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Effects of different concentrations of clove (*Syzygium aromaticum* L.) extract on shelf life of strawberry

Fatima Alobiedi[1], Hamid Madani[1]*, Saied Chavoshi[1] and Aswan Hamadallah[2]

[1]*Department of plant Science, Arak branch-Islamic Azad University- Arak-Iran*

[2]*Department of Food Science, College of agriculture, University of Baghdad*

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***Corresponding author:** Hamid Madani, Arak branch-Islamic Azad University- Arak-Iran

Abstract

Strawberry fruit have a very short shelf-life period due to their high degree of infections. The aim of this study was to determine the efficiency of clove oil solution on the shelf-life and quality of strawberry fruit. Clove oil solutions 0,100,300 and 500 ppm were applied on immature and mature stages of strawberry fruits and stored at room temperature. Clove oil application showed significant delays in the change of Weight Loss (WL), Soluble Solid Content (SSC) and Shelf life significantly. These findings suggest that the use of 300 ppm clove oil coatings is useful for extending the shelf-life and health quality of strawberry fruit.

Keywords: Strawberry, Shelf life, Heath index, Calyx form, Color score

Introduction

The clove tree is an evergreen plant. Cloves flower consist of a long calyx that terminates in four spreading sepals, and four unopened petals that form a small central ball with aromatic scent [1]. The original clove zone is in Indonesia and Philippines [2]. Cloves are used in the cuisine of Asian, African, Middle East countries and may be used to give aromatic and flavor qualities to hot beverages. A mine component of clove plant parts is eugenol, that it has not been classified for its potential toxicity [3]. Other important essential oil of clove is acetyl eugenol, beta-caryophyllene and vanillin, crategolic acid, tannins such as bicornin, gallotannic acid, methyl salicylate, the flavonoids eugenin, kaempferol, rhamnetin, and eugenitin, triterpenoids such as oleanolic acid, stigmasterol, and campesterol and several sesquiterpenes [3]. Pervious study about essential oil of clove on the fruit health showed that the eugenol compound can function as antimicrobial activity in living things [4]. Thus, foods should be preserved against the microbial spoilage throughout the storage periods [5].

In addition to clove extracts could affects as anti-oxidative, fungicidal, and antibacterial effects on foods [5]. It has been reported that clove essential oil is one of the natural fungicides and antibacterial phytomaterial [6]. The garden strawberry need to remain on the plant to fully ripen because they do not continue to ripen after being picked [7]. Rotted and overripe berries are removed to minimize insect and disease problems [8]. The berries do not get washed until just before consumption.In large operations, strawberries are fall victim to a number of diseases like powdery mildew, leaf spot, leaf blight and slime molds [9].

Now, strawberry waste occurs mainly due to disease during shelf life. The use of biocontrol agents with plant extracts in plant disease control has been employed by Zeng and colleagues [10] suggested that clove extract might be a viable alternative to synthetic fungicides to extend the postharvest storage period and maintain fruit quality of navel orange too. The edible coatings can act as barriers, preventing moisture and aroma loss from fresh-cut fruit, delaying color changes, and maintaining the general appearance of the product during storage. The aim of this study was determination of efficiency of clove oil solution on the shelf-life and quality of strawberry fruit against disease and firmness factors.

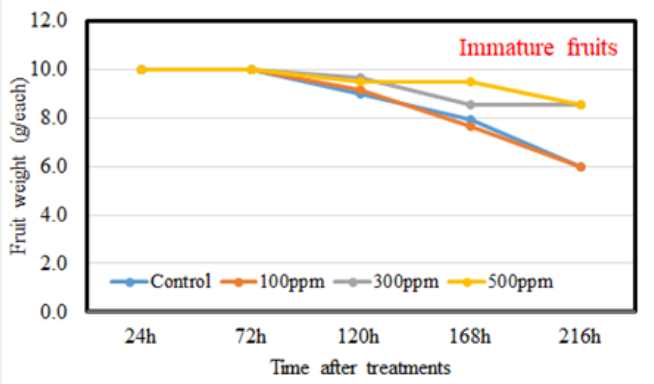

Figure 1: Immature strawberry fresh weight changes.

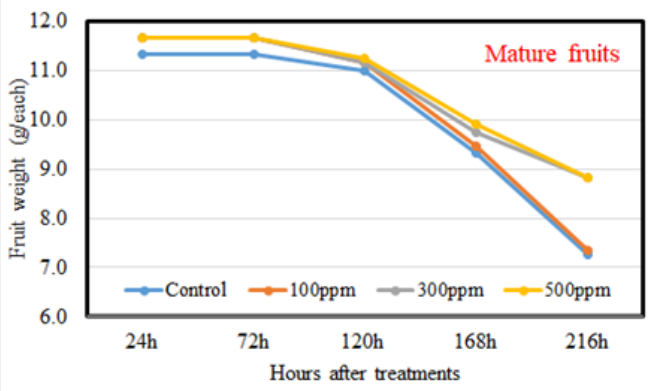

Figure 2: Mature strawberry fresh weight changes

Material and methods

The experiment was planted in August of June 2019 with 2 different strawberry growth stages by means of the fruits were divided into two groups of mature and immature fruits. The samples were stored under different conditions of clove oil concentrations. The observation on the strawberry fruit quality was daily, after 24, 48, 72, and 96 hours of storage in 25ºC in a room without air conditioning by RH about 60-85%.

Strawberries of the variety "Albino" (Fragaria x ananassa), grown off-ground, were provided by a local producer. In this study, the samples were handpicked directly, and strawberries were handled with care and placed gently into the container or plastic boxes (size: 10. 20. 5 cm), the mass was 25 strawberries fruit in each box) in lab condition of privet food laboratory.

The containers have different treatments to the fruits. Berries were chosen with the calyxes attached. Only the healthy berries were collected, the samples did not contain discards or any fungal lesions or injuries. Clove essential oil was extracted by hydro distillation 1:2. Dried clove buds were grinded for 1 h to obtain fine powder with a uniform particle size.

Distilled water was used as solvent. The distilled water and clove powder were heated for 1 h in the distillation container as starter (warm-up), and then distillation was continued about 4 h at 110 °C.

The extracted clove oil solution (0.0, 100, 300, and 500 microliter/liter respectively) in distilled water for 1 h at room temperature. A solution containing 0% clove oil was used as a control solution. Preservative of clove oil were applied on whole strawberry fruits using spray. With this method, the mixture was either sprayed on the fruits using spray bottle separately. Before the experiment start all fruits, material were weighed. 25 samples were prepared for each concentration of clove oil as well as for a control solution in three replications [11].

Data obtained from the experiment results were analyzed by CRD in three replications [SAS Institute, Inc., 1982]. Tukey test was used for assessing differences between the groups.

Results and discussion

Evaluation of strawberry qualities were divided into Weight Loss (WL), Soluble Solid Content (SSC) and Shelf life (SL) under different dosages of clove oil application [12].

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Weight and weight loss

Weight loss occurred during storage regardless the type of fruit or vegetable evaluated. However, the rate of water loss was dependent on the type of crop evaluated, and was greatly related to the physiological and morphological characteristics of each individual fruit or vegetable, and with the expected shelf life under the environmental conditions used in this study [13-15].

Weight loss gradually increased in mature strawberry fruits over time sharply, in immature fruits weight loss was affected by time and the high clove extract dosage significantly. Weight loss percentage of strawberry fruit at RTC was recorded on the 48-96-144 and 192 h. The rate of weight loss was controlled by 300 and 500 ppm clove oil application at 192 h by 10%. This is significantly lower than control and 100 ppm clove extract applications treatments (Figures 3,4).

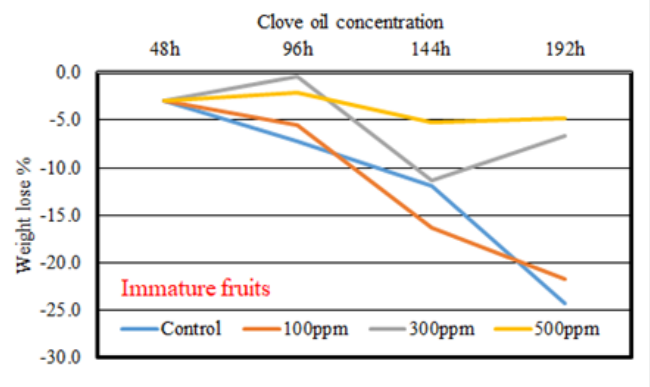

Figure 3: Weight loss rate of Immature strawberry

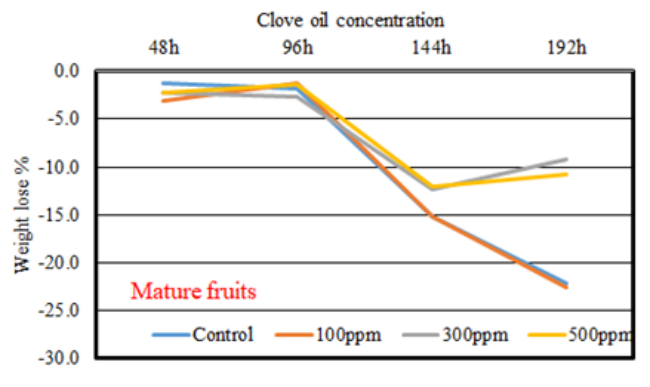

Figure 4: Weight loss rate of mature strawberry Soluble solid content

Table 1: Anova table for strawberry fresh weight.

SOV	df	Mean Square for fresh weight				
		24h	72h	120h	168h	216h
Maturity	1	15.042**	15.042**	18.904**	12.042**	6.407**
Clove oil	3	0.042	0.042	0.159	0.734	4.304*
Interaction	3	0.042	0.042	0.065	0.112	0.011
Error	16	0.167	0.167	0.173	0.358	0.807
CV.		3.78	3.78	4.05	6.72	11.9

Soluble solid content

The brix percentage of strawberry were measures from strawberry extracts. Clove oil application by different dosages were measured by using refractometer. The results show that the maturity stages and clove oil concentration could affected soluble solid content (SSC) significantly. The brix index was maximum

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by heist rate of clove oil application in mature and immature strawberry fruits too. Figure 5 and 6 showed the rates of SSC in mature and immature fruits separately.

Shelf life

Shelf life of strawberry fruit was recorded by every 2 days in normal room temperature for different clove oil application conditions and fruit ripening stages (Figure 7 and 8). The increase of shelf life supported by clove oil application at high dosage utilization. We find that the shelf life of strawberry fruits at the mature fruits was higher depended to clove oil application compare to immature fruits significantly. Post-storage shelf life (days) of strawberries at ordinary room conditions was observed by 15 as a record for shelf life duration compare to 10 day as control (Figure 7).

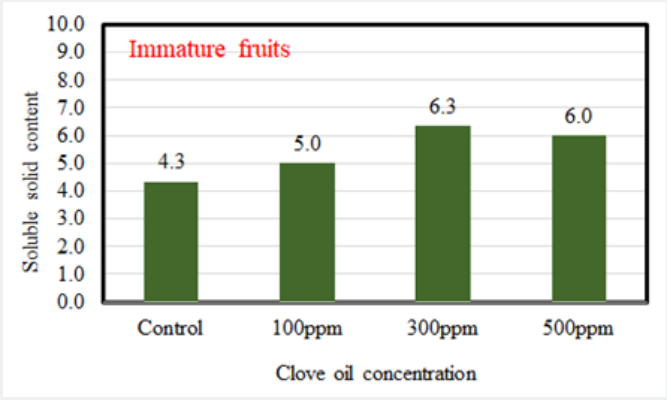

Figure 5: Soluble solid contents in immature strawberry

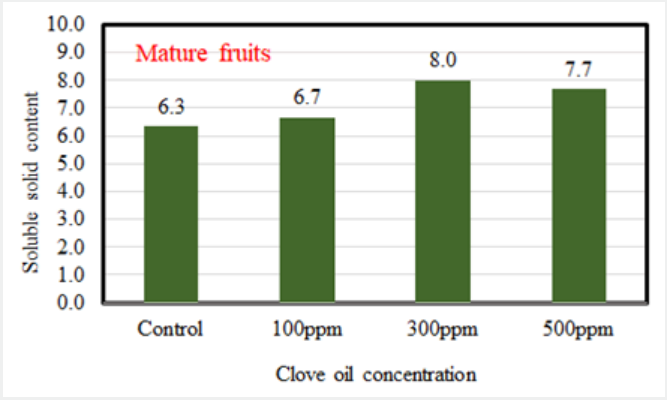

Figure 6: Soluble solid contents in mature strawberry.

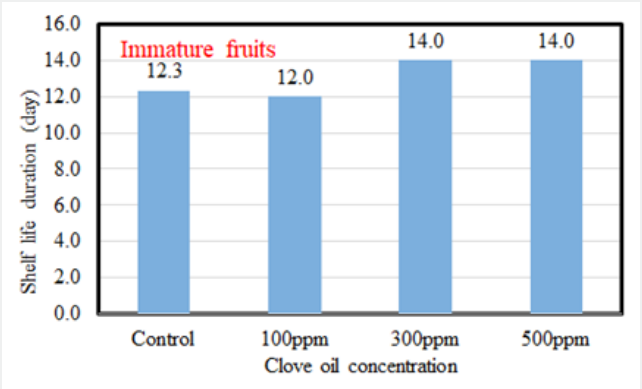

Figure 7: Shelf life in immature strawberry.

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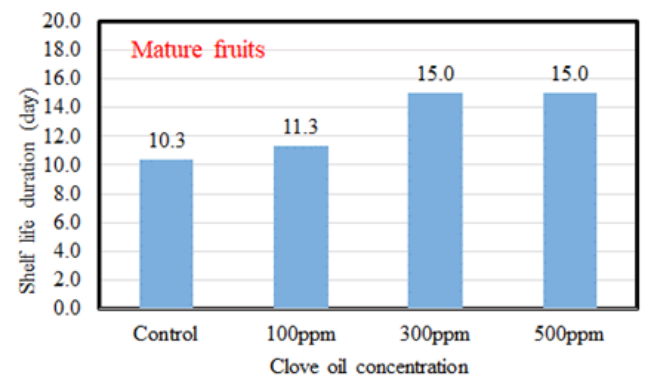

Figure 8: Shelf life in mature strawberry.

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