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RESEARCH ARTICLE

Physico-Chemical Attributes of Soursop Fruits during Storage under Treatment of 1-Methylcyclopropene (1-MCP)

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Abstract

Owing to high moisture content, soursop (*Annona muricata*) fruit has a short shelf-life by turning soft and bruised easily after harvesting. It quickly becomes unacceptable for fresh consumption. This valuable fruit should be preserved for a long shelf life. However, the lack of improved postharvest technology limits it on domestic and foreign markets. This research evaluated the effectiveness of 1-methylcyclopropene in different concentration (0, 50, 100, 150, 200 ppm) to shelf-life of soursop fruits during 12 days at ambient temperature storage. The use of this ethylene inhibitor at 150 ppm improved the shelf-life and quality of soursop fruit, including lower weight loss, maintain firmness, retent ascorbic acid and soluble solid during preservation

Keywords: *Soursop, 1-methylcyclopropene, Preservation, Firmness, Weight loss, Soluble solid, Ascorbic acid, Post-harvest.*

Introduction

Fruit ripening is generally dependent on factors that affect ethylene production including low temperature [1], ethylene removal [2], inhibition of effect of ethylene [3, 5], chemical removal of ethylene [6]. 1-methylcyclopropene (1-MCP) has been shown to be highly effective inhibitors of ethylene action [7].1-methylcyclopropene delays fruit ripening, delays chlorophyll degradation and colour changes, reduces respiration rates, maintains firmness and other quality aspects (total soluble solid, titratable acidity, ascorbic acid), lower fruit weight loss and extends shelf-life of fruits such as apple, avocado, banana, mango, plum, tomato, apricot, mango, guava, lime, brocolli, carrot, cherry, nectarine, orange, strawberry, pineapple etc during post-harvest [8, 18, 14, 19, 27].

Response of the fruit to 1-MCP depends upon a number of variables such as cultivar, maturity, concentration, temperature, duration of exposure, application technique, and storage environment [28]. Soursop (*Annona muricata*) fruit is one of important tropical plant contributing to the economic growth as well as poverty reduction and hunger elimination in rural and mountainous area of Vietnam. It can adapt well to climate change. Soursop fruit contains various types of nutrients beneficial to human health. It has various therapeutic properties [29]. It is prized as its very pleasant, sub-acid, aromatic juicy, distinctive flavour flesh with a major source of antioxidants [30, 33].It accounted for major pharmacological activities including cytotoxic, antileishmanial, wound healing, antimicrobial activity. It softens very rapidly during ripening and becomes mushy and difficult to consume fresh [34]. Its high perish ability of soursop and the short shelf life after harvesting are the main difficulties in enhancing its potential market for fresh fruit consumption [35]. Deterioration is caused by several factors such as intrinsic attributes of soursop fruit itself and storage conditions.

Stability of soursop fruits may reach consumer maturity up to 7 days depending on the maturation stage in which they were harvested and ripened at room temperature. Soursop fruit harvested and stored at 16∘C with the application of 1-methylcyclopropene (1- MCP) require between 8 and 9 days to ripen [36]. The combination of 1-MCP and wax emulsions can preserve nutritional composition and antioxidant activity of soursop [37]. Soursop (*Annona muricata* L.) fruits were treated with various concentrations of 1-MCP (0, 400, 800 and 1200 nL/L) at 15°C for 24 h and subsequently being stored at ambient temperature (25°C). Objective of our study focused on the effectiveness of 1-methylcyclopropene in different concentration (0, 50, 100, 150, 200 ppm) to shelf-life of soursop fruits during 12 days at ambient temperature storage.

Material and Method

Material

Soursop fruits at technical maturity were harvested from gardens in Soc Trang province, Vietnam. After collecting, they must be conveyed to laboratory for experiments as soon as possible. 1-MCP and other chemical substances were all supplied from Rainbow Technique Trading Co. Ltd, Ho Chi Minh City, Vietnam.

Researching Procedure

The fruits were placed in plastic boxes and treated with 1-MCP in different concentration (0, 50, 100, 150, 200 ppm). All treated samples were then stored at ambient temperature for 12 days. The physicochemical quality characteristics such as firmness (N), weight loss (%), soluble solid (°Brix), ascorbic acid (mg/100g) were evaluated in 3 day-interval.

Physico-chemical, Sensory and Statistical Analysis

Texture firmess (N) was measured by penetrometer. Weight loss %) was calculated by comparision the initial and final weight of a fruit. Total soluble solid (°Brix) was analyzed by refractometer. Ascorbic acid (mg/100g) was determined by iodometric titration where dark blue complex forms in the presence of starch at the end point [38]. The experiments were run in triplicate with three different lots of samples. Statistical analysis was performed by the Statgraphics Centurion XVI.

Result & Discussion

Firmness of Soursop Fruits Treated by 1-MCP

It's obviously noticed that significantly higher pulp firmness was exhibited by the soursop fruits treated with 1-MCP as compared to control fruits (see Table 1). Application of 1-MCP treatment above150 ppm significantly delayed fruits' softening. In soursop, firmness reveals the stage of ripeness, especially in reflecting the edible period.

Fruit softening along ripening by deconstruction of cell wall and middle lamella with modifications to the polysaccharide with the support of enzymes and proteins [39]. The soursop fruits exposed at 15° C had a decreased firmness more than 90% [40].The pulp of 1-MCP soursop fruits which were treated with 400 nL/L remained firmness throughout 6 days of observation at 25°C [41]. Retention of soursop firmness by 1-MCP treatment could be explained by reduction in ethylene production in utilization of 1-MCP as mentioned by Khan and Singh [42]. Similar findings also recorded in storage of cherimoya [43], mangosteen [44], banana [45] and pear [46].

Table 1: Firmness (N) of soursop fruits treated by 1-MCP (ppm) during storage

Storage (days)	0	50 ppm	100 ppm	150 ppm	200 ppm
0	5.29±0.03^{a}	5.29±0.03^{a}	5.29±0.03^{a}	5.29±0.03^{a}	5.29±0.03^{a}
3	4.86±0.02^{c}	5.07±0.02^{b}	5.12±0.00^{ab}	5.24±0.03^{a}	5.25±0.00^{a}
6	4.54±0.00^{c}	5.01±0.01^{b}	5.06±0.03^{ab}	5.17±0.00^{a}	5.20±0.03^{a}
9	4.31±0.00^{c}	4.96±0.04^{b}	5.01±0.00^{ab}	5.12±0.01^{a}	5.14±0.01^{a}
12	4.12±0.01^{c}	4.85±0.03^{b}	4.93±0.00^{ab}	5.04±0.02^{a}	5.07±0.00^{a}

Note: the values were expressed as the mean of three repetitions; the same characters (denoted above), the difference between them was not significant (α = 5%)

Weight Loss of Soursop Fruits Treated by 1-MCP

Weight loss (%) of soursop fruits was monitored during 12 days of preservation (see table 2). This indicated the efficacy of 1-MCP in slowing down the respiration rate as well as metabolism mechanism in soursop fruit. 1-MCP postponed in ripening by prolonging the oxidation of ascorbic acid in soursop. Our results were in accordance to one report by José Orlando Jiménez-Zurita et al [40]. They showed that the soursop fruits exposed at 15°C had a significantly lower weight loss (5%).

Table 2: Weight loss (%) of soursop fruits treated by 1-MCP (ppm) during storage

Storage (days)	0	50 ppm	100 ppm	150 ppm	200 ppm
0	0	0	0	0	0
3	2.19±0.03[a]	1.74±0.00[b]	1.13±0.03[bc]	0.75±0.02[c]	0.73±0.02[c]
6	3.53±0.02[a]	1.96±0.00[b]	1.65±0.01[bc]	1.27±0.01[c]	1.24±0.01[c]
9	5.27±0.03[a]	2.19±0.01[b]	1.94±0.02[bc]	1.71±0.03[c]	1.66±0.03[c]
12	8.12±0.01[a]	2.75±0.02[b]	2.39±0.02[bc]	2.05±0.01[c]	2.00±0.01[c]

Note: the values were expressed as the mean of three repetitions; the same characters (denoted above), the difference between them was not significant (α = 5%)

Total Soluble Solid of Soursop Fruits Treated by 1-MCP

The increase in total soluble solid during storage could due to the conversion of starch into soluble sugars contributing to sweetness and flavour of edible fruit. However, the increased total soluble solid in treated samples was lower than control (see Table 3). This could be explained that 1-MCP effectively postponed in the production of total soluble solid which probably due to the slowing down metabolism actions, therefore retarding the ripening process. The concentration of total soluble solid increased to 5.3 to 15° Brix for soursop fruit stored at 22°C [40]. Our results were consistent with the findings of Espinosa et al [36].

Table 3: Total soluble solid (°Brix) of soursop fruits treated by 1-MCP (ppm) during storage

Storage (days)	0	50 ppm	100 ppm	150 ppm	200 ppm
0	3.41±0.02[a]	3.41±0.02[a]	3.41±0.02[a]	3.41±0.02[a]	3.41±0.02[a]
3	6.15±0.01[a]	5.97±0.03[ab]	5.23±0.03[b]	4.98±0.00[bc]	4.12±0.03[c]
6	9.94±0.03[a]	7.18±0.00[b]	6.85±0.01[bc]	6.29±0.01[c]	5.75±0.01[d]
9	13.27±0.02[a]	9.74±0.01[b]	8.33±0.03[c]	7.78±0.00[cd]	6.83±0.02[d]
12	18.41±0.00[a]	12.29±0.02[b]	10.26±0.02[c]	9.34±0.03[d]	8.41±0.00[e]

Note: the values were expressed as the mean of three repetitions; the same characters (denoted above), the difference between them was not significant (α = 5%)

Ascorbic Acid of Soursop Fruits Treated by 1-MCP

Soursop fruits stored at 22 °C recorded the highest amount of vitamin C [47]. In our findings, treated fruit revealed a higher content of ascorbic acid compared with untreated fruit (see Table 4). Ascorbic acid was higher at the initial ripening stage and decreased during the ripening process.

Table 4: Ascorbic acid (mg/100g) of soursop fruits treated by 1-MCP (ppm) during storage

Storage (days)	0	50 ppm	100 ppm	150 ppm	200 ppm
0	45.29±0.02[a]	45.29±0.02[a]	45.29±0.02[a]	45.29±0.02[a]	45.29±0.02[a]
3	42.11±0.03[c]	42.33±0.00[bc]	42.86±0.02[b]	43.51±0.03[ab]	43.89±0.00[a]
6	39.40±0.00[d]	41.56±0.01[c]	42.03±0.03[b]	42.38±0.02[ab]	42.74±0.00[a]
9	36.53±0.01[d]	40.71±0.00[c]	41.54±0.01[b]	41.94±0.01[ab]	42.13±0.01[a]
12	34.11±0.00[e]	38.85±0.00[d]	40.21±0.00[c]	41.15±0.02[b]	40.87±0.03[a]

Note: the values were expressed as the mean of three repetitions; the same characters (denoted above), the difference between them was not significant (α = 5%)

Conclusion

Soursop fruit contains high nutritional carbohydrates and appreciable amounts of micronutrients, antioxidants and minerals with many therapeutic properties. It is a major source of income for many farmers. Promising retail prices for soursop provides great opportunity to growers for cultivation. It has been received considerable attention from the public. 1-methylcyclopropene (1-MCP) is an ethylene antagonist by inhibiting ethylene action through binding strongly to ethylene receptors in plant tissues. The use of this ethylene inhibitor improved the preservation and quality of soursop, including lower weight loss, maintain firmness, retent ascorbic acid and soluble solid during 12 days of preservation at normal environment.

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