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Effect of modified atmosphere packaging on shelf life and post-harvest quality of *Coccinia indica* Wight & Arn: A least known medicinal plant

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Abstract

Coccinia indica Wight & Arn, commonly called Ivy gourd or Scarlet gourd is a tropical plant in the Cucurbitaceae family. Ivy gourd grows well in India as well as in other tropical areas. The roots, fruit, and leaves of *Coccinia indica* have been used for many medical conditions, including inflammation, asthma, cardiovascular disease (heart disease), and high cholesterol. *Coccinia indica* has mainly been studied as an antidiabetic agent. It has been shown to decrease blood sugar levels in humans and in animals. It is one of the choice plant of traditional medicine practitioners and used to relieve pneumonia, dysentery, cough and cold. The extracts of fruits reported to contain alkaloids, tannins, saponins, flavonoids, glycosides and phenols which are responsible for antimicrobial activity of the fruit. Loss in quality and comparatively limited shelf life are major problems faced in marketing of fresh ivy gourd in India due to its high respiration and transpiration rates at warm temperature. So the present investigation designed in order to extend the shelf life and maintaining quality of ivy gourd, it is essential to pack it in appropriate packaging materials to reduce the rate of respiration and transpiration so as to maintain freshness and high nutritional quality.

Keywords: modified atmosphere packaging (MAP), antidiabetic, antimicrobial, shelf life

Introduction

Ivy gourd [*Coccinia indica* Wight & Arn], is a tropical plant in the Cucurbitaceae family. It is an aggressive climbing vine that can spread quickly over trees, shrubs, and fences. The flower is large and white and contains five long, tubular petals. Ivy gourd grows well in India and Thailand, as well as in other tropical areas. The fruit, leaves and roots of *Coccinia indica* have been used in different medicinal preparations including treatment of inflammation, asthma, cardiovascular disease (heart disease) and high cholesterol. *Coccinia indica* has been studied as an antidiabetic agent mainly. It has been shown to decrease blood sugar levels in humans and in animals. It is one of the choice plant of traditional medicine practitioners and used to relieve pneumonia, dysentery, cough and cold. The bioactive compounds of fruits of *Coccinia indica* were show much significant antimicrobial activity. The organic extracts (petroleum ether and methanol) showed the highest activity against the test bacteria. The activity was more pronounced on gram-positive organisms with *Staphylococcus aureus* being more susceptible and *Salmonella paratyphi* being more resistant (Shaheen *et al.*, 2009) [7]. The fruits have hepatoprotective activity due to its antioxidant property exerted by flavonoids (Vadivu *et al.*, 2008) [12]. Taur and Patil (2011) [11]. Reported that fruit contain saponin, steroids, alkaloids, flavonoids and glycosides which contribute to most cell stabilizing; anti anaphylactic and antihistaminic potential which might be used in treatment of asthma.

There is very little work has been done with respect to shelf life studies though it is a well-known tropical vegetable extremely popular on the diet of large part of human populations living in developing countries. Commercially, fresh fruits are usually marketed in open street markets or supermarkets without any kind of temperature or humidity control. Consumers identify the loss of fruit quality by the external color and by the toughening or lack of turgidness of fruits. Policegoudra and Aradhya (2007) [4] reported moderate low temperature minimized the biochemical changes, maintained or increased the antioxidant activity and doubled the shelf-life as a function of temperature with storage time in stored mango ginger.

Loss in quality and comparatively limited shelf life are major problems faced in marketing of fresh ivy gourd in India due to its high respiration and transpiration rates at warm temperature.In Indian market conditions, fresh ivy gourd fruits are usually marketed in open street markets or supermarkets without any kind of package and temperature control. Ivy gourd left for more than five days at ambient temperature tend to become fibrous and unsuitable for direct use. Hence, there is an urgent need to extend their storage life using different pre and post-harvest management practices and their integration so as to enhance the marketable period for better disposal of the harvested produce with minimum losses.

MAP resulted in better maintenance of ascorbic acid content during storage (Zagory and Kader, 1989) [15] and greater humidity inside the packages possibly served to better preserve vitamin C content. Respiration and transpiration continue after harvest and since the produce is detached from its source of water, photosynthates and minerals, it is entirely dependent on its own food reserves and moisture content. Water loss is loss of saleable weight and thus a direct loss to the grower or seller. A loss in weight of only 5 % will cause many plant origin products to appear wilted or shriveled, and under warm, dry conditions without the correct packaging this can happen in a few hours (Sandhya, 2010) [6]. The respiration rate was faster at higher temperatures (40 °C) but remained stable at lower temperature (10 °C). This shows that the respiration rate was less at lower temperature, which in turn increases the shelf life of the ivy gourd fruit (Sushma Rani *et al*, 2013) [10]. Modified atmosphere packaging (MAP) is a gracious, cheap and convenient packaging system that has the capacity to preserve natural quality of food commodity in addition to extend the storage life, if it is used properly. MAP has been a proven technology to meet the consumer's demand for more natural and fresh foods, which is increasing day by day. It is also commercially successful for preserving certain fresh fruits and vegetables (Mangaraj *et al*., 2009) [1]. Storage at low temperature immediately after harvest reduces the rate of respiration resulting in reduction of buildup of respiration heat, thermal decomposition, microbial spoilage and also helps in retention of quality and freshness for a long period (Shantha, 1989) [8].

Generally, the lower the O_2 concentrations achieved by the MAP, the lower the rate of chemical as well as biochemical changes, resulting in reduced respiratory metabolism and other biochemical processes, and leading to retention of chemical quality characteristics (Workneh and Osthoff, 2010) [13].Qualitative changes in the broccoli (*Brassica oleracea var. italica*) under modified atmosphere packaging in perforated polymeric film have also been studied (Rai *et al.,* 2009) [5]. It has been found that perforated PP film packages (2 holes, each of 0.3 mm diameter) and having a film area of 0.1 m^2 could be used to store broccoli for 4 days under MAP with maintenance of chlorophyll and ascorbic acid. Ngure *et al.* (2009) [3] observed suppressed fruits quality deterioration and improved shelf life for 21 days when okra fruits were packaged in perforated polyfilm bags and stored at 13 °C. Muneruzzaman *et al.* (2009) [2]. Observed that tomato fruits harvested at half ripe stage treated with 0.5 per cent $CaCl_2$ and packed in polythene bag significantly extended the storage life with highest vitamin C, increase in reducing and non-reducing sugar. The quality and post-harvest life of produce depends on the biochemical processes taking place after harvest.

Frozen and low temperature storage are suggested by Srivastava *et al.,* (2007) [9]. To retain the bioactive components in plant products. In order to extend the shelf life and maintaining quality of ivy gourd, it is essential to pack it in appropriate packaging materials to reduce the rate of respiration and transpiration so as to maintain freshness and high nutritional quality. Keeping in view the above gaps, the present investigation deals with effect of modified atmosphere packaging on shelf life and quality maintenance in ivy gourd.

Materials and Methods

The studies were conducted at Department of vegetable science lab, College of Horticulture, Sirsi, Uttar Kannada, Karnataka. Sirsi is situated in Hill Zone of Karnataka (Zone – 9) State at 13°55'- 14°32'N latitude and 74°05'- 75°03'E longitude with altitude of 600 m above MSL.

Preparation of packages and sample

The fresh ivy gourd fruit required for present experiment was purchased from known farmer immediately after harvesting. After receiving in the laboratory, fruits of uniform size were selected to maintain homogeneity in the experiment. Then they were treated with 1% $CaCl_2$ solution for 30min and surface dried and then packaged in two different types of packaging films *viz*. Polyethylene (PE) and Polypropylene (bag size: 10x15 cm) with 0.5 per cent perforation (ten pin holes of 0.8 mm diameter each) and non-perforation then packages were heat sealed. After sealing each package was weighed and the weight recorded as the initial weight, and then they are kept at two storage condition *viz*. Room temperature (RT) and Low temperature (LT). Ivy gourd fruits which are unpacked and kept in plastic trays were taken as control sample and all the packages were replicated three times.

Experiment details

Storage condition (T): 2
Package treatments (P): 5
No of replication: 3
Total number of samples : 5 X 3X2 = 30
Statistical Design: CRD

Treatment details

Packaging Levels

T1= Packed in Poly Ethylene film (perforated)
T2= Packed in Poly Ethylene film (non perforated)
T3= Packed in Poly Propylene film (perforated)
T4= Packed in Poly Propylene film (non perforated)
T5= Control (No packaging)

Storage condition

A= Room Temperature (RT)
B= Low Temperature (LT)

Observation recorded

Physiological loss in weight (PLW)

Known quantities of fruits were kept in each treatment to record the physiological loss in weight. The weight of the fruits was recorded using electronic weighing balance (Model: Sartorius, BSA 320 2S d=0.01g) before storage. Thereafter, the weights were recorded regularly during storage and the cumulative PLW was calculated with the following formulae:

$$\text{PLW (\%)} = \frac{\text{Initial weight-Final weight}}{\text{Initial weight}} \times 100$$

Moisture content

Moisture content was determined by taking known quantity of sample in a Petridish and drying in a solar drier till the weight of the Petri dish with its content was constant. It is finally expressed as percentage.

$$\text{Moisture (\%)} = \frac{\text{Fresh weight} - \text{Dry weight}}{\text{Fresh weight}} \times 100$$

Shelf-life

Ivy gourd fruits were observed periodically at the time of taking weights for PLW calculation. The marketability in terms of the overall shelf life of ivy gourd was determined taking into account the general appearance, initiation of chilling injury, spoilage/rotting and PLW. The number of days the fruits were in edible condition was taken as the shelf-life or keeping quality.

Statistical analysis

The observations recorded under each parameter were statistically analysed with simple and factorial completely randomised design. The analysis permits evaluation of individual as well as interaction effects between the different factors involved in experiment.

Results and Discussion

Physiological loss in weight (PLW)

PLW during storage is due to transpiration and respiration losses. Weight loss through transpiration and respiration which affects stable weight and eventually the fruit become unsalable because of shrinkage the increase in weight loss during storage in the present study could be attributed to the foresaid reason. Physiological weight loss progressively increased with storage time and there was significant difference in weight loss of Ivy gourd stored in polypropylene, polyethylene, and unwrapped Ivy gourd as shown in Table 1 & 2. Under room condition, at 4 DAS Physiological loss in weight was higher in unwrapped Ivy gourd sample (15.92%) followed by perforated polypropylene (0.92%) and least weight loss was observed in polyethylene without perforation (0.46%). At 7 DAS the highest PLW was in non-perforated polypropylene (1.73%) and least was observed in perforated polyethylene (1.55%). At 13 DAS highest PLW was observed in perforated polyethylene (3.07%) & less was in perforated polypropylene (2.92%). Under low temperature condition at 12 DAS Physiological loss in weight was higher in unwrapped Ivy gourd sample (9.74%) followed by perforated polyethylene (1.05%), least was in non-perforated polyethylene (0.06%). At 24 DAS the highest PLW was in perforated polyethylene (1.83%) followed by perforated polyethylene (1.37%), least was in non-perforated polypropylene (0.17%). At 26 DAS highest PLW was observed in non- perforated polyethylene (0.25%), least was in non-perforated polypropylene (0.2 %).

Weight loss was higher in unwrapped Ivy gourd samples than sample in polyethylene and polypropylene stored in room temperature this was due to uncontrolled water loss and food reserve loss from tissues of Ivy gourd due biochemical activities such as transpiration and respiration. Further the weight loss was minimum in non-perforated packages compared to perforated packages because of reduced gas exchange in packages.

Table 1: Effect of MAP on physiological loss in weight (PLW), of *Coccinia indica* stored at room temperature (24-30 °C)

Treatments	PLW (%)													Shelf life (Days)
	1 Das	2 Das	3 Das	4 Das	5 Das	6 Das	7 Das	8 Das	9 Das	10 Das	11 Das	12 Das	13 Das	
1	0.34	0.49	0.71	0.89	1.07	1.30	1.55	2.72	1.97	2.25	2.52	2.77	3.07	13
T_2	0.24	0.26	0.37	0.46	0.62	0.77	0.89	-						7
T_3	0.30	0.50	0.72	0.92	1.11	1.34	1.60	1.85	2.03	2.24	2.44	2.72	2.92	13
T_4	0.18	0.26	0.41	0.58	0.74	0.92	1.73	-						7
T_5	6.76	9.98	13.39	15.92	-									4
F-Test	**	**	**	**	**	**	**	**	**	**	**	**		
S. Em ±	0.01	0.02	0.02	0.02	0.02	0.03	0.03	0.03	0.03	0.04	0.04	0.04	0.04	
C.D (5%)	0.04	0.05	0.05	0.05	0.05	0.08	0.08	0.08	0.10	0.12	0.11	0.12	0.13	
C.D (1%)	0.06	0.07	0.07	0.06	0.07	0.12	0.11	0.12	0.14	0.17	0.15	0.16	0.18	
CV	1.76	1.49	1.08	0.81	4.76	6.46	4.98	7.66	8.70	9.12	7.33	7.19	7.05	

** Significant @ 1 % * Significant @ 5% DAS**:**

Table 2: Effect of MAP on physiological loss in weight (PLW), of *Coccinia indica*stored at low temperature (8°C)

Treatments	PLW (%)												
	2 Das	4 Das	6 Das	8 Das	10 Das	12 Das	14 Das	16 Das	18 das	20 Das	22 Das	24 Das	26 Das
T1	0.09	0.27	0.39	0.52	0.83	1.05	1.15	1.27	1.40	1.66	1.76	1.83	-
T2	-0.07	-0.12	-0.09	-0.07	-0.01	0.04	0.01	-0.09	-0.02	0.15	0.18	0.21	0.25
T3	0.05	0.17	0.24	0.29	0.49	0.57	0.69	0.83	0.97	1.24	1.30	1.37	-
T4	-0.09	-0.04	-0.06	-0.08	-0.02	0.05	0.05	-0.02	0.01	0.14	0.16	0.17	0.20
T5	1.15	3.49	4.97	6.38	7.73	9.74	-						
F-Test	**	**	**	**	**	**	**	**	**	**	**	**	**
S. Em ±	0.02	0.03	0.04	0.05	0.08	0.08	0.07	0.08	0.07	0.08	0.11	0.09	0.02
C.D (5%)	0.06	0.10	0.12	0.14	0.23	0.23	0.22	0.23	0.23	0.26	0.34	0.26	0.05
C.D (1%)	0.08	0.14	0.17	0.19	0.32	0.31	0.30	0.31	0.31	0.35	0.47	0.36	0.07
CV	16.54	9.15	7.48	6.47	8.49	6.58	38.51	37.93	31.60	26.58	30.98	24.16	37.52

** Significant @ 1% * Significant @ 5% DAS: Days after storage

Table 3: Effect of MAP on moisture content of *Coccinia indica*

Treatment	Moisture Content (%)	
	LT	RT
T1	94.58	94.59
T2	94.35	95.70
T3	94.76	94.53
T4	92.90	96.06
T5	94.15	95.22
F-Test	**	**
S. Em ±	0.17	0.11
C.D (5%)	0.52	0.33
C.D (1%)	0.72	0.45
CV	0.46	0.29

** Significant @ 1% * Significant @ 5%

Days after storage

Moisture content (%)

Significant difference was observed for moisture content and data on moisture content of Ivy gourd fruits are presented in the table 3. Under room temperature, it was observed that moisture content was more in Ivy gourd packed in non-perforated polypropylene packages (96.06%), followed by Ivy gourd packed in non-perforated polyethylene packages (94. 0%). The lowest moisture content was observed in unwrapped Ivy gourd sample (82.15%). Where as under low temperature, higher moisture was observed in Ivy gourd packed in non-perforated polypropylene packages (94.90%), followed by perforated polypropylene packages (94. 76%). The lowest moisture content was observed in unwrapped Ivy gourd sample (86.22%). Sample in polyethylene retained moisture better than the control samples due to the property of the low density polyethylene which exhibit good barrier to water vapor loss and had the ability to reduce respiration rate of vegetable which in turn reduced respiration loss.

Shelf life

The data on shelf life of Ivy gourd during the experiment showed that, Ivy gourd fruits which are stored in low temperature has better shelf life than Ivy gourd stored in room temperature condition. Highest shelf life was found in Ivy gourd packed in the non-perforated polyethylene and polypropylene packages (26 days). Yahia (2006) [14] reported shelf life is increased byelevated concentrations of CO_2which inhibits the senescence-inducive effect of accumulated ethylene in non-perforated package. The lowest was observed in unwrapped Ivy gourd (12 days) in room temperature. Under low temperature both polyethylene and polypropylene packages has highest shelf life of (26 days) and lowest in unwrapped Ivy gourd (12days).

Plate 1: Effect of Modified Atmosphere Packaging on Shelf Life and Post-Harvest Quality of *Coccinia indica*

Conclusion

From these finding sit can be concluded that ivy gourd fruits packed in modified atmosphere packages (non-perforated polyethylene and polypropylene packages) shows better shelf life and better quality in terms of moisture content and physiological loss in weight.

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