sessile (static)drop measurements of contact angle for water in air on the film surface were obtained with a Kibron tensiometer .The tangent method-1 was selected to determine the contact angle in the accompanying software DSA1 version 1.9.Film sample was cut from each prepared film and affixed,top side up,to a blank glass microscope slide with two sided tape.Two additional sample were taken from both the films and affixed to blank glass microscope slides,bottom side up,to measure the contact angle of the bottom of the films.

SOLUBILITY IN WATER

There's been a surge in interest in water soluble film,especially for pre measured packets of ingredients,because it can offer source and cost reduction potential while simplifying handling by increasing measuring accuracy ,minimizing dust and reducing worker exposure.Water resistance is an important property of edible films for application in food protection,where water activity is high ,or when the film must be in contact with water during processing of the coated food,to avoid exudation of fresh or frozen products.Therefore,edible films with high water solubility is required for example ,to contain pre measured portions,which will be dissolved in water or in hot food.

Both film A and B were partially soluble in water.

FILM SWELLING

Film A has higher swelling of 0.65 less than Film B which shows film swelling of 0.59.

as covalence and hydrogen bonding between polyamide polar groups and phenolic compounds of green tea reduces water permeability.Interaction between polymer and green tea leads to reduce availability of hydrophilic groups of polymer and consequently reduce water permeability.

$$q=\frac{mass\ swollen}{mass\ dry}$$

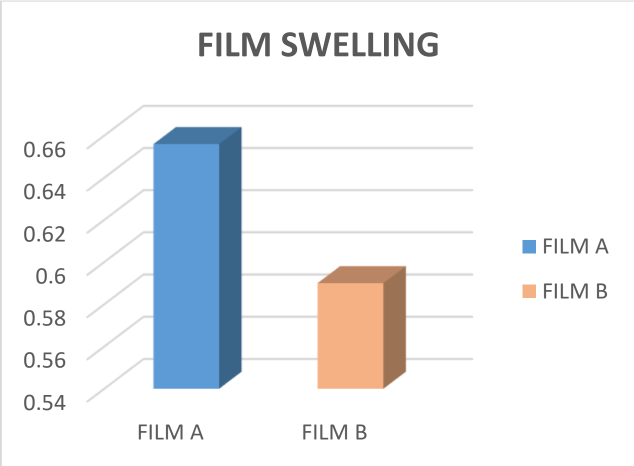

Figure 1: Swelling ratio for film A and film B

CONTACT ANGLE

Both film A and film B are statistically non significant (0.5),hence it shows that contact angle of film A is better than that of film B.Therefore surface of gluten film is hydrophilic and has a higher surface energy or good wetting property while of green tea has a lower surface energy due to the presence of antioxidants which increases the contact angle.

Heating gluten encourages disulphide interchange reaction .Heating induces protein unfolding which exposes hydrophobic groups and cysteine residues that are usually hidden inside protein molecules.The exposed cysteine residues react to restabilize the molecule by participating in disulphide interchange reaction with other cysteine residues.The total number of disulphide bond in system does not increase,the interchange of disulphide bond throughout protein shift the bond from intramolecular to intermolecular and locks the protein into a more stable less soluble network that remains even after cooling.

In contrast addition of gallates break the disulphide bonds and hence the rate of disulphide interchange reaction slows for gluten molecules.

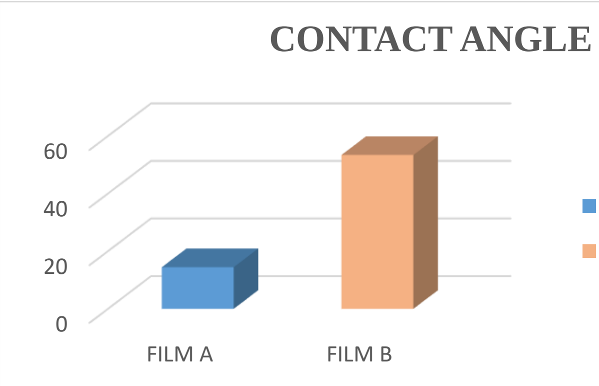

Figure 2:Comparison of contact angle between film A and film B

CONCLUSION

Conclusion obtained from this study were:

1. Production of edible films from cast gluten and gluten + green tea based film forming solution was consistent enough to allow for measurement of selected mechanical and barrier film properties.
2. Both films were found to be partially soluble in water
3. Film with green tea showed lower film swelling ratio thus having improved barrier properties .
4. Gluten edible film showed a lower contact angle thus having improved surface hydrophobicity

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