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Effects of Edible Coatings from Aloe Vera Gel on Quality and Postharvest Physiology of Ananas Comosus (L.) Fruit During Ambient Storage

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Abstract - Pineapple (Ananas comosus (L.) Merr.) is an important fruit crop grown in Nigeria. Extension of the shelf life of pineapple fruits continues to be a challenge in Nigeria. The search for safe, healthy and environmental friendly treatments has led to increased interest in research into edible and biodegradable films and coatings. The aim of this study was to evaluate the effect of Aloe vera gel as an edible coating on weight loss, ascorbic acid, pH and firmness in order to extend the shelf-life of pineapple stored at ambient temperature of (27+2oC) and relative humidity of 55-60% for seven weeks. The above parameters which are related to post-harvest quality loss were however significantly controlled in the pineapple coated with A. vera gel. The storability of orange fruits was extended by seven weeks. It was concluded that A. vera gel used as a coating for pineapple could serve as an alternative to post-harvest chemical treatments.

Keywords : *Pineapple, Edible coating , Aloe vera gel, biodegradable films.*

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I. Introduction

Postharvest losses of tropical fruits are a serious problem because of rapid deterioration during handling, transport and storage (Yahia, 1998). Edible coatings are thin films that improve produce quality and can be safely eaten as part of the product and do not add unfavourable properties to the foodstuff (Baldwin, 1994; Ahvenainen, 1996). Edible coatings provide a barrier against external elements and therefore increase shelf life (Guilbert *et al*., 1996) by reducing gas exchange, loss of water, flavours and aroma and solute migration towards the cuticle (Saltveit, 2001). The first kind of edible coatings were water–wax microemulsions, 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 (Debeaufort *et al*., 1998). Edible waxes can also offer protection against cold damage under storage (Nussinovitch & Lurie, 1995). Nowadays, an edible coating is made of polysaccharides, proteins and lipids (Guilbert *et al*., 1996) and resins as well (Baldwin *et al*., 1995).

Pineapple (*Ananas comosus* (L.) Merr.) is an important fruit crop grown in many tropical and subtropical countries. Fresh pineapple fruit is perishable (Chen and Paull, 2001; Avallone *et al*., 2003; Soares *et al*., 2005; Wilsonwijeratnam *et al*., 2005; Ko *et al*., 2006).

The fruit is known for its nutritive and health promoting properties. It is commonly used as table fruit or in desserts. The shelf life of ripe pineapple is short and limited to 4-6 days (Hajare *et al*., 2006). Fresh pineapple contains thick, thorny inedible peel and a large crown, which consumes storage space and also results in higher transportation costs (Fernandes *et al*, 2006)

Currently, there is an increasing interest in the use of *Aloe vera* gel in the food industry, being used as a source of functional foods in drinks, beverages and ice creams (Moore and MacAnalley, 1995). Nevertheless, processing techniques used to obtain *A. vera* gel are very important to ensure the product quality and to maintain almost all the bioactive components (He et al., 2005).Recently, Adetunji *et al* .,2012 discover that *Aloe vera* gel could prolong the shelf life of citrus stored at ambient condition for seven weeks while it maintain all the good qualities of oranges. The aim of this work was to study the effect of *A. vera*, applied as an edible coating, on the change in physicochemical parameters and shelf life in Pineapple, related to fruit quality during ambient storage for a period of seven weeks.

II. Materials and Methods

a) Preparation of edible coatings

i. Preparation of Aloe vera gel

Matured leaves of *Aloe vera* plant was harvested and washed with a mild chlorine solution of 25%. *Aloe vera* gel matrix was then separated from the outer cortex of leave and this colorless *hydroparenchyma* was ground in a blender .The resulting mixture was filtered to remove the firbres. The liquid obtained constituted fresh *Aloe vera* gel. The gel matrix was pasteurized at 70ºC for 45min. For stabilized the gel was cooled immediately to an ambient temperature and ascorbic acid (1.9 - 2.0g L^{-1})was then

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added citric acid (4.5 - 4.6gL^{-1}) was added to maintain the pH at 4.The viscosity of the stabilized Aloe vera gel and it coating efficiency was improved by using 1% commercial gelling agent and was used as coating agent .It was later be stored in brown Amber bottle to prevent oxidation of the gel. Adetunji *et al* (2012).

a. Materials

Freshly harvested Pineapple were procured from the local market of Ilorin, kwara state, Nigeria. They were selected on the basis of sized, color and absence of external injuries. Fresh leaves of *Aloe vera* was obtained from Nigeria stored products research institute garden.

b. Surface preparation of the pineapple

The primary purpose of surface preparation was to remove all contaminants that would hinder proper coating adhesion and to render a sound clean substrate suitable for firm bonding. The surface should be in paint ready condition. Mold, mildew and/or algae should be removed and sterilized with a 25% hypochlorite solution (1 gallon household bleach to 3 gallons water). The Pineapple will be soaked in the 25% hypochlorite solution for two minutes.

ii. *Treatments*

T_o (control):- T_0 was selected as the control (untreated Pineapple)

T_1 Pineapple was coated with *Aloe vera* gel.

The treated and untreated Pineapple were packed in small plastic baskets and each basket contained 20 Pineapple fruits. The baskets were stored at ambient temperature (27+2°C) and at 50-60% relative humidity .Physiochemical analysis were carried out from 1-7weeks after coating.

a. Weight loss

To evaluate weight loss, separate samples in 3 replicates of each treatments were used. The same samples were evaluated for weight loss each time at weekly intervals until the end of experiment. Weight loss was determined by the following formula:

$$\text{Weight loss (\%)} = [(A-B)/A] \times 100$$

where A indicates the fruit weight at the time of harvest and B indicates the fruit weight after storage intervals. (A.O.A.C., 1994)

b. Firmness

Firmness was measured as the maximum penetration force (N) reached during tissue breakage, and determined with a 5 mm diameter flat probe. The penetration depth was 5 mm and the cross-head speed was 5 mm s^{-1} using a TA-XT2 Texture Analyzer (Stable Micro Systems, Godalming, UK), MA. Pineapple were sliced into halves and each half was measured in the central zone.

c. pH

After firmness analysis, oranges were cut into small pieces and homogenized in a grinder, and 10 g of ground Pineapple was suspended in 100 ml of distilled water and then filtered. The pH of the samples were assessed using a pH meter (pH-526; WTW Measurement Systems, Wissenschaftlich, Technische Werksta¨tten GmbH, Wellhelm, Germany)

d. Ascorbic acid

Ascorbic acid content was measured using 2,5-6 dicholorophenol indophenols' method described by A.O.A.C 1990.

b) Statistics

The results of this investigation are means of seven measurements. To verify the statistical significance of all parameters the values of means ± S.E. were calculated. SPSS software (version 12.0, SPSS Inc., US) was used for all statistical analysis for Analysis of variance. The significance level used was 0.05.

c) Firmness

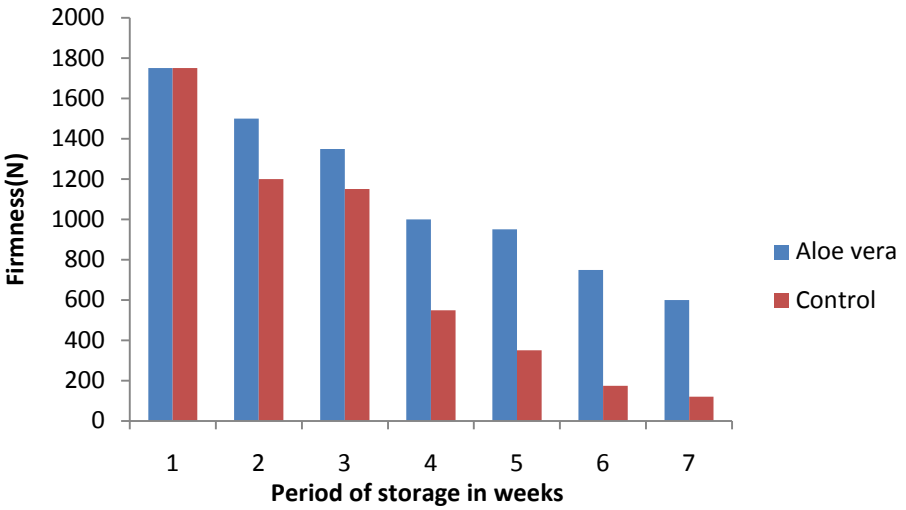

Fig 1 : Effect of Aloe vera gel coatings on Firmness of pineapple at ambient temp

Firmness is an important factor that influences the consumer acceptability of fresh-cut fruits and it is related to water content and metabolic changes (Rojas-Grau *et al.*, 2008).

The mean±SE value for the firmness was 7900±157.43N and while the mean±SE value for the of uncoated was 5295±233.11N. The analysis of variance shows that edible coating from *Aloe vera* gel on firmness of pineapple were significant ($p<0.05$) compared to the uncoated.

Lerdthanangkul and Krochta (1996) also made similar observations and concluded that coatings and/or films significantly affected firmness of fruits in storage. The softening process in pineapple has been reported to be dependent on the increase in polygalacturonase, ßgalactosidase and pectinmethylesterase activities Rem´on *et al.*, 2003, being responsible for fruit quality loss. *A. vera* treatment significantly reduced the firmness losses (more than 50%) during ambient storage compared with control fruits. In addition, *A. vera* gel probably had some effects on the reduction of cell wall degrading-enzymes responsible for pineapple softening. These results show beneficial effects of the *Aloe vera* coating on increasing the pineapple shelf life, since it has been postulated that fruit softening and texture changes during pineapple storage determine fruit storability and shelf life, as well as reduced incidence of decay and less susceptibility to mechanical damage (Batisse *et al.*, 1996; Vidrih *et al.*, 1998).

d) Water content

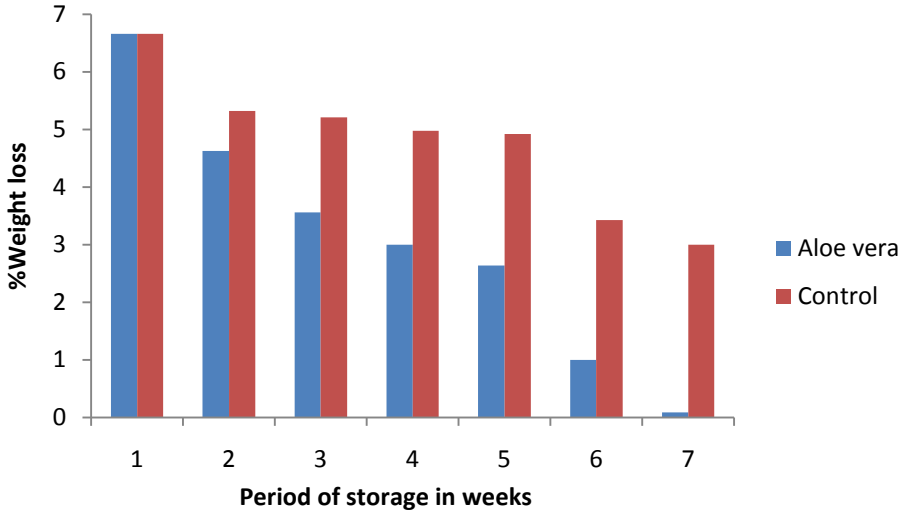

Fig 2 : Effect of Aloe vera coatings on % Weight loss of pineapple at ambient temp

The mean±SE value for the weight loss of coated pineapple was 33.52 ±0.46 % while the mean±SE value for the weight loss of uncoated pineapple was 21.58±0.83%. The analysis of variance shows that edible coating from *Aloe vera* gel on the percentage of weight loss of pineapple were significant ($p<0.05$) compared to the uncoated.

These results are in agreement with those of Mahmoud and Savello (1992) and Avena-Bustillos *et al.* (1997) who concluded that coatings and/or films significantly conserved water content.

Post harvest weight changes in fruits and vegetables are usually due to the loss of water through transpiration. This loss of water can lead to wilting and shriveling which both reduce a commodity's marketability. Edible films and coatings can also offer a possibility to extend the shelf life of fresh-cut produce by providing a semi-permeable barrier to gases and water vapor and therefore, they can reduce respiration, enzymatic browning and water loss (Guilbert, 1986; Baldwin & Nisperos-CarriedoBaker, 1995).

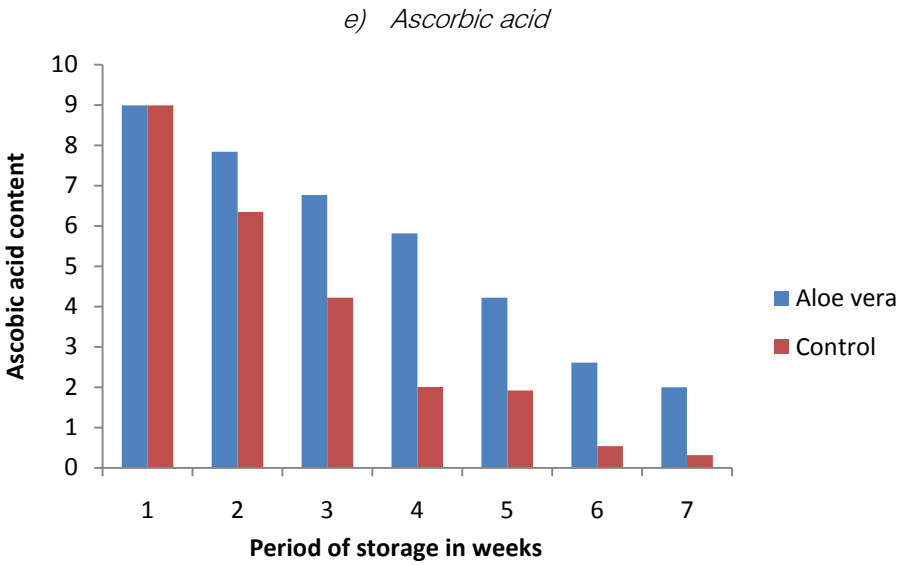

Fig 3 : Effect of Aloe vera coatings on Ascobic acid content of pinapple at ambient temp

The mean±SE value for the coated pineapple for Vitamin C was 38.25±0.99 and while the mean±SE value for the of uncoated was 24.35±1.22. The analysis of variance shows that edible coating from *Aloe vera* gel on Ascorbic acid of pineapple were significant ($p<0.05$) compared to the uncoated.

Ascorbic acid content. Ascorbic acid is lost due to the activities of phenoloxidase and ascorbic acid oxidase enzymes during storage (Salunkhe *et al*., 1991). Weichmann *et al*. (1985), while studying green bean, spinach and broccoli, postulated that the lower the oxygen content of the storage atmosphere, the smaller is the loss of ascorbic acid. The claim was that the oxidation of Vitamin C was mainly regulated by ascorbic acid oxidase and other oxidases, most of which had a low affinity for oxygen. Ascorbic acid content decreased for cherries stored at both ambient temperature and cold temperature.

Aloe vera gel coatings were effective in reducing the ascorbic acid loss for both storage conditions (Fig. 3). At the ambient temperature, the ascorbic acid contents of *Aloe vera gel* coated pineapple were significantly different from the control orange. The reduction of ascorbic acid loss in coated orange was due to the low oxygen permeability of *Aloe vera gel* coating which lowered the activity of the enzymes and prevented oxidation of ascorbic acid.

The effect of low temperature significantly reduced the ascorbic acid loss. This shows the effect of temperature on the activities of the related enzymes.

III. Conclusion

Aloe vera gel, applied as edible coating in pineapple fruit, has beneficial effects in retarding the ripening process. This treatment was effective as a physical barrier and thus reduced the weight loss during postharvest storage. In addition, *A. vera* gel delayed softening, Ascorbic acid, and maintained the quality of pineapple fruit.

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