EFFECT OF *Aloe Vera* GEL COATING AND BAGGING OF FRUITS IN ENHANCING THE SHELF LIFE OF TOMATO.

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ABSTRACT

Postharvest losses of climacteric fruits in India is a serious problem mainly because of poor infrastructure and rapid deterioration during handling, transport and storage. Hurdle technology which involves the combination of two or more methods like application of edible coatings, active packaging, cold storage, etc. is the modern methodology, taking advantage of synergistic effect of different treatments to enhance the shelf life of climacteric fruits. Aloe vera has antimicrobial properties and does not add unfavourable properties to the food. Edible coatings have been granted GRAS status (Generally Regarded as Safe) by Food and Drug Administration. Objective of this work was to evaluate the combined effect of Aloe vera gelcoatingand bagging of mature unripe fruits in enhancing the shelf life of tomato. Effect of different treatments stored at ambient temperature was carefully monitored during ripening of fruits for their shelf life, loss in fruit weight (g), texture (kg/cm^2) , polygalacturonase activity (mg of glucose equivalent/g fresh wt. /hr) and fruit peel colour (6 point scale). Untreated control tomato fruits stored at ambient temperature exhibited the shelf life of 8 days . When Aloe vera gelcoating was applied on mature unripe tomato fruits, ripening was delayed by 4 days and fruits could maintain consumer acceptable quality for 12 days. It was interesting to note that combined effect of Aloe vera coating of mature unripe fruits followed by their bagging had tremendous effect on delaying the ripening process and fruits exhibited the shelf life of 40 days. Aloe vera coating followed by bagging of fruits had inhibitory effect on polygalacturonase activity, respiratory and transpirational loss in fruit weight, chlorophyll breakdown and consumer acceptable fruit texture could be maintained for 40 days. From the results,it was concluded that the application of edible Aloe vera gel coating combined with bagging of mature unripe fruits may be potentially applicable for commercial acceptability, for extending the shelf life and marketing of climacteric fruits.

Keywords: Aloe vera, edible coating,ethylene, polygalacturonase,shelf life, Tomato,

I. INTRODUCTION

Climacteric fruit ripening is an active process which is characterised by a sudden increase in respiration and ethylene production. Climacteric fruits are more susceptible to post harvest losses due to their fast ripening,

which is triggered by ethylene. If the rate of ethylene formation is decreased or prevented during ripening, then post-harvest storage life of fruits can be prolonged.

Plants naturally produce ethylene from the precursor methionine (MET), which is converted to S-adenosyl-methionine (SAM) by enzyme SAM synthetase. The key enzyme of the pathway, ACC synthase, converts SAM to 1-aminocycloprane-1-carboxylic acid (ACC) and in presence of oxygen, ACC oxidase converts ACC to ethylene [1]. Ethylene initiates the ripening process and triggers cascade of ripening accelerating pathways like respiration, activation of cell wall hydrolases as polygalacturonase, chlorophyll degradation, formation of lycopene.

Fruit production in India is about 76% and the post harvest losses of fruits in India is estimated to be about 30% in 2014 according to the Government of India, due to lack of storage facilities, transportation, pre and post harvest infrastructure . Post harvest loss of tomatoes in India are about 30-34%. Hurdle technology has come up to increase the shelf life of fruit which involves the combination of two or more methods like application of edible coatings, active packaging, cold storage etc , to obtain their synergistic effect on enhancing the shelf life of fruits.

Of late, significant research is being conducted on the essential oils and edible coatings which can potentially be used as coatings for enhancing the fruits storage life [2] . The advantages of using edible coatings on mature unripe fruits include:

- It provides moisture barrier on the surface of fruit and decrease the problem of transpirational fruit moisture loss . Moisture loss during postharvest storage of fresh produce leads to weight loss and changes in texture, flavour, and appearance not acceptable to the consumer.
- It provide a gas barrier thereby controlling gaseous exchange between the fruit and its surrounding atmosphere. This contributes to slow respiratory deterioration of fruits. The gas-barrier also delays ethylene production as the conversion of ACC to ethylene requires oxygen .This further may inhibit the cascade of ripening accelarating pathways.
- It has antimicrobial properties and thus may check the microbial deterioration of fruits .

The edible coatings of bee wax, *Aloe vera* gel or essential oils like lemongrass oil, eucalyptus oil, cinnamon oil extracted from plants have anti microbial and anti fungal properties and can be used in active packaging system without impairing any off odour to the product. Essential oils and edible coatings have been granted GRAS by FDA [3].

Aloe vera is a tropical or subtropical plantand contains nutrients and active compounds including sugar, vitamins, anthraquinones, minerals, enzymes, salicylic acid, lignin and amino acids [4].*Aloe vera* is beneficial to human health and has been proven to be biologically safe and one of the best edible coatings because of its hygroscopic properties, antimicrobial actions and biochemical properties. *Aloe vera* gel reduces a-galactosidase, polygalacturonase, and pectinmethyl-esterase activities in the fruit, thus delaying the ripening of the fruit. The reduced respiration in *Aloe vera* gel coated fruit may be described to the hygroscopic properties that enable the formation of a barrier to diffusion of gasses and water vapour between fruit and environment. Bagging of fruits also checks the gaseous exchange of fruits.This further controls deterioration of fruits by reducing the respiration rate and the transpirational loss of water.

Objective of this research was to study the synergistic effect of *Aloe vera* gel coating combined with bagging using low density polythene bags, in enhancing the shelf life of tomato fruit. Visual and biochemical changes during ripening of mature unripe tomato fruit were monitored to evaluate their role in influencing ripening process.

II. MATERIAL AND METHODS

Tomato fruits harvested at mature green stage were equally divided into three lots for :Control, *Aloe vera* coated and *Aloe vera* coated followed by bagging of fruits. Fruits were washed thoroughly and air dried. 100% *Aloe vera* gel and low density polyethylene bags were used for the treatment. *Aloe vera* coating was done at mature green stage.

Different stages of tomato fruit during ripening were identified by following USDA colour maturity stage chart [5]. The fruit weight decreases with ripening because of the transpirational water loss and respiration. Loss in fruit weight (g) was recorded till they attained full ripe red color stage 6 as they deteriorated in edible quality thereafter [6].

Fruit texture (kg/cm^2) is linked to the state of maturity and ripeness as it indicates the activity of cell wall hydrolases. It is one of the main limiting factor in quality [7]. Firmness or fruit texture (kg/cm^2) of tomato was analysed by using penetrometer.

Polygalacturonase (PG) is the major enzyme responsible for pectin disassembly in ripening fruit. As the fruit ripens, polygalacturonases cut pectin chains and thus releases galacturonic acid which softens the fruit and marks the ripening process of a fruit. The polygalacturonase activity increases with ripening. The increase in PG is a consequence of ethylene production [8].To determine the PG activity, absorbance of the enzyme extract was taken at 490 nm and calculation was done using the formula below:PG activity= (288.07*O.D) mg of glucose equivalent / g fresh wt./ hr.

III. RESULTS AND DISCUSSION

	Stage of Fruit			Weight (g)			Firmness (kg/cm^2)			PG Activity (mg glucose equivalent/g fresh weight/hr)		
Days After Treatment	Control	Coated	Coated + Bagging	Control	Coated	Coated + Bagging	Control	Coated	Coated + Bagging	Control	Coated	Coated + Bagging
0	1	1	1	38.1 ± 19.28	43.9 ± 20.46	35.6 ± 0.94	4.6 ± 2.14	6.4 ± 2.76	6.7 ± 0.66	74.61 ± 61.78	61.89 ± 49.08	42.3 ± 26.38
2	3	2	1	37.5 ± 19.28	43.5 ± 20.46	35.5 ± 0.94	4.3 ± 2.14	6 ± 2.76	6.5 ± 0.66	98.8 ± 61.78	67.69 ± 49.08	57.61 ± 26.38
4	5	2	2	37.2 ± 19.28	42.8 ± 20.46	35.3 ± 0.94	4 ± 2.14	5.7 ± 2.76	6 ± 0.66	140 ± 61.78	104.56 ± 49.08	85.26 ± 26.38
6	6	4	4	36.5 ± 19.28	42.4 ± 20.46	35.1 ± 0.94	3.6 ± 2.14	5.5 ± 2.76	6 ± 0.66	142.01 ± 61.78	106.87 ± 49.08	88.72 ± 26.38
8		5	4		41.8 ± 20.46	35.1 ± 0.94		5.5 ± 2.76	5.8 ± 0.66		107.84 ± 49.08	90.01 ± 26.38
10		5	5		41.1 ± 20.46	35 ± 0.94		5.4 ± 2.76	5.6 ± 0.66		108.5 ± 49.08	92.1 ± 26.38
12		6	5		40.7 ± 20.46	34.9 ± 0.94		5.3 ± 2.76	5.6 ± 0.66		109.43 ± 49.08	93.3 ± 26.38
14			6			34.6 ± 0.94			5.4 ± 0.66			108.69 ± 26.38
20			6			33.8 ± 0.94			5.2 ± 0.66			131.43 ± 26.38
40			6			32.5 ± 0.94			4.4 ± 0.66			119.02 ± 26.38

Fig 1: Effect of different treatments on Stage of fruit, Weight(g), Firmness (kg/cm^2) and PG activity (mg glucose equivalent/g fresh weight/hr)

Statistical Analysis: Mean fresh weight, firmness and PG activity of all three samples are 26.43g, 3.78 kg/cm^2 and 67.69 mg glucose equivalent/g fresh weight/hr respectively. Using one-way ANOVA, p values of fresh weight (0.029 < 0.05), firmness (0.001 < 0.05) and PG activity (0.13 < 0.05) indicated that there was a significant difference between PG activity of all treatments applied to tomato fruits. Also, no significant difference was observed between fresh weight and firmness between all three samples of tomato fruit. Standard deviation in above parameters is shown in Fig 1.

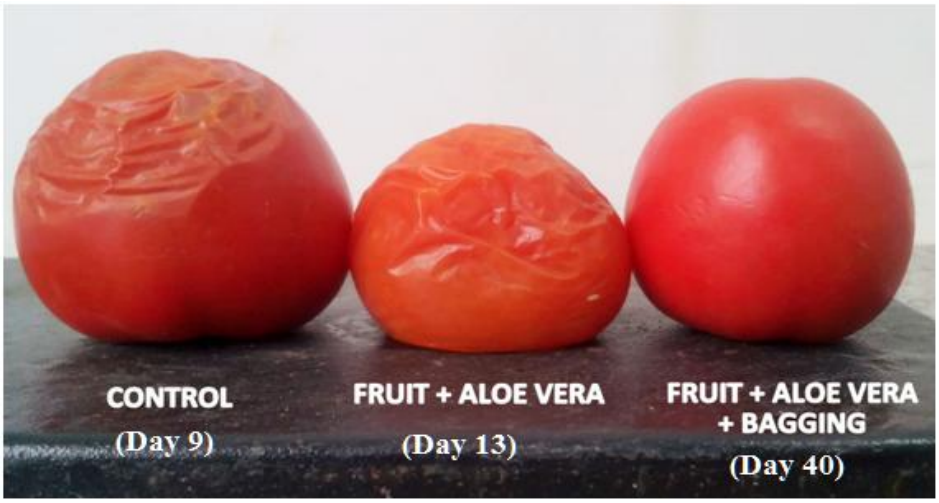

Fig 2: Effect of different treatments on Shelf Life of tomato fruits

Control tomato fruits reached full ripe stage 6 within six days and *Aloe vera* coated fruits maintained consumer acceptable quality for an extended period till 12th day. However, when *Aloe vera* coating was followed by bagging of fruits, the saleable quality of fruits could be extended till 40th day, suggesting the synergistic effect of *Aloe vera* coatingand bagging treatment. Due to rapid ripening rate in control fruits, sudden loss in fruit weight (g), degradation of chlorophyll , loss of fruit texture or firmness(kg/cm^2) and activation of polygalacturonases (mg of glucose equivalent / g fresh wt./ hr) was noted within 6 days beyond which control fruits deteriorated in quality. Mature unripe fruits coated with *Aloe vera* showed an extended shelf life for four days in comparison to control, which may be attributed to its antimicrobial properties and hygroscopic properties of gel that enable the formation of a barrier to diffusion of gasses and water vapour between fruit and environment. Extended quality of *Aloe vera* coated fruits is due to reduced transpirational water loss, respiratory loss of fruit weight, ethylene formation and therefore reduced activation of cell wall hydrolases. Formation of ethylene requires oxygen which is supplied at reduced rate in coated fruits delaying ripening. *Aloe vera* coating along with bagging was the most effective treatment for maintaining the shelf life of fruits for 40 days by slowing down the ripening process as compared to the control and only *Aloe vera* coated fruits. Synergistic effect of Aloe vera coating followed was bagging was experimentally noted in reduced respiratory and transpirational loss in fruit weight, maintenance of fruit texture or firmness , activity of cell wall hydrolase and reduced rate of chlorophyll degradation and thereby extending shelf life for 40 days.

IV. CONCLUSION

Ripening in perishable climacteric fruits can be effectively delayed and prevented from deterioration by applying edible coatings that have been granted GRAS status in combination with bagging of fruits. Both approaches delay ripening process of climacteric fruits by providing gas barrier across the fruit with the environment thereby retarding transpirational water loss, ethylene formation, respiration, activation of cell wall hydrolases by maintaining fruit texture and chlorophyll degradation. Synergistic effect of edible coating of mature unripe fruits followed by bagging can be a promising approach for marketing the fruits they have physiological and well as microbial control on delaying the ripening of climacteric fruits. As there is increased market demand for minimally processed fruits and vegetables, in the future, edible coatings that have antimicrobial properties in combination with will certainly become commercially important as part of hurdle technology.

Acknowledgements

Earnest gratitude is due to Dr Sunil Saran,Chairman, Amity International Centre for Post Harvest Technology and Cold Chain Management,Amity University Uttar Pradesh and Dr Chanderdeep Tandon ,Director and Professor, Amity Institute of Biotechnology, Amity University Uttar Pradesh, for their consistent support and help by providing all the necessary facilities for carrying out the research work.

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