EFFECT OF ALOE VERA AND WHEAT GRASS JUICE AS AN EDIBLE COATING TO PROLONG THE SHELF LIFE OF BANANAS

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Abstract-*The marketability of bananas over long distances has been limited due to their highly perishable nature and sensitivity to ethylene. To increase the shelf-life several alternatives have been tested in attempts to maintain quality characteristics. In this study natural plant sources i.e. aloe vera juice and wheat grass juice were used as edible coatings for extending the shelf life of bananas. Sensory analyses wasconducted to monitor the changes in colour, firmness, taste, odour and overall acceptability The results showed that coated banana fruit demonstrated delayed ripening processes compared to the uncoated banana. This also confirmed by the reduction in weight loss as well as in titrable acidity in comparison to the uncoated banana. The analysis was carried out for 16 days with an interval of 4 days. Results were statistically significant($p<0.05$) for all the sensory parameters. Treatments and storage intervals had significant effect on both weight loss and titrable acidity of bananas.Aloe vera juice proved to be the most suitable coating among the others for reducing the weight loss, titrable acidity and for maintenance of desirable sensory analysis since it is composed mostly of polysaccharides, thus acting as a natural barrier to moisture and oxygen which can speed up food deterioration. It can also enhance food safety since it appears to contain various antibiotic and antifungal compounds that can potentially delay or inhibit microorganisms that are responsible for food spoilage The application of these new edible film for fruits extends their shelf life and elevates the antioxidant potential.*

***Keywords:* Banana, shelf-life,weight loss, titrable acidity,edible coatings**

1.INTRODUCTION

Banana is one of the most favoured specialtytropical fruits and is very popular worldwide. Bananafruits are climacteric in nature which ripen rapidlyand soften after harvest.[1]Dueto its high nutritive value, banana is susceptible todiseases caused by microorganisms. In addition,banana is also sensitive to low temperature storage.[2]All these mentioned factors limitthe handling, storage, distribution and marketingpotentials of banana fruit. Banana fruit are usuallyharvested at mature green stage and stored eitherat ambient or at low temperature. Some extensionof banana's shelf life has been demonstrated usingmodified atmosphere (MA) storage (relatively highCO_2 and low O_2) and controlled atmosphere (CA)storage.[3] However, CO_2 injury, tasteand flavour problems because of anaerobic respirationand ethanol production have been reported for bananafruit [4]

In order to overcome the above constrains, 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 unfavourable properties to the foodstuff. [5] Edible coatings provide a barrier against external elements and therefore increase shelf life by reducing gas exchange, loss of water, flavours and aroma and solute migration towards the cuticle. [6]

Medicinal plants are reservoirs of various metabolites and provide unlimited source of important chemicals that have diverse biological properties and represents a rich source from which antimicrobial agents can be obtained.[7]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.[8] Wheatgrass is a food prepared from the cotyledons of the common wheat plant (Triticumaestivum) belonging to family Graminea. It is a powerful health food supplement that is packed with highly concentrated vitamins, minerals, chlorophyll and enzymes. The chlorophyll in wheatgrass has antibacterial properties, which can stop the development of harmful bacteria in the body. Wheat grass juice has a high content of bioflavonoids which may contribute towards antimicrobial effects of the supplement. [9]

2.MATERIAL AND METHODS

2.1 Procurement of Plant Material

Bananas were purchased from a local market. The bananas with similar size, shape, and colour were selected. Fresh aloe vera and wheat grass was obtained from a local nursery. Only the fully extended mature leaves of aloe vera and wheat grass were taken with absence of any bruises or physical injuries.

2.2. Preparation of coatings

ALOE VERA JUICE [10]

- Break off a few leaves from an Aloe Barbadensis Miller plant.
- Take a sharp knife and carefully peel the rind from the plant leaves and discard.
- Peel the yellow layer just beneath the rind with a sharp knife and discard.
- Aloe vera matrix is then separated from the outer cortex of leaves and this colourless hydroparenchyma is ground in a blender with water.
- The resulting mixture was filtered to remove the fibres.
- The liquid obtained constituted fresh Aloe vera juice.

WHEAT GRASS JUICE[11]

- Cut the wheatgrass just above the white portion, wash well under water.
- Put the chopped wheatgrass in a blender with some water.
- Blend the wheatgrass and water together using the highest speed.
- Place a mesh strainer over a clean glass bowl.
- Pour the wheatgrass juice from your blender through the strainer.
- Using a rubber spatula, press down on the wheatgrass pulp to squeeze out additional juice.

2.3 Surface preparation of fruits

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 plant ready condition. This method was carried out in two steps:

WASHING-The fruits were first washed thoroughly under running water to remove any dirt or foreign material.
CLEANING- After washing, the fruits were cleaned with muslin cloth.

2.4 Application of coatings

The coating solutions were aloe vera juice[A], wheat grass juice[B], aloe vera +wheat grass juice 1:1 [C], control [D]. Bananas were dipped completely into the coating solutions at room temperature for 5 min. The fruit was allowed to drain and then dried at room temperature to allow a thin film layer to be formed on the banana. Bananas were then stored at room temperature and at refrigeration temperature.

2.5Sensory Evaluation

Sensorial differences among treatments were evaluated using composite scoring tests. In a first assay, differences in peel colour, firmness and odour were evaluated using wholes bananas. In a second assay taste and overall acceptability of bananaswas evaluated using small pieces of cut bananas.Panel of evaluation was integrated by 10 trained panel members.

2.6 Analytical evaluation

Bananas were divided into four samples on the basis of coatings of aloe vera and wheat grass juice They were kept at room temperature as well as at refrigeration temperature. Various parameters were evaluated at 4 day intervals until the overall acceptability became unsatisfactory for each lot of samples.

Scheme of Study

Sample A – Bananas coated with aloe vera juice
Sample B – Bananas coated with wheat grass juice
Sample C – Bananas coated with aloe vera juice + wheat grass juice [1:1]
Sample D – Uncoated bananas[Control]
4,8,12,16-Represents the number of days

Weight Loss (WL)

Weight loss was determined using analytical weighing balance. The percentage of weight loss was determined according to the following equation [12]

$$\%WL(t) = \frac{W_0 - W_t}{W_0} \times 100$$

Where W0 is the initial weight and Wt is the weight of fruit after various storage times.

Titrable Acidity(TA)

TA was determined in triplicate by titration with 0.1 N NaOH, using 10 mL of juice in 50 mL of distilled water.

2.7Statistical Analysis

Mean, standard deviation and test of significant difference (p<0.05) was performed using SPSS software package version 20.

3. RESULTS AND DISCUSSION

3.1 Organoleptic evaluation of bananas stored under room temperature and refrigeration temperature.

Table 3.1-Mean score of sensory attributes of banana kept at room temperature

DAYS	SAMPLES	PEEL COLOUR	FIRMNESS	TASTE	ODOUR	ACCEPTABILTY
4 DAY	AV	3.5±1.08	4.1±0.87	4.3±0.82	4.2±0.91	4.2±0.78
	WG	3.8±1.08	3.6±0.84	3.6±0.69	3.6±0.51	3.9±0.56
	AV+WG[1:1]	4.1±0.73	4.1±0.56	4±0.81	3.9±0.56	3.8±0.78
	CG	2±0.94^{abc}	2.5±0.84^{abc}	2.5±0.70^{abc}	2.5±0.70^{abc}	2.5±0.70^{abc}
8 DAY	AV	3.7±0.48	3.6±0.84	3.5±0.70	3.4±0.96	4±0.47
	WG	3.1±0.87	3.3±0.94	3.1±0.56	2.9±0.73	3.4±0.51
	AV+WG[1:1]	3.2±0.91	3.3±0.94	3.3±0.82	3.3±0.67	3.4±0.84
	CG	1.3±0.48^{abc}	1.2±0.42^{abc}	1.2±0.42^{abc}	1.3±0.48^{abc}	1.3±0.67^{abc}
12 DAY	AV	2.8±0.78	2.6±0.69	2.4±0.51	2.2±1.03	2.4±0.84
	WG	2.1±0.31	2.3±0.67	2.2±1.03	2±0.94	2±0.47
	AV+WG[1:1]	2.8±0.78	2.7±0.94	2.4±1.07	2.5±1.26	2.6±1.17
	CG	1.1±0.31^{abc}	1.1±0.31^{abc}	1.1±0.31^{abc}	1.2±0.42^{c}	1.1±0.31^{ac}

BANANA DAY 4[ROOM TEMPERATURE]

In peel colour, there was a statistically significant difference between the batches as determined by one-way ANOVA i.e. 0.001. Sample C has the highest mean value i.e. 4.1±0.73 whereas Sample D has lowest mean value i.e. 2±0.94.

Sample A and C has the highest mean value for fruit firmness whereas Sample D has lowest value 2.5±0.84. The differences are statistically significant among batches.

For taste Sample A has the highest mean value i.e. 4.3±0.82 which means it was more acceptable as compared to Sample D which has the lowest value i.e. 2.5±0.70 and it was thus the least acceptable among all the batches.

Sample A has the highest mean value for odour i.e. 4.2±0.91and lowest for Sample D i.e. 2.5±0.70. The differences were statistically significant.

The overall acceptability was highest for Sample A with mean value of 4.2±0.78, however it was lowest for Sample D. The results are however statistically significant.

BANANA DAY 8

In peel colour, there was a statistically significant difference between the batches as determined by one-way ANOVA i.e. 0.001. Sample A has the highest mean value i.e. 3.7±0.48 whereas Sample D has lowest mean value i.e. 1.3±0.48.

Sample A has the highest mean value for fruit firmness i.e. 3.6±0.84 whereas Sample D has lowest value1.2±0.42. The differences are statistically significant among batches.

For taste Sample A has the highest mean value i.e. 3.5±0.70 which means it was more acceptable as compared to Sample D which has the lowest value i.e. 1.2±0.42 and it was thus the least acceptable among all the batches. The differences were statistically significant among batches.

Sample A has the highest mean value for odour i.e. 3.4±0.96 and lowest for Sample D i.e. 1.3±0.48. The differences were statistically significant
The overall acceptability was highest for Batch A with mean value of4±0.47, however it was lowest for Batch D.

BANANA DAY 12

In peel colour, there was a statistically significant difference between the batches as determined by one-way ANOVA i.e. 0.001. Sample A and C has the highest mean value i.e. 2.8±0.78whereas Batch D has lowest mean value i.e. 1.1±0.31.
Sample C has the highest mean value for fruit firmness i.e. 2.7±0.94 whereas Sample D has lowest value 1.1±0.31. The differences are statistically significant among batches.
For taste Sample A and C has the highest mean value which means these batches were more acceptable as compared to Sample D which has the lowest value i.e. 1.1±0.31and it was thus the least acceptable among all the batches. Sample C has the highest mean value for odour i.e. 2.5±1.26 and lowest for Sample D i.e. 1.2±0.42. The differences were statistically significant.
The overall acceptability was highest for Sample C with mean value of 2.6±1.17, however it was lowest for Sample D. The differences are however statistically significant.

Table3.2-Mean score of sensory attributes of banana kept at refrigeration temperature

DAYS	SAMPLES	PEEL COLOUR	FIRMNESS	TASTE	ODOUR	ACCEPTABILTY
4 DAY	AV	3.8±0.63	4.8±0.42	4.3±0.48	4±0.47	4.3±0.48
	WG	3.8±0.42	3.8±0.63[a]	4.1±0.31	3.7±0.67	3.8±0.42
	AV+WG[1:1]	3.8±0.63	4.4±0.51	4.5±0.52	4±0.47	4.1±0.56
	CG	2.1±0.73[abc]	2.8±0.63[abc]	2.8±0.42[abc]	2.5±0.52[abc]	2.9±0.56[abc]
8 DAY	AV	3.4±0.51	4.1±0.31	4.1±0.31	3.6±0.51	3.9±0.31
	WG	3±0.66	3.4±0.51[a]	3.5±0.52a	3.4±0.51	3.3±0.48[a]
	AV+WG[1:1]	3.1±0.56	3.7±0.48	4.1±0.31b	3.4±0.51	3.8±0.63
	CG	1.7±0.48[abc]	2.1±0.31[abc]	2.3±0.48abc	2.1±0.56[abc]	2.1±0.31[abc]
12 DAY	AV	2.5±0.70	2.9±0.87	2.9±0.73	2.8±0.78	2.9±0.56
	WG	2.2±0.63	2.8±0.63	3±0.66	2.6±0.69	2.8±0.63
	AV+WG[1:1]	2.8±0.78	3.3±0.48	3.2±0.42	3±0.81	3.2±0.63
	CG	1.4±0.51[abc]	1.8±0.78[abc]	1.6±0.69[abc]	1.4±0.51[abc]	1.4±0.51[abc]

Values are mean ± standard deviation
Significant tests were carried out after 4 days interval. Values in a row followed by different letters are significantly different($p<0.05$)

BANANA DAY 4[REFRIGERATION TEMPERATURE]

In peel colour, there was a statistically significant difference between the samples as determined by one-way ANOVA i.e. 0.001. Sample A, B and C has the highest mean value as compared to Sample D which has the lowest mean value i.e. 2.1±0.73.
Sample A has the highest mean value for fruit firmness i.e. 4.8±0.42 whereas Sample D has lowest

value 2.8±0.63. The differences are statistically significant among the batches.
For taste Sample C has the highest mean value i.e. 4.5±0.52 which means it was more acceptable by the panelist as compared to Sample D which has the lowest value i.e. 2.8±0.42 and it was thus the least acceptable among all the samples.
Sample A and C has the highest mean value for odour i.e. 4±0.47 and lowest for Sample D i.e. 2.5±0.52. The differences were statistically significant.
The overall acceptability was highest for Sample A with mean value of 4.3±0.48 whereas it was lowest for Sample D i.e. 2.9±0.56. The differences are however statistically significant.

BANANA DAY 8

In peel colour, there was a statistically significant difference between the samples as determined by one-way ANOVA i.e. 0.001. Sample A has the highest mean value i.e. 3.4±0.51 as compared to Sample D which has the lowest mean value i.e. 1.7±0.48.
Sample A has the highest mean value for fruit firmness i.e. 4.1±0.31 whereas Sample D has lowest value 2.1±0.31. The differences are statistically significant among samples.
For taste Sample A and C has the highest mean value i.e. 4.1±0.31 which means they were more acceptable by the panelist as compared to Sample D which has the lowest mean value i.e. 2.3±0.48 and it was thus the least acceptable among all the samples.
Sample A has the highest mean value for odour i.e. 3.6±0.51 and lowest for Sample D i.e. 2.1±0.56. The differences were statistically significant.
The overall acceptability was highest for Sample A with mean value of 3.9±0.31whereas it was lowest for Sample D i.e. 2.1±0.31. The differences are however statistically significant.

BANANA DAY 12

In peel colour, there was a statistically significant difference between the samples as determined by one-way ANOVA i.e. 0.001. Sample C has the highest mean value i.e. 2.8±0.78 as compared to Sample D which has the lowest mean value i.e. 1.4±0.51.
Sample C has the highest mean value for fruit firmness i.e. 3.3±0.48 whereas Sample D has lowest value1.8±0.78. The differences are statistically significant among samples.
For taste Sample C has the highest mean value i.e. 3.2±0.42 which means it was more acceptable by the panelist as compared to Sample D which has the lowest mean value i.e. 1.6±0.69 and it was thus the least acceptable among all the samplesSample C has the highest mean value for odour i.e. 3±0.81 and lowest for Sample D i.e. 1.4±0.51. The differences were statistically significant.
The overall acceptability was highest for Sample C with mean value of 3.2±0.63 whereas it was lowest for Sample D i.e. 1.4±0.51. The differences are however statistically significant.

3.2Titrable Acidity

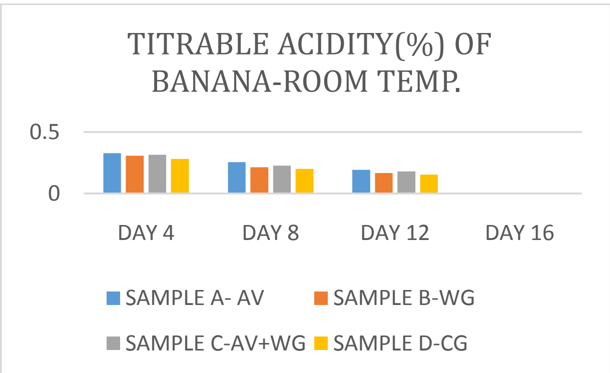

Figure 3.1-Titrable acidity (%) of banana stored at room temperature

On day 4 Sample A has the highest percentage of titrable acidity i.e. 0.328 whereas Sample D has the lowest percentage of titrable acidity with a value of 0.281.

Sample A has the highest value of titrable acidity i.e. 0.254 on day 8 as compared to sample D which has the least percentage of titrable acidity among all the groups.

On day 12 Sample A has the highest acid percentage of 0.194 as compared to Sample D in which the value was found to be the lowest i.e. 0.154

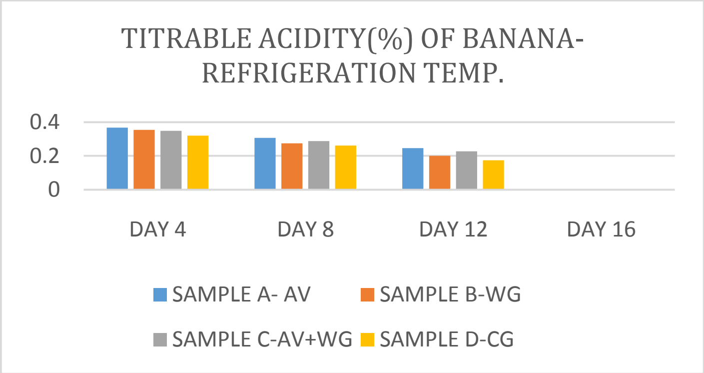

Figure 3.2- Titrable acidity (%) of banana stored at refrigeration temperature

On day 4 Sample A has the highest percentage of titrable acidity i.e. 0.368 whereas Sample D has the lowest percentage of titrable acidity with a value of 0.321.

Sample A has the highest value of titrable acidity i.e. 0.308 on day 8 as compared to sample D which has the least percentage of titrable acidity among all the batches.

On day 12 Sample A has the highest acid percentage of 0.247 as compared to Sample D in which the value was found to be the lowest i.e. 0.174

3.3Weight Loss

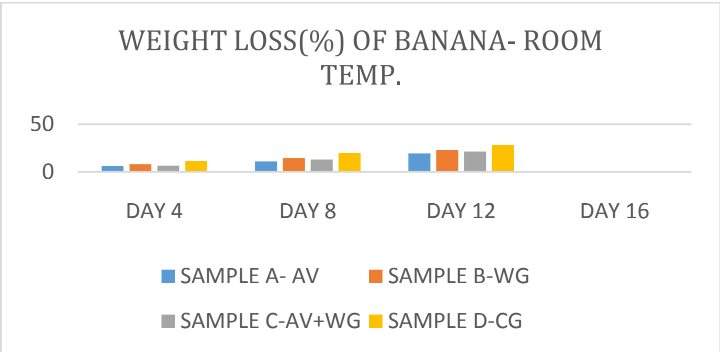

Figure 3.3-Weight Loss (%) of banana stored at room temperature

On day 4 Sample A has the lowest value of percent weight loss i.e. 5.71 % whereas Sample D has the highest percentage of weight loss with a value of 11.42%.

Sample A has the lowest weight loss percentage i.e. 10.71% on day 8 as compared to Sample D which has highest weight loss i.e. 20 %

On day 12 Sample A i.e. aloe juice coated bananas has the lowest value of percent weight loss i.e. 19.28% which means it was more acceptable as compared to Sample D which has the highest weight loss percentage i.e. 28.5% among all the batches.

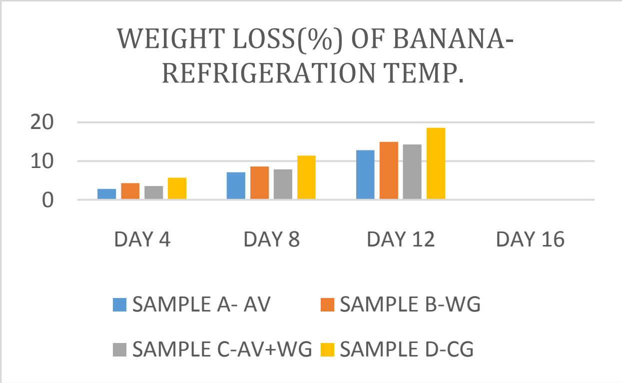

FIGURE 3.4- Weight Loss (%) of banana stored at refrigeration temperature

On day 4 Sample A has the lowest value of percent weight loss i.e. 2.85 % whereas Sample D has the highest percentage of weight loss with a value of 5.71%.

Sample A has the lowest weight loss percentage i.e. 7.14% on day 8 as compared to Sample D which has highest weight loss i.e. 11.42 %

On day 12 Sample A i.e. aloe juice coated bananas has the lowest value of percent weight loss i.e. 12.85% which means it was more acceptable as compared to Sample D which has the highest weight loss percentage i.e. 18.57% among all the batches.

4.CONCLUSIONS

Comparing with the uncoated bananans, all the coated bananas showed significantly reduced weight loss and delayed changes in ripening parameters such as titrable acidity. Sample A i.e. aloe vera juice coated bananas had the maximum acidity percentage followed by Sample C, Sample B and least percentage of acidity was found in Sample D i.e. the control sample. Ripening of fruits is associated with decrease in levels of organic acids during final senescence in plant tissues This is attributed to their oxidation via the respiratory metabolic pathways. Thus, it can be concluded that a high proportion of acidity found in coated fruits could be contributed to the use of various edible coatings which act as a preservative and barrier between the fruit and external atmosphere and therefore help to delay ripening as well as breakdown of organic acids into simpler compounds in fruits and therefore help in maintenance of quality of fruits throughout storage. Similar pattern was found in weight loss percentage which further states that apart from delaying the ripening of fruits edible coatings also helped to preserve the quality by reducing the loss of moisture from fruits by acting as a barrier between the fruits and the external environment. When water loss is avoided or at least reduced, firmness and changes in enzymatic metabolism that conduces to an accelerated senescence are also reduced.

All the coated samples kept at refrigeration temperature had higher percentage of acidity and weight loss as compared to the treated samples kept at room temperature since low temperature preservation acts synergistically with the edible coatings and thus delay the active metabolism of fruits.

Natural plant sourcescan thus be employed for preparation of edible coatings for extending the shelf life of fruits without causing any change in quality characteristics. Further studies can be carried out where other natural plant sources can be identified and their juices can be used as edible coatings with incorporation of various antimicrobials and antioxidants which would help to increase the overall effect of the developed coating solutions.

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