Madras Agric. J. 89 (1-3) : 89-91 January-March 2002
https://doi.org/10.29321/MAJ.10.A00192

Effect of carbendazim, plant extracts and bio control agents on the physical, microbial and biochemical qualities of vacuum packed banana

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Abstract: Experiments were conducted to assess the effect of carbendazim, plant extracts and bio control agents on the physical, microbial and biochemical qualities of vacuum packed banana. The banana fruits treated with carbendazim (bavistin) had better shelf life when compared to bananas treated with plant extracts as a pretreatment before vacuum packaging. Among the plant extracts, fungicidal effect was better in the case of neem oil when compared with the leaf extracts. The firmness of the fruit was better in bavistin and neem oil treated fruits than in leaf extract treated fruits. The biocontrol agent *Trichoderma viride* was found to be better in controlling the microbial population than *Pseudomonas fluorescens*. The shelf life of vacuum packed banana fruit was 21 days. The approximate cost involved in vacuum packaging of banana is one rupee per kg of fruit. The residual level of fungicide present in the one-week vacuum stored banana was lower than the admissible limit. *(Key words : Carbendazim, Vacuum packaging, Microflora)*

India is the largest producer of banana in the world with an annual production of 130.95 lakh tonnes. Apart from India, the other major producers of banana are Brazil, Equador, Philippines, China, Indonesia, Columbia, Costa Rica, Mexico and Thailand. Bananas are grown all over the country, with significant amounts produced in central and southern states. Banana is the major fruit crop of Tamil Nadu next to mango, grown in an area of 79.31 thousand hectares accounting a production of 31.18 lakh tonnes of fruits. The share of Tamil Nadu to national production is 28.2 per cent.

In addition to increase in the area and production, there is need to provide facilities for adopting optimum post harvest technologies. It includes provision of necessary infra structure facilities in the form of field transport, packing house facilities with cooling system and refrigerated transport and storage. This will put Tamil Nadu in a position to supply bananas to other states of India and other countries.

Post harvest handling and storage is considered a major problem in the development of fruit and vegetable industry. Since, fruits and vegetables are constantly subjected to spoilage caused by senescence and microbial decay it is highly desirable to delay their ripening and senescence until they are consumed. It has been estimated that about 40% of perishable commodities are lost annually in India during various post harvest stages. Storage of fruits and vegetables are not practical except when associated with export. There is no viable technology available for suitable packaging for enhancing the shelf life, including during transit period. Various methods employed for enhancing the shelf life of perishable commodities such as waxing and respiration inhibitors were not very successful. Gorries and Peppelenbos (1992) reported that the application of modified atmosphere and vacuum packaging to extend the shelf life of food products that rapidly deteriorate.

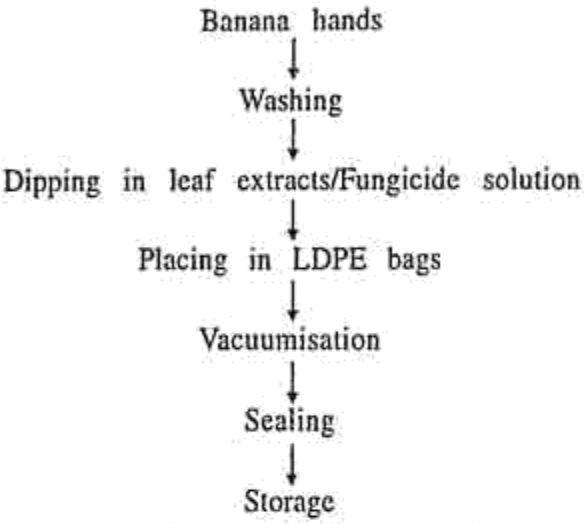
Rangavalli *et al.* (1993) studied the storage behavior of mango fruits and reported that fruits dipped in 6% wax emulsion containing 0.1% carbendazim and 200 ppm GA and kept in perforated polyethylene bags registered maximum shelf life compared to other treatments like 2, 4,5-T, KMnO4 and Ca $(OH)_2$. This treatment also recorded a reduction in loss of weight, acidity, respiration rate and an increase in sugar content. Fruits treated with fungicide were quite free from pathogen infection even at advanced stages of ripening. Church and Parsons (1995) reported that only harmonising a complex relationship between product and process might optimise the shelf life, sensory quality and safety of packaged products.

The application of vacuum packaging and storage (involves placing a product in a film of low O_2 permeability, removal of air from the package and application of hermetic seal) would delay ripening; retard physiological processes such as respiration, ripening and deterioration; minimise handling injuries and microbial infections to maintain optimum quality and extend the shelf life. Hence attempts have been made during 1998 to study the microbial flora and the biochemical changes occurring under vacuum packed condition with graded levels of carbendazim, plant extracts and bio control agents as a pretreatment.

Materials and Methods

Vacuum Packaging of Banana

Banana variety rasthali obtained from the market were separated depending upon the size of banana hands, cleaned and dipped in leaf extracts of 10% concentration for 10 minutes. They were air dried for 20 minutes to remove the excess moisture and vacuum packed in 400 G polyethylene bags using a vacuum sealing unit.



Flow diagram for Vacuum Packaging of Banana

Similarly the banana hands were dipped in bavistin for 5 minutes in respective concentrations, air dried for 20 minutes and vacuum packed in 400 G polyethylene bags in vacuum sealing unit as given in the flow diagram. Experiment was conducted to assess the shelf life of banana (variety rasthali) using plant products and as well as fungicide (Bavistin) as a pre treatment before vacuum packaging. The plant products *viz.* Tulasi leaf extract, Neem leaf extract, Karpuravalli leaf extract and Neem oil were used. Along with the plant products, the fungicide carbendazim at 500 ppm and 1000 ppm were also used to assess the shelf life of banana.

Experiment was also conducted using biocontrol agents *viz. Pseudomonas fluorescens* and *Trichoderma viride* as a pretreatment along with three different levels of Bavistin *viz.* 500, 1000 and 2500 ppm respectively before vacuum packaging in 400 gauge polyethylene bags. Banana hands were dipped in *Pseudomonas fluorescens* (3.8×10^9 per g of carrier) for 10 minutes and vacuum packed in 400 gauge polyethylene bags. Similarly pretreatments with 10g per litre of *Trichoderma viride* for 10 minutes was given to banana hands and vacuum packed

Observations were taken on 15th day and 30th day after packing for changes in pulp peel ratio, firmness of the fruits, microbial population and biochemical qualities of the fruits. Firmness of the fruits was measured by using a penetrometer and expressed as depth of the penetration in mm.

Results and Discussion

Effect of plant products and biochemical agents on physical and microbial qualities of banana

The effect of plant products and biochemical agents on physical qualities of banana *viz.* the pulp - peel ratio and firmness of banana is presented in Table 1.

It is observed from the Table 2 that the pulp - peel ratio for the *Pseudomonas floureseen* and *Trichoderma viride* treated samples was highe than all other treatments. These samples also had high firmness. This might be due to the lesser anti-microbial activity of these products. The major spoilage agent's namely aerobic microorganisms require oxygen. Therefore its unavailability will inhibit spoilage and thus maximises quality and storage life. Among the plant extracts studied neem oil gave higher pulp peel ratio and among the fungicides carbendazim at 500 ppm was fond to be better.

The total carbohydrate, total sugars, reducing sugars and non-reducing sugars were estimated on 15th day after packing and the results are presented in Table.3.

The rate of carbohydrate decomposition was higher in the case of plant products treated samples when compared to carbendazim treated samples. This may be due to the increased level of fungal population noticed in the plant product treated samples, which might have utilized the carbohydrates for their metabolic activities. Rangavalli *et al.* (1993) reported that mango fruits dipped in 0.1 % Bavistin and 200 ppm Gibberillic acid and kept in polythene bags registered maximum shelf life which reduced loss of weight, acidity respiration rate. In the present study also, in carbendazim treated samples, biochemical qualities remained without much change, due to the effective fungicidal action of carbendazim and reduced

Table 1. Effect of plant products and biochemical agents on pulp – peel ratio and firmness

Treatments	Pulp-Peel ratio		Firmness (mm)	
	15th day	30th day	15th day	30th day
Tulasi leaf extract	1.63 a*	1.71 a*	62.47 b*	45.13 b*
Karpuravalli leaf extract	1.73 ab	1.84 ab	57.25 b	41.31 b
Neem leaf extract	1.70 ab	1.72 ab	65.57 b	52.35 b
Neem oil	1.85 ab	1.91 ab	20.75 a	13.63 a
Pseudomonas fluorescens	3.24 d	5.04 d	46.43 d	29.18 d
Trichoderma viride	2.40 c	4.73 c	28.30 c	27.30 c
Carbendazim (500 ppm)	2.09 b	2.12 b	31.07 a	15.32 a
Carbendazim (1000 ppm)	2.07 ab	2.18 ab	25.75 a	14.67 a

* Means followed by a common letter are not significantly different at 5% level by DMRT

Table 2. Microbial population on vacuum packed banana

Treatments	Bacteria x 10^6		Fungi x 10^5	
	Days After Packaging		Days After Packaging	
	15	30	15	30
Tulasi leaf extract	-	2.5	23.6	32.3
Karpuravalli leaf extract	-	1.8	18.3	25.6
Neem leaf extract	-	3.2	28.0	33.6
Neem oil	-	9.6	16.3	26.3
Pseudomonas fluorescens	16.2	11.2	-	13.2
Trichoderma viride	-	1.8	-	12.4
Carbendazim (500 ppm)	-	2.0	2.8	9.6
Carbendazim (1000 ppm)	-	2.1	1.0	8.5

Initial Population : Bacteria 2.2 x 10^6 Fungi 3.2 x 10^5

Table 3. Biochemical studies on the quality of vacuum-packed banana

Treatments	Total Carbohydrate mg/100 mg	Sugar mg/100 mg		
		Total	Reducing	Non Reducing
Tulasi leaf extract	25.39	5.00	3.96	1.04
Karpuravalli leaf extract	26.92	4.85	3.50	1.35
Neem leaf extract	25.39	5.39	3.96	1.43
Neem oil	27.69	4.62	3.00	1.62
Pseudomonas fluorescens	24.55	4.32	2.95	1.55
Trichoderma viride	26.66	9.85	3.45	1.75
Carbendazim (500 ppm)	30.77	3.46	2.55	0.91
Carbendazim (1000 ppm)	30.77	2.54	2.82	0.72

water loss, the firmness of the fruit remains unchanged.

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(Received: November 2001; Revised: January 2002)