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Preparation of Edible Coating Using Food Waste and Its Application

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ABSTRACT

Fruit waste such as peels, seeds are one of the most serious concerns today.With the increase in population, the loss and waste of food products were also increased which drastically impact the environmental and human health. Fruitswaste are rich in nutrients, polysaccharides, antimicrobial compounds which can be used for preparation of edible coatings. Edible coating protects the fruits from nutritional, mineral loss and enhanced the shelf life. Thus, in this study the polysaccharides such as cellulose, starch and pectin were extracted from thefruitwaste and used for preparation of edible coating along with the aloe vera extract. The strawberry and potato sliceswere used for the practical application of edible coating.The obtained results showed that when coating was applied on the strawberry and potato slices it delayed the deterioration and increased the shelf-life as compared to the uncoated strawberry and potato slices.

Keywords: Fruit waste; Polysaccharides; Extraction;Edible coating.

Introduction

The food loss or waste is increasing with the increase of population in the world. In total food production, around one-third of food is waste or loss and become unhygienic (Gustavsson *et al.*, 2011). The waste or loss of food leads to the degradation of the consumption of edible part of food. The amount of food loss or waste is different in different countries. In developed countries, such as Europe and North America, the food loss is much more than developing countries with an average annual capita of 280-300 kg. In developing countries, such as South-east Asia and Sub-Saharan Africa, the average food waste per year is 120-170 kg (Papargyropoulou et al., 2014, Sing, 2021). In India also, 40% of total food produced is waste, loss or left uneaten. The waste food, if not decomposed or reused properly, can affect the environment and living being's life drastically (Gandhi *et al.*, 2018; Singh et al., 2021). The food waste can be categorised into biodegradable and non-biodegradable food waste. The non-biodegradable one is those which cannot be decomposed fully through natural process and should have to recycle and reuse, this waste category mainly includes the packages used for the protection of food such as LDPE, PVC, etc. On the other hand, the biodegradable wastes are those which can be decomposed easily through natural process and their examples are food peels, leftover and seeds, etc. These wastes can be utilized for the extraction of different biomolecules such as cellulose, starch, pectin, chitosan, etc. The most common type of different food waste such as waste of sugarcane viz. sugarcane bagasse, potato peel, and orange peel could be used for the extraction of cellulose, starch and pectin respectively.

The sugarcane bagasse is one of the most common bio-waste as sugarcane is harvested world widely (Cherubini, 2010). Along with cellulose, the sugarcane bagasse also consists of hemicellulose, lignin, ash and other residues (Viera *et al.*, 2007). In essence of extraction of pure cellulose, the removal of other layers is important. The layers of other and different polysaccharides are removed using different types of treatments (Ejaz *et al.*, 2020). Cellulose can also be produced by some animals such as tunicates and some bacteria but are different from the cellulose produced by plants in terms of structure and chemical composition. Cellulose is differing from other polysaccharides as it is in crystalline form (Lynd *et al.*, 2002). Cellulose was firstly used for fuel production and then it is used for flex production (Hon, 1994). Cellulose is most common polysaccharide used for the protection of food in the form of edible film or coating.

Other than sugarcane bagasse, potato peel waste is also found abundantly in the world. It is also one of the most common house-hold wastes of the world. Potato and potato peel are rich in starch polysaccharide and could be used for the extraction of starch. During processing about 15-60% of potato peel is waste. The potato peel consists of fibre, starch, lignin, polyphenol, lipids and proteins. Potato peel could be considered as the cheapest or inexpensive source of starch because potato peel is one of the most common by-products of many types of industries (Sepelev and Galoburda, 2015). Starch considered as one of the most important polysaccharides in human life as well as in industrial purpose, therefore, the production and modification in production of starch is increases day per day. During the production of starch, many important laws and theories such as Kirchhoff's law, torrefication method, etc. were invented or discovered (Whistler *et al.*, 2012). Starch is used for the protection of food with some other polysaccharide as the starch is easily breakable in comparison to other polysaccharides.

The orange peel, same as potato and sugarcane bagasse, is very common household and industrial waste. Orange peel can be used in multiple processing which may results in cleaning of environment (Ogunka- Nnoka and Atinlikou, 2016). These peels could also be used as room freshener. Essential oils, candied peel, orange marmalade and pectin are the major by-products of orange.During ripening of food, pectin breakdown by pectinases and pectin esterase which results in softening of food (Sriamornsak, 2002). Pectin consists of Galacturonic acid.Because of the properties of pectin, it also acts as a stabilizing and gelling polymer in some food and specific products. Pectin has a positive impact on different biomedical use and human health. In some industries, pectin is majorly used as water binders, stabilizers, yoghurts thickening agent and in fruit juices. Pectin is used widely in pharmaceutical, food, and other industries. Most of the citrus peel is discarded as waste at small juice extraction units and household, which can be used as a great source of pectin (Siddiqui et al., 2021). Due to abundantly presence and not being proper used or recycle of orange peel, it might be considered as one of the cheapest sources of pectin. Pectin is used as edible coating as it controls the quality and nutritional loss of foodand provide the essential nutrients to the food (Valdés *et al*., 2015).

For the binding purpose of coating while preparing it herbal with minimum chemicals, aloe vera is considered as binding agent because of its binding and gel forming property. Aloe vera, when mix with other resources, gives a smooth structure and texture which may leads to the formation of smooth film. Aloe vera has properties of healing mechanism, anti-inflammatory property, laxative effects, etc. which helps in providing maximum protection to the food (Surjushe*et al.,* 2008).

Therefore, different polysaccharides are used for the production of edible coating. Edible coating is a coating of single or a mixture of compounds such as polysaccharides which creates a barrier between the food and the outer environment and protect the food from physical damage. Other than physical damage, edible coating also protects the food from microbial attack and delayed the ripening of food by delaying the moisture loss. The component used for the preparation of edible coating is depend upon the type of food used to protect (Krotcha and Mulder, 1997;Wisniewski*et al.*, 2016; Sampaio *et al*., 2020).Edible coating used in various item including the pharmacy and food industry. The combination of different polysaccharides used as an edible coating with minimum chemicals is not as much common as the formation of edible coating using single polysaccharides with chemicals. Therefore, the following study is conduct for the preparation of edible coating using different polysaccharides viz cellulose, starch and pectin and its application on strawberry and potato slices forextension of shelf-life.

2 Material and methods

2.1 Selection of raw material

The demand of potato peels in pharmaceutical and food industries are increasing because it is rich source of phenolics, and other minerals. Considering the properties and importance of potato peels, it is used for the extraction of starch. The potato peels were collected from household waste.The sugarcane bagasse and orange peelswerecollected from the Prem Nagar, nearby region of Uttaranchal University, Dehradun, Uttarakhand, India and used for the extraction of cellulose and pectin. The peels were sorted, washed with water and then grind into a thick paste.

2.2 Extraction of cellulose

Cellulose was extracted by sugarcane bagasse dipped in water for 24 hours and then dried in tray dryer. The bagasse was treated with acid for 2 h at continuous stirring using magnetic stirrer and then washed till neutral pH,and thenalkali treatment was given and again washed till neutral pH. The cellulose was extracted which is then cleaned using hydrogen peroxide.

2.3 Extraction of starch

Starch was extracted when potato peel was washed and ground then treated with acetic acid and centrifuged followed by filtration and washing with cold water.

2.4 Extraction of pectin

Pectin was extracted by soaking and grinding of orange peels and then treated with acetic acid followed by the centrifugation, filtration and washing.

2.5 Preparation of edible coating

The cellulose, starch and pectin (1g)were mixed with 15 ml of Aloe vera filtrate, prepared by grinding and treating aloe vera with acetic acid. The slurry is applied on strawberry and cut slices of potato manually by brush method. The samples were observed in an open environment on consecutive days.

3. Result and discussion

The prepared slurry was applied on strawberries and potato slices and the changes were observed on the basis of visual appearance and extent of decay of coated and non-coated samples.Schematic diagram of edible coating developed from foodwasteand its application was shown in Figure 1.

3.1 Analysis of edible coating on strawberry

The studies showed that the shelf-life of strawberry in open environment is 1-2 days. Therefore, in the present investigation, the analysis of shelf-life extension of strawberry by the application of edible coating was analyzed.The coated and non-coated strawberries were observed on consecutive days. On day 2, it was observed that the coated strawberry looks glossy and shiny whereas non-coated strawberry looks dull (Figure 2). On day 4, it was observed that the coated strawberry was in its shape, shiny and glossy whereas the non-coated strawberry was shrunk and lost the color(Figure 3). It was observed that when strawberries were coated using edible coating, theirshelf-life increased, softening and textural changes were delayed (Nadim *et al*., 2014).

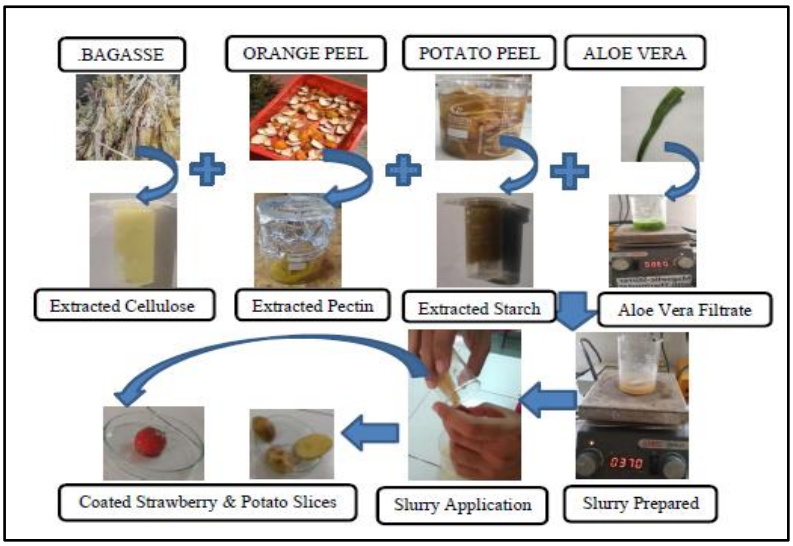

Figure: 1 Schematic diagram of edible coating developed from foodwaste and its application.

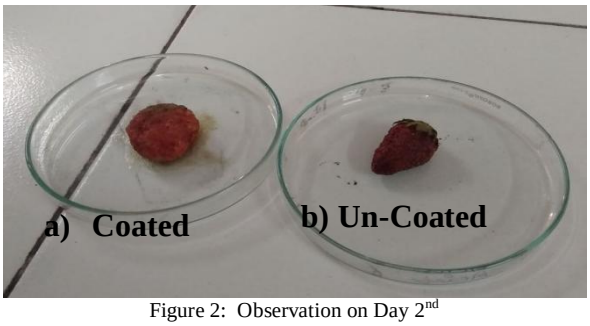

Figure 2: Observation on Day 2nd

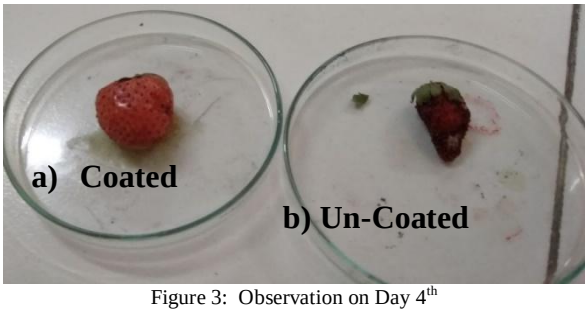

Figure 3: Observation on Day 4th

3.2 Analysis of edible coating on potato slices

According to the studies, the shelf-life of potato slices is not more than 24 hours. In the present study, the potato was cut into different slices, half of them were coated and half remain uncoated and observed after 2 days of coating application. On 2nd day of coating application, it was observed that the coated slices of potato were glossy, shiny but little shrunk from the edges but the non-coated slices of potato were darkened, dull and shrunk overall (Figure 4). The cut fruits and vegetables are most active towards the microbial attack and edible coating delayed the period of deterioration (Baldwin *et al*., 1996).

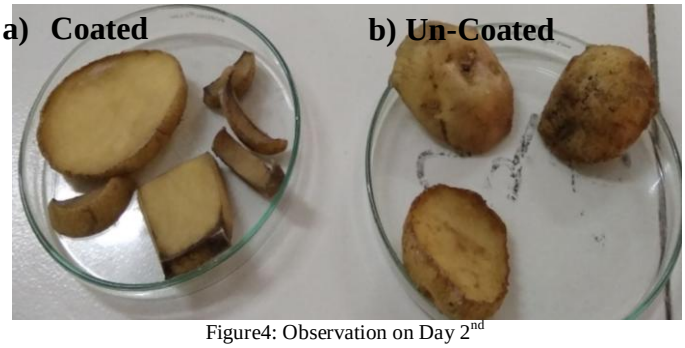

Figure4: Observation on Day 2nd

4. Conclusion

Today food waste is a major concern of the world. The peels of various fruits and vegetables are discarded as waste but these can be used for the extraction of different polysaccharides such as cellulose, starch and pectin.These extracted polysaccharides could be used in various functions such as in preparation of edible coating which provides a barrier to food fromthe outside environment. In the present investigation, waste generated from sugarcane, potato and orange, viz. bagasse, potato peel and orange peel, were used for the extraction of cellulose, starch and pectin respectively. Edible coating was prepared using these polysaccharides with aloe vera as plasticizer which made the coating slurry organic.Strawberries and potato slices are meant to be deteriorate easily when expose to the open environment. Due to this reason, potato slices and strawberry were used for the application and observation of edible coating. It is apparent from the study that the edible coating prepared from the polysaccharide extracted by food waste is an effective solution of waste management and the edible coating by this method is also cost effective. The shelf life of strawberry and cut slices of potato have been extended by the use of polysaccharides based edible coating.

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