



## SHELF LIFE ENHANCEMENT OF FRUITS BY USING BACTERIAL EXOPOLYSACCHARIDE AND ALOE VERA COATING

### Microbiology

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### ABSTRACT

As the demand for high quality fruits and extended shelf life is increasing, efforts were made to explore the potential to meet the needs of consumers. Many natural and artificial preservatives are being used to increase the nutritional value by use of edible coatings, such as EPS (Exopolysaccharide) and Aloe vera gel coating. In current work Exopolysaccharide produced from *Bacillus subtilis*, Aloe vera and combination of Aloe vera and EPS was studied. Results were recorded until three months in interval of 15 days. Combination of Aloe vera and exopolysaccharide coating was proved to be efficient as preservative to keep the nutritive value of fruits.

### KEYWORDS

EPS, Aloe vera, Fruits and Shelf life

### Introduction

Fruits are low in calories and fat and are a source of simple sugars, fiber, and vitamins, which are essential for optimizing our health. Fruits provide plenty of soluble dietary fiber, which helps to avoid cholesterol and fats from the body and to help in smooth bowel movements as well as offer relief from constipation ailments. Fruits compose of many antioxidants such as polyphenolic flavonoids, vitamin-C (Hulme et al., 1970) and anthocyanins.

Fruits are rich in nutrients which are vital for health. The potassium in fruit reduces risk of heart disease, risk of developing kidney stones and bone loss. One of the components is folate which is essential for pregnant women.

There are different preservation methodologies available and developed such method extending self life is the use of the edible coatings. The natural or artificial preservative which are used able to increase the nutritional value of the food they preserve some method like coating for artificial media such as EPS (exopolysaccharides) and Aloe vera gel.

Many microorganisms have the ability to synthesize Exopolysaccharide. Lot of research has been done on the applications of bacterial exopolysaccharide (Feng, et al., 2012). EPS may not be essential for the growth and viability in free living bacterial cultures but protect cells from hostile environments (Horn, et al., 2006 & Gutnick, et al., 2000). Exopolysaccharides are naturally formed macromolecules during growth of many organisms. EPS have found diverse applications in food, pharmaceutical, medical and other biotechnological applications (Stewart et al., 2001; Laue et al., 2006). Production of EPS by several microbial groups; including strains belong to genus *Bacillus*, especially *Bacillus subtilis*, have been investigated (Manca et al., 1996; Orsod et al., 2012). For commercial production of exopolysaccharides, it is crucial to lower the production costs.

### Importance of Aloe Vera

Aloe Vera, commonly referred to as a "medicinal plant", is known for its wide range of therapeutic properties. It has been mentioned throughout recorded history and given a high ranking as an all-purpose herbal plant. The two major liquid components of Aloe Vera are a yellow latex (exudate) and clear gel (mucilage), which proceeds from the large leaf parenchymatic cells (Atherton et al., 1998).

Aloe Vera is a plant made up of many complex ingredients including polysaccharides, glycoproteins, phenolic compounds, salicylic acid, lignins, hormones, amino acids, vitamins, saponins and enzymes which give Aloe Vera its many beneficial properties. The main use of Aloe vera gel is in the cosmetic industry including treatment of burns and scars and wound healing. Recently, the use of Aloe Vera gel as an edible coating has been reported to prolong the shelf life of fruits (Delieghere et al., 2004)

### Edible Coatings for increasing shelf life

In order to overcome the above constraints, coatings for extension of life of fruits and vegetables (without refrigeration) are being developed. Edible coatings are thin films that improve product quality and can be safely eaten as part of the product and do not add unfavorable properties to the foodstuff (Baldwin, 1994). The first kind of edible coatings were water-wax micro emulsions, used since the 1930s to increase brightness and colour in fruits, as well as fungicide carriers. Water loss is another problem that can be controlled with edible wax coatings. Edible waxes can also offer protection against cold damage under storage (Adetunji et al., 2012)

### MATERIALS AND METHOD

#### Maintenance of *Bacillus subtilis*

*Bacillus subtilis* culture was maintained on nutrient agar plates. It was sub-cultured on nutrient agar slants and plates and were incubated at 37°C for 24 hrs. The slants and plates were stored at 4°C.

#### Production of Exopolysaccharides

*Bacillus subtilis* was inoculated in a standardized medium "EPS basal medium" with composition (gms/lit): Glucose - 10gm, Yeast extract - 3gm, Malt extract - 3gm, Peptone - 5gm, MgSo<sub>4</sub>.7H<sub>2</sub>O - 1gm, KH<sub>2</sub>PO<sub>4</sub> - 0.3gm, pH 5.2, Distilled water 1000 ml (Fig. 1)

The 1000ml flasks containing 500ml of the EPS basal medium was inoculated with the bacterium and the flasks were incubated at 37°C for 10 days in rotary shaker at 50 rpm.



Fig 1: Production of Bacterial Exopolysaccharide

#### Extraction of EPS

EPS was then precipitated by addition of equal volume of ethanol. The mixture was then agitated during addition of ethanol to prevent local concentration of the precipitate and left overnight at 4°C and centrifuged at 7000 rpm for 20 min to pellet out exopolysaccharides. Then, the precipitate was collected in petriplates and dried at 60°C. EPS.

#### Preparation of Aloe Vera gel

The liquid obtained constituted fresh Aloe Vera gel. The gel matrix was

pasteurized at 70°C for 45min. The gel was cooled immediately to an ambient temperature to stabilize and ascorbic acid (4g l<sup>-1</sup>) was then added citric acid (2g l<sup>-1</sup>) was added to maintain the pH at 4. It was later be stored in bottle

### Combination of Aloe vera and EPS

Aloe Vera gel 500ml + some amount of EPS mixed together as shown in fig 3



**Fig 3: Preparation of Aloe vera gel and EPS for coating**

### Collection of fruit

Fresh healthy fruit such as Apple (*Malus domestica*), Pear, Guava, Bananas (*Musa acuminata*), Grapes, Chikoo (*manilkara zapota*), Amla (Fig.4) were purchased from local market of Nagpur and transferred to laboratory under aseptic condition. The fruit were washed with sterile distilled water and alcohol to remove the dirt.



**Fig 4: Fruits collected from the market**

Fruits used in this experiment were divided into four batches; Control, Coated with only EPS, only Aloe vera and combination of Aloe vera and EPS. The fruits were stored in box with different temperature.

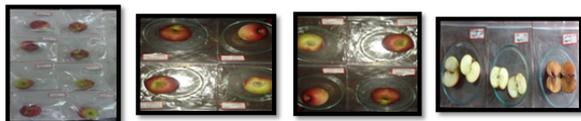
### Optimization of Different Treatment

Optimization was carried out by varying storage temperature (freezing temperature and room temperature) and pH.

### Experiment and result

In the present study total 9 different type of fruit were collected from market such as Apple, Banana, Chikoo, Pear, Guava, Amla, Grapes etc.

Fruits were further processed for experimentation in Microbiology laboratory. It was observed that the fruits coated with Aloe vera+ EPS were not affected at room temperature and refrigerator even after 3 months. Control fruits were spoilt within 15 days itself. Some Fruits coated with only Aloe vera and EPS alone were good after 15 days but some fruits were spoilt within 30 days. Hence only results of fruits good after 3 months storage were recorded.



**Fig 5: Experimental Apple after 30 days, 3 months respectively**



**Fig. 6: Experimental Pear after 30 days, 3 months respectively**

### Discussion:

Largest market in India is the fruit market. Fruits because of its nutritive value are in great demand. Due to improper transportation and storage there are maximum chances of increase in wastage. As a result, cost of fruits is also becoming high and is not affordable to common people.

Effort was made to overcome the wastage of fruits. Edible coatings were of choice. EPS, EPS + Aloe vera, Aloevera were applied on the fruits and quality was checked until three months in 15 days interval. EPS+Aloe vera mixture was to be potent and efficiently responsible in increasing the shelf life of fruits without losing its nutritive value. Edible coatings may be providing a barrier for external conditions thereby reducing the loss of water from fruit, aroma and flavor.

### Reference

1. Adetunji C. O., Fawole O.B, Afolayan S.S, Olaleye O.O, Adetunji J.B.(2012)Effects of Aloe vera gel coatings on shelf life of Citrus sinensis fruits stored at ambient temperature.
2. Atherton P (1998). Aloe vera: magic or medicine. Nursing Standard, 12(41) 49-54.
3. Baldwin, E.A, Nisperos - Carriedo, M.O. and Baker, R. A (1995). Use of edible coatings to preserve quality of lightly (and slightly) processed products. Critical Review in food science and Nutrition, 35, 509-524.
4. Devlieghere F, Vermeulen A & Debevere J, Chitosan: 21 (2004) Antimicrobial activity, interactions with food components and applicability as a coating on fruits and vegetables, Food Microbiol, 703-714.
5. Feng, M.X., Chen, C., Li, R., Nurgul, M., Dong. (2012). "Isolation and identification of an Exopolysaccharide-producing lactic acid bacterium strain from Chinese pickled radish (Pb (II) by its exopoly-saccharide," Journal of Food Science, vol. 77, no. 6, pp. T111-T117, 2012. View at Publisher: View at Google Scholar.
6. Gutnick, D.L., Bach, H. (2000). "Engineering bacterial biopolymers for the biosorption of heavy metals; new products and novel formulations," Appl. Microbiol. Biotechnol. Vol. 54, no. 4, pp. 451-460.
7. Horn, H., Morgenroth, E. (2006). "Transport of oxygen, sodium chloride, and sodium nitrate in biofilms," Chem. Eng. Sci., Vol. 61, no. 5, pp. 1347-1356, 2006.
8. Hulme, A.C (editor) (1970). "The Biochemistry of Fruits and their Products". 1. London & New York: Academic Press.
9. Laue, H., Schenk, A., L.I., H., Lambertsen, L., Neu, T.R., Molin, S., Ullrich, M.S. (2006). Contribution of alginate and levan production to biofilm formation by *Pseudomonas syringae*. Society for General
10. Manca, C.M.; Lama, L.; Importar; Esposito, E.; Gambacorta, A.; Nicolaus, B.(1996). Chemical Composition of Two Exopolysaccharides from *Bacillus thermoantarcticus*. Applied and Environmental Microbiology 62 (9): 3265-3269.
11. Orsod, M., Mugambwa, J., Huyopf, M. (2012). Characterization of exopolysaccharides produced by *Bacillus cereus* and *Brachybacterium* sp. Isolated from Asian sea bass (*Lateolabrax niloticus*). Malaysian Journal of Microbiology 8: 170-174.
12. Stewart, P.S., Rayner, J., Roe, F., Rees, W.M. (2001). Biofilm penetration and disinfection efficacy of alkaline hypochlorite and chlorosulfamates. Journal of Applied Microbiology 91: 525-532.