The effects of peppermint essence (Mentha piperita)and thyme (Zatariamultiflora) on quality and postharvest longevity of strawberry (Fragaria ananassa L.cv gaviota)

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Abstract

The aim of this study is evaluation the impact of peppermint (Mentha piperita) and thyme(Zataria Multiflora) essence on the longevity of strawberry (Fragaria ananassa L.cv gaviota) after harvesting. The concentration of these two essences was o, 250,500,750 mg/Lit that used in two forms of spraying and immersion. The method of experiment in this study was in factorial form in completely random frame and repeated in three times. After treatments, all fruits taken in plastic boxes transferred to fridge with 4 centigrade and 90% moisture. Different factors such as contaminant percentage, total suspended solids(TSS), Total Acidity(TA), Glucose to Acid ratio(TSS/TA), fruit reaction(pH), firmness of fruit tissue and weight loss were measured. The results of this research have demonstrated that the treatment of peppermint and thyme can be used as a proper method to improve the qualification of strawberry. Being attentive, the results showed that the thyme essence with the 750 mg/l and the peppermint with 500 and 750 mg/l had the best result considering their firmness, TSS increase, contaminant decrease, Vitamin C increase, enhance of fruit taste index and loss of fruit weight. Treatment of distilled water had the lower effects than thyme and peppermint on the features mentioned above.

Introduction

Fruits and vegetation are the most important of horticultural productions and have an essential role in fulfill of nutrition requirement and human health-being. Having high moisture, these types of productions are putrescent and usually after harvesting main part of them (5-50%) are lost. The rate of putrescence in some cases increases by 80 per cent. Lowering of this damages so-called “hidden harvest” can be one of the most effective ways in nutrition provision of a society (Zarekish, 2012).

In some countries with advanced agricultural system, remarkable progress has been occurred in postharvest technology. This performance not only minimizes products wastage but also can enhance the quality in transferring, storing and distribution circumstance. Pests and plant disease control, proper harvest technology, non-chemical treatments, use of natural compounds, pre-

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cooling activities, modern packaging system, proper storage method and appropriate method of distributions are the most common acts to minimize the wastage amount of fruits. Therefore, protection of these products requires a proper transfer method from farm to storage and marketing [2].

Phytology

The strawberry (*Fragaria sp*.) is the member of *Rosaceae.*

Wild strawberry (*Fragaria vesca L*.) with small and aromatic fruits, have been cultivating for centuries and in the sixties century the species of F. *virginiana* from Northern America gradually has replaced. Resistance to cold weather and drought, precocity, long fruiting period, sweetness, odor, firmness and size of the fruit are the specifications of this species [9].

The first species of strawberry was domesticated approximately 2000 years ago. In middle centuries, strawberry consumption was common between people. The leave of strawberry was used as a medicine in the thirteenth century [5].

Strawberry is herbaceous perennial plant and lives about 3-5 years. This plant has a short crown and lateral buds on it that can generate corymb. Adventitious roots are generated from below part of the crown. The height of crown is so short and is about5-10cm [6].

The strawberries' leave are Composite with three trifoliate. The average age of leaves on the crown is about 56 days. There are 15 flowers on each corymb.

The history of strawberry cultivation in Iran

Strawberry cultivation have been developed from Qajar era. From very early time, there were different species of wild strawberry in forest and mild regions. But the first modified type of it was entered into Iran from Atabak time, that the reason this is called Atabaki. Strawberry was introduced in 1317 for the first time to Kurdistan region. The research on strawberry was started in Iran from 1337.

Although climate condition is suitable for strawberry cultivation, but because of lacking information, pests and disease, and many other factors cause decrees in quantity and quality of strawberry.

The position of strawberry in the world and Iran

According to the FAO statistics import and export of strawberry in 2009 was about 712171 tone that worth about 1764475$. Spain, United State and Greece were respectively in the first, second and the third place. Iran with one tone export was ranked in the 77th place that valued about 1000 $. The amount of import in the globe was 702109 tones with value of 1848645$ that France was 106831 tone, Germany103673 tone and Canada 103073 tone. Iran potentially is able to export of the strawberry (FAO, 2009).

Nutritional value of the strawberry

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A ripe strawberry is a rich source of vitamins and minerals. This fruit contains ofvitamin A(60 mg in 100 g dry weight) vitamin C(30-120 mg in 100 gram dry weight), high amount of Salicylic acid, Vitamin B, minerals: Phosphor(P), Cobalt(Co), Ferrous(Fe), Sulfur(S), Silica(Si), Bore(B) and Pectin. Total suspended solid is about 7-12 per cent and 90% water.

Strawberry is consumed as a fruit and Jellies, jam, ice cream and sweet as well (Ozyogone and yolmaz, 2002). The chemical compounds of strawberry are summarized in table 1-1(Charma, 2002).

Table 1-1- different chemical substances in strawberry

Water (%)	85-90	Carbohydrates(gr)	8.5-9.2
Protein(gr)	0.25-0.7	Lipid(gr)	0.2-0.5
fructose	1.5-3.5	Glucose	1.5-3
Sucrose	0.8-2.5		
Minerals		Organic Acids	
Potassium	160-168	Citric	400-1250
Calcium	20-21	Malic	90-675
Phosphor	20-21	Succinic	90-100
Ferron	1-1.2	Oxalic	20-24
Sodium	1-1.2	Tartaric	15-17

The importance of postharvest treatment of strawberry

The age of strawberry is short after harvesting and can be stored only 7 days in optimum condition (0 C, moisture 90-95%). The reasons of such a short age are high sensitivity to mechanical damages, high rate breath and fungal decay. Therefore, the wastage rate of strawberry is so intense even in some cases 80-85% may be ruined [2].Abatement of the rate of this destruction as hidden harvest can be considered as an effective way in food provision of the society [9].

Fungal contamination is the factor that brings about detriment after harvesting. The most important postharvest fungi in strawberry is *Botrytis cinerea* which is the agent of gray mold disease [3].

Thyme

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Thymus vulgaris is a species of flowering plant in the mint family Lamiaceae, Growing to 15–30 cm tall and in some cases it reaches by 45 cm. it is a bushy, woody-based evergreen sub shrub with small, highly aromatic, grey-green leaves.

The essence is the effective substance of the thyme [10]. The essence is yellow or brown or dark red liquid which is highly aromatic, spicy flavorand is the compound of different chemicals (Velagjan and jiri Stodola, 1992).the leave contains essence, tannins, bitter substances, saponins and powerful disinfectant [11].

Table1-2 shows the other substances of this herb.

Thyme includes 08.-2.6% essence that most contain phenol (20-80%), mono terpinene hydrocarbons like p-cymene, y-terpinen, alcohols like limalool, α-terpinene, thujanlol. Thyme essence is extracted by distillation or steaming. This extract would be deteriorating in light exposure.

Mint

Mentha piperita is the herbaceous plant that its long reaches to 90cm. its leaf mostly used in food science and cosmetic industry.one of the most popular essence from mint is called peppermint. This essence has the antiviral property.

Previous study

Hasani et al.(2008) studied on impacts of thyme, basil and rosemary on the *B.cinerea* growth in pear. The results showed that the impacts of thyme essence on growth decline were more than the other essences. Vesal talab et al (2010) demonstrated that cloves extract with 150 ppm concentration decreased fungal acts in white grapes.

The results showed that thyme and copticum essences (0,250,500 ppm) have antifungal feature in white grapes. The concentration of 500ppm is more effective than 250ppm.

In a research done to study the impacts of savory, caraway, thyme and tarragon essences in control the act of *B. cinerea* and *B. Rhizopus* in strawberry. 250 microliter in liter any of the essence has not the antifungal feature

Asghari marjanlu et al., [5] showed that basil extract in different concentrations (60,250, 500, 1000 ppm) inhibit notably from *B.cinera* growth in strawberry.

Materials and methods

First proper, healthy and free of any pests strawberries were selected and after packaging, immediately were transferred to laboratory. For doing experiments, first required treatments (solutions) were provided and the samples exposed to these in two forms of submission and spraying. Then they were conveyed to fridge with 4 Celsius 90% moisture in boxes. These samples were kept two weeks in fridge then their specifications separately were recorded.

Experiment design and required treatments

The experiment was done in Factorial form (2 factors) that the first factor contains different

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levels of thyme and peppermint essence (0, 250, 500, 750 mg/l) and the second factor is the form of essence usage (spray or submission). These tests was done completely random with 3 times repetitions. In each unit 17 strawberries were tested.

Physicochemical experiments

The tests of weight loss percentage, TSS percentage, TA, pH , fungal pollution rate, firmness of texture and vitamin C were measured in especial machine And then they were analyzed**.**

5-3-data collection and statistical analysis

After collecting data, they transferred into Excel, and then analyzing in MSTAT-C software, the means comprised by Duncan test in 5 per cent and the diagrams were drawn in Exel.

Results

Table 4-1- variance analysis of different specifications

Source of change	**Degree of freedom**	**Mean square**			
		TSS	**TA**	**TSS/TA**	**Percent weight loss**
Concentration of different essences(A)	6	0.77^{*}	0.011^{*}	7.302^{**}	17.21^{**}
Consumption method(B)	1	0.105^{ns}	0.000230^{ns}	0.460^{ns}	13.85^{**}
Interaction A*B	6	0.345^{*}	0.001^{*}	6.597^{**}	16.13^{**}
Test bias	28	0.25	0.0054	1.76	3.54
Coefficient of variation (%)	-	7.15	9.68	14.86	16.27

^{ns} non-significant, *significant in 5% degree, **significant in one per cent degree

Source of change	Degree of freedom	Mean square			
		Contamination percentage	Tissue firmness	Vitamin C	Ph of fruit
Concentration of different essences(A)	6	59.65^{**}	1.131**	68.35**	0.026^{ns}

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Consumption method(B)	1	36.21**	0.23ns	0.21ns	0.015ns
Interaction A*B	6	45.82**	2.174*	4.76ns	0.031*
Test bias	28	35.26	0.021	31.02	0.025
Coefficient of variation (%)	-	19.03	11.66	17.76	6.12

ns non-significant, *significant in 5% degree, **significant in one per cent degree

Analysis of the results

The results have shown that the use of thyme and peppermint in 750 and 500 mg/l concentration respectively cause TSS increase.The highest changes during the ripping process in fruits are related to breaking down the carbohydrates especially the sugar in cell wall, these lead to flavor and tissue change. The flavor of fruits mostly associated with the sugar/Acid ratio and volatile compounds. Change of taste in a ripe fruit is because of sugar increase. In the ripping process approximately all amount of starch convert into sugar. This converting has two important impacts: sweetening and softening fruit firmness. Starch hydrolysis increases the amount of sugar. Starch content usually converts into sucrose instead of glucose. Starch decomposition is done by phosphorylase or amylase enzymes. The amount of sugar is so important in fruit quality. If a fruit lacks starch then its sweetness would not change.

Using peppermint (750mg/l) in two forms spraying and submission caused TA increase in strawberry. Usually organic acids during fruit ripping decreases (Jalili marandi, 2003, Rahemi 2004). Peppermint application in this experiment caused metabolism decreases, therefore organic acid consumption is postponed. There are many organic acids in plant tissues that are more than the required amount in Krebs cycle. The remained amount is stored in free form or dissolved form. The sour taste of the fruits is associated with acid. The amount of organic acid after harvesting decreased sharply. Decrease in acidity during ripping is because of acid participation in metabolism (Asna ashari, 2009).

Using thyme (250mg/l) in submission form increased pH. High pH protects vitamin C and also inhibits from pathogenic agent. So, it prolongs the store age. Hence, it is clear that using treatment to increase pH is a proper way to protect fruits.

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Flavour index of fruit was the highest in 750mg/l thyme and 250 or 500mg/l of peppermint. The sugar and organic acid ratio is the important factor in sweet and sour taste. The sweet taste of fruits is related to organic acid decomposition and high ratio sugar to acid. Peppermint and thyme essences cause decrease in ethylene production and metabolism and consequently decrease in breaking down in polysaccharides of cell wall and decrease of TSS/TA.

The highest weight loss has been accrued in control sample (without any treatment). The peppermint and thyme essences in 750 and 500 mg/l were more effective than other treatments.

The results gained from comparing treatments the lowest amount of contamination was related to treatments of thyme (500mg/l) peppermint (750mg/l).

These results are the same with former study by Maskuki and Mortazavi(2004). They found that thyme and rosemary essence decreased microbial decay and fungal growth. Antimicrobial effect is dependent on hydrophobicity in cytoplasmmembrane.

Restriction of bacterial growth by theme, peppermint and rosemary treatment, is because of hydrophobic feature and hydrogen banding by phenol compounds (Jun et al, 1994). The antibacterial feature of essences can restrict electron transforming and penetration in cytoplasm membrane(Tasou et al,2000). Thyme and peppermint can change the capacity of penetration in cytoplasm of microorganisms can decrease proton, phosphate and potassium and decrease firmness of the tissues(Lniotti, et al 2004).

Fruit firmness was in the best circumstance using peppermint (500, 750mg/l) and thyme (750mg/l). Cell wall particularly pectin during ripping process is decomposed, these treatments restrict this breaking down and consequently the quality of the fruit will be preserved. These results confirmed the findings by Olti et al(1999).

Strawberry is the rich source of vitamin C and thus has high antioxidant activities. Using of 750 and 250 mg/l peppermint and 500 mg/l thyme showed the highest amount of vitamin C. Structurally, vitamin C is one of the simplest vitamin which is synthesized from glucose or other simple sugar. Vegetation and fruits are the main source of vitamin C provision in human body. Vitamin C is decreased gradually after harvesting. The cause of this fact can be the oxidation of Acid Ascorbic (Chun et al., 2003). This vitamin oxidize by ascorbic enzyme and then decompose and hydrolysis. The amount of ascorbic acid would be constant until separation from mother plant (Asna ashari, 2008).

Conclusion

1- The results have shown that the treatments like peppermint and thyme can be considered as a proper method to maintain of quantity and quality of the

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fruit. So it is strongly recommended to marketerof this production to use these treatments.

2- Considering the results and the analysis, it seems that the thyme essence with 750 mg/l concentration and peppermint with 500 and 750 mg/l have shown the optimum results.
3- Distilled treatment on studied features have shown a lower effect than thyme and peppermint essences.

Recommendations

1- Study of the results show that thyme and peppermint essence consumption in submission form can maintain the quality of the strawberry. The life of strawberry after harvesting is so short. It is recommended that orchardists in order to enhance their productions, marketing and facilitate transportation and diminish of wastages, use these treatments.
2- The study should be expanded to identify the most effective submission time.
3- Considering physiology science, postharvest can be different regarding the weather, geography. Hence it seems these knowledge should be localized.

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