



STORED PESTS DISINFESTATIONS BY THERMAL TREATMENTS AND ITS IMPACT ON SOME QUANTITATIVE AND QUALITATIVE CHARACTERISTICS OF PYAROM DATE FRUITS

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ABSTRACT: In order to, disinfest Pyarom date fruits, they were subjected to a range of heat treatments (50, 60 and 70 °C for 2 hours) and cold treatments (-5, 0 and 5 °C for 2, 4 and 6 days). After treatment, fruits were packed and stored in a common store for 2, 4 and 6 months. At the appointed times, treated fruits were analyzed to count their living pests, larvae, pupa and egg. In order to determine quantitative and qualitative status of Pyarom date fruits, some characteristics such as pH, TSS, titratable acid (TA), moisture percent, dry matter percent and loss weight percent were measured. Results indicate the presence of some pests such as *Plodia interpunctella* and *Oryzaephilus surinamensis* in the fruits. Heat and coldness treatments significantly decreased fruit infestation. The most efficient treatments were 60-70 °C for 2 hours and 0 and -5 °C for 4 and 6 days. This was while they did not significantly affect fruit quantitative and qualitative traits.

Keywords: Pyarom Date Fruit, Stored Pests, Heat and Coldness Treatments.

INTRODUCTION

Iran is the first date producer countries in the world. Therefore date could play an important role as an exported crop in agricultural economic sector. Lack of care during harvest, packaging, handling and transport could lead to fruit contamination by pest eggs, larvae, pupa or even mature insect which consequently decrease fruit quantity and quality during storage [1]. Pyarom date is one of the most commercially favored and valued semi-dried date fruits. This cultivar is yellow in Khalal stage and dark brown in Tamar or full ripening stage. Fruit peel sticks to pulp and wrinkles on fruit surface. Fruit shape in long and elongated [2]. One of the most important deterioration factors in dried dates is storage pest infestation. Beside fruit damage, insects leave residuals in fruits and decrease their marketable value. They also provide a suitable substrate for Microbial proliferation and growth [3]. Some of store pest are Tooted weevil (*Oryzaephilus surinamensis*), Flour weevil (*Tribolium castaneum*), Tobacco beetle (*Lasioderma serricornis*), Indian bat (*Plodia interpunctella*) and Flour butterfly (*Anagastis kuehniella*). Other insects such as Fig bat (*Ephesia cautella*), Carob butterfly (*Ectomylosis ceratoniae*) and raisins bat (*Ephesia figulilella*) also have a role in infesting dried and semi-dried dates [3,5,43]. Indian bat larvae feeds on clusters of ripen dates, dopes dates on ground and exists in dates while they are in packaging factory. Larvae penetrate to fruit via cracks which exist on fruit surface or make a hole in safe fruit and imports to fruit. Larvae with weaves of web fully from refuse have important role in increase of damage. Raisins bat also infests date fruit on cluster and after harvest and its larvae feeds from ripen dates. Both Indian and Raisins bat are active in non-decayed and dried date fruits [4,5]. For disinfestations of date fruit stored pests can be used chemical and physical methods. Initial elimination of infection consists of: controlling relative humidity of storage facility, decrease of storage temperature, compact date fruit packaging and finally fruit disinfection [6,7]. At least during the last 70 years Methyl bromide (MB) has been used as disinfectant compound. MB is effective in controlling many pests, nematodes, weeds, viruses, bacteria and fungi and is used for soil disinfection. Beside that, MB is also used for disinfecting agricultural products such as date fruits, nuts, seeds and animal meal [1,3]. In addition to MB, Phosphin is also used to disinfest and control various store pests. Application of Phosphin has less environmental and health cautions compared to MB which is due to its primary release delay. Therefore Phosphin needs a longer time to influence compared to MB and also it's less efficient at low temperatures [8]. Due to environmental contamination and health risk, application of fungicides and insecticides has to be reduced. Beside that, some countries only allow the import of organic crops and practice difficult quarantine rules for importers.

Therefore demand for organic crops and crops that are disinfected by non chemical methods is gaining more consumers. Methods such as coldness, heat and radiation treatments are acceptable from most countries which import agricultural crops. These methods do not left any chemical poisons on crops and do not pollute the environment [1]. Insects are very sensitive to heat therefore heating more than 62°C for one hour kills many insects. Heat treatments (pasteurization) beside killing pests, inactivates enzymes and also are kills microorganisms [9]. Utilization of 87°C for 20 min, 71°C for 50 min or 66°C for 60 min has been reported effective to decrease contamination [7]. Some reports have showed that more stored pests could be killing if treated with 52-53°C for 3 hours. This heat is able to kill insect at all stages even egg [10]. Navarro *et al.* [11] reported that application of low temperatures about 0 °C lead to destruction of *Carpophilus hemipterus* beetle (important pest of 'Medjool' date). Johnson *et al.* [12] also suggested 0 °C for destruction of Carob butterfly (*Ectomyosis ceratoniae*). This pest contaminates 'Dajlat Noor' date fruit. Modarres Najafabadi [13] reported that coldness treatments (0, -5, -10 and -15°C) are effective on different stage of Indian bat (*Plodia interpunctella*). If an infected mass that is containing of all stages of Indian bat, put in -15 °C for 1.5-2 hours, all different stages will destruct. Karampour [1] reported that among heat treatment of 40, 50, 60 and 70°C for disinfestations of stored pests of 'Deiri' and 'Estaamaran' dates, heat treatment of 60 and 70 °C for 2 hours had the best influence. Homayoonfar [14] reported that thermal treatments of 50, 55, 45+ (-18), 50+ (-18), 55+ (-18) and -18 °C for 3 hours had the most influence on controlling stored pests of 'Zadehi' date fruits. Production of date fruit has increased during recent years but due to lack of proper packaging and processing industries and also appropriate storage in different provinces of Iran, losses of this product is at its highest level. As application of chemical treatments such as methyl bromide for date fruit disinfection (is forbidden now), it is necessary to evaluate the effects of different non-chemical treatments (coldness and heat) in controlling stored pests on the best and the most commercial date fruit of Iran i.e. 'Pyarom'.

MATERIAL AND METHODS

In order to, evaluate the effects of heat and coldness treatments on stored pests control, and consequently quantitative and qualitative traits of Pyarom date, an experiment was performed as factorial in CRD with 4 replications. First factor was storing durations which consisted of 2, 4 and 6 months and second factor was heat treatments of 50, 60 and 70 °C for 2 hours and coldness treatments of 5, 0 and -5 °C for 2, 4 and 6 days. For this purpose, completely ripen Pyarom dates were harvested from uniform trees in a garden in Aliabad, Hajiabad Township and were transferred to laboratory. For heat treatment application a regulative oven was used. In coldness treatments date fruits were put in 5, 0 and -5 °C for 2, 4 and 6 days individually. Each replication consisted of a 500 g package of dates which were wrapped in plastic bags after treatment. Treated dates fruits were then kept in common storage (T 20-25 °C and RH 45-50%) for 2, 4 and 6 months until measuring time. At the mentioned time, packages were withdrawer and transferred to a laboratory for measurement. Evaluated traits were: weight loss percentage, contamination or infestation percent to pest egg, larvae, pupa or mature insect of stored pests by use of pest use a compendium, total acid (by titration with 0.1 N NaOH), fruit pulp pH, TSS, fruit moisture and dry matter percentage (by drying samples in 72 °C for 48 hours. Statistical analysis was performed by MSTAT-C software and means were comparing by Duncan's Multiple Range test (DMRT).

RESULTS AND DISCUSSION

Regarding variance analysis, there was not significant interaction between two factors (storing durations and heat treatment). This was while the single effects of factors had a significant effect. Mean comparison indicated that during Pyarom date storage in common warehouse, dry matter percentage, stored pests infection percent and weight loss percentage significantly increased. This was while, traits such as fruit moisture percentage and pH during storage significantly decreased. Total acid do not changed during storage. Initially TSS significantly decreased after which it showed an increasing trend (table 1). Thermal treatments evaluation results showed that most fruit moisture percent belonged to 50°C heat treatment (13.77 %) and lowest belonged to -5 °C coldness treatment for 2 days (8.96 %). Generally, fruit moisture percent in zero and below zero treatments was significantly lower than above zero treatments. With temperature increment in heat treatments up to 70 °C, fruit moisture percent significantly decreased. The least dry matter percentage was observed in heat treatment of 50°C (86.22 %) and highest in coldness treatment of -5 °C for 2 days (91.04 %). Generally, dry matter percentage in zero and below zero treatments was significantly more than above zero treatments.

Identified pests in this experiment were: Indian bat (*Plodia interpunctella*), Flour weevil (*Tribolium castaneum*), Tooted weevil (*Oryzaephilus surinamensis*), date fruitarian worm and in some cases Tobacco beetle (*Lasioderma serricorne*). The highest infestation was observed in 5°C and control treatments and least in heat treatment of 70 °C. With temperature increment, infestation percentage decreased. It appears the effect of high temperatures in control of stored pests is above zero and below zero temperatures.

There were not any significant differences between different treatments in some traits such as pH, TSS and titratable acid (TA). The most weight loss percentage was observed in heat treatment of 70 °C (2.03 %) and the least was seen in coldness treatment of 5°C for 6 days (1.29 %). In this aspect, only coldness treatments of 5°C for 4 days, 0°C for 2 days and heat treatment of 70°C had a significant difference with control. Pyarom date is among semi-dried cultivars and harvest in Tamar stage. In this stage fruit flesh hardens and its moisture content is about 10-20 % or less. Therefore a naturally decrease in fruit moisture content (to cause compression of sugar substances) and a decrease in fruit weight and volume and microorganisms have not important role to rancidity of this date cultivar. Therefore, cause of 'Pyarom' date fermentation and decay is increase of air humidity during harvest time and transfer, as fungi grow in warm and humid condition and lead to decrease of quality and deterioration of fruit. In this study, coldness treatments of 0 and -5 °C and also heat treatments of 60 and 70°C compared to control and other treatments had very good impact on Pyarom date stored pest's control. The mentioned was best achieved by heat treatment of 70°C. Cold treatment was also effective in preventing undesirable biochemical process, decrease in microorganism's proliferation, and insect activity and therefore as a result it also increased date fruit storage life. In this regard, Karampour [1] reported that necessary temperature for destruction of microorganisms and especially their spore is more than needful temperature for destruction of the insects itself. Application of sterilization temperature (more than 100°C) is impossible as it damages date fruit. For dried and semi-dried dates, Barreveld [7] suggested the application of 60-65°C heat treatments for pasteurization. According to our findings, Barreveld [7] found 0 and -5 °C does not influence disinfestations compared to heat treatments of 60 and 70 °C. This is while some previous researches have reported 87°C for 20 min and more effective than 65 °C for 2 hours for disinfestations [7,15].

Table 1- Effect of different storing times on qualitative and quantitative traits of 'Pyarom' dates.

Trait \ Storage duration	2 months	4 months	6 months
Fruit moisture %	13.18 ^a	11.90 ^b	9.54 ^c
Dry matter %	86.82 ^c	87.91 ^b	90.44 ^a
Infestation %	11.38 ^c	21.65 ^b	41.44 ^a
pH	6.12 ^a	6.03 ^b	5.94 ^c
TSS	87.39 ^a	64.51 ^c	66.63 ^b
Titratable acid	0.326 ^a	0.333 ^a	0.334 ^a
Weight loss %	0.70 ^c	1.57 ^b	3.10 ^a

Means with same letter in each row, don't have significant different at 1% level of DMRT test.

Table 2- Effect of different heat and coldness treatments on qualitative and quantitative traits of 'Pyarom' dates.

Trait \ Treatments	Weight loss %	Titratable acid	TSS	pH	Infestation %	Dry matter %	Fruit moisture %
Control	1.36 ^c	0.333 ^a	72.13 ^a	6.00 ^a	51.75 ^a	86.24 ^e	13.76 ^a
5 °C for 2 days	1.31 ^c	0.331 ^a	72.30 ^a	6.04 ^a	52.42 ^a	86.33 ^e	13.67 ^a
5 °C for 4 days	1.98 ^{ab}	0.315 ^a	73.04 ^a	6.06 ^a	41.33 ^a	86.88 ^{de}	13.03 ^a
5 °C for 6 days	1.29 ^c	0.318 ^a	72.93 ^a	6.06 ^a	47.25 ^a	87.22 ^{de}	12.78 ^a
-5 °C for 2 days	1.38 ^{bc}	0.339 ^a	73.72 ^a	6.07 ^a	17.92 ^{bc}	91.04 ^a	8.96 ^c
-5 °C for 4 days	1.68 ^{abc}	0.325 ^a	72.80 ^a	6.02 ^a	18.00 ^{bc}	90.51 ^{ab}	9.49 ^c
-5 °C for 6 days	1.88 ^{abc}	0.338 ^a	72.18 ^a	5.99 ^a	24.58 ^b	89.12 ^{bc}	10.88 ^b
0 °C for 2 days	1.98 ^{ab}	0.343 ^a	72.58 ^a	5.98 ^a	18.75 ^{bc}	89.96 ^{ab}	10.04 ^{bc}
0 °C for 4 days	1.77 ^{abc}	0.344 ^a	72.73 ^a	6.01 ^a	14.00 ^{bcd}	90.17 ^{ab}	9.83 ^{bc}
0 °C for 6 days	1.68 ^{abc}	0.324 ^a	73.56 ^a	6.04 ^a	9.33 ^{cd}	89.82 ^{ab}	10.18 ^{bc}
50 °C for 2 hours	1.67 ^{abc}	0.327 ^a	72.57 ^a	6.07 ^a	13.58 ^{bcd}	86.22 ^e	13.77 ^a
60 °C for 2 hours	1.81 ^{abc}	0.338 ^a	73.43 ^a	6.00 ^a	10.25 ^{cd}	87.27 ^{de}	12.73 ^a
70 °C for 2 hours	2.03 ^a	0.328 ^a	72.97 ^a	6.06 ^a	3.58 ^d	88.28 ^{cd}	10.88 ^b

Means with same letter in each column, don't have significant different at 1% level of DMRT test

CONCLUSION

In this study 0 and -5°C temperatures and heat treatments of 60 and 70°C had considerable influence on disinfestations of stored pests in 'Pyarom' dates. The most desirable was achieved by heat treatments of 60 and 70°C for 2 hours. As for heat treatments operation oven or regulative electro heaters are needed, and that these facilities are used in all date packaging units; heat treatment is more economical than cold treatments.

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