HortScience 50(10):1531–1536. 2015.

Effect of Heat Treatment on Protein Content and the Quality of 'Hujingmilu' Peach [*Prunus persica* (L.) Batsch]

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Additional index words. 'Hujingmilu' honey peach, heat treatment, protein content, quality, heat-stable protein

Abstract. **Heat treatment induces resistance to low temperature in horticultural crops. Changes in soluble protein and heat-stable protein (HSP) contents, the total soluble solids (TSS), titratable acidity (TA), reducing sugar, weight loss and firmness of honey peach (cv. Hujingmilu) during heat treatment and refrigerated storage were investigated. Low-temperature storage alone led to decreasing of TA and reducing sugar and caused severe fresh mealiness. The hot-air treatment before low temperature combined with the use of a plastic bag (thickness of 0.03 mm) could counteract this effect. Heat treatment before refrigerated storage increased both soluble protein and HSP contents, and the ratio of heat-stable to soluble protein. The most favorable effect was obtained with 46 °C for 30 minutes. In addition, heat treatment before storage retarded the increase in fruit firmness, maintained the highest contents of the TSS and reducing sugar and inhibited the decline of TA during refrigerated storage. Treatment for 30 minutes at 46 °C before low-temperature storage in combination with a 0.03-mm plastic bag might be a useful technique to alleviate chilling injury (CI) and maintain honey peach fruit quality during cold storage.**

'Hujingmilu' honey peach fruit [*Prunus persica* (L.) Batsch], a living organism of large size (250 g), sweet flavor, smooth, and rich in nutrients, is loved by Chinese consumers. However, it has high metabolic activity after harvest, is sensitive to CI and quality rapidly deteriorates—this requires appropriate safe postharvest treatments and storage techniques to extend storage and shelf life.

Heat treatment can be used postharvest for many different fruits (Lurie and Pedresch, 2014). A number of studies have reported that heat treatment can safely and effectively delay ripening of various fruits (Paull and Chen, 2000), maintain their quality and reduce fruit CI (Ma et al., 2014). Appropriate heat treatment can retain fruit firmness in strawberries (Lara et al., 2006), tomatoes (Lu et al., 2010), bananas (Kamdee et al., 2009), apples (Lurie et al., 2005) and peaches (Lauxmann et al., 2013). Heat treatment has been commercially applied postharvest to stone fruit (Lurie and Pedresch, 2014; Mari et al., 2010) to maintain fruit quality after harvest and to investigate ethylene-related processes in ripening and senescence (Watkins, 2006). Heat treatment has been used in peach fruit to control post-harvest diseases (Karabulut et al., 2010; Liu et al., 2012), control decay (Hong et al., 2007), reduce CI (Jin et al., 2009), maintain fruit quality (Budde et al., 2006), maintain cell walls (Lara et al., 2006) and prevent ripening (Hayama et al., 2008).

The heat temperature and treatment duration are cultivar dependent due to different ripening behaviors. For example, heat treating at 39 °C, and then storing at 0 °C and 20 °C resulted in significant differences in the levels of galactosidase, melitriose, and benzene, a precursor of amino acids in 'Dixiland' peaches (Lauxmann et al., 2013). Heat treatment combined with methyl jasmonate vapor alleviates CI of 'Flavorcrest' peach during storage (Murray and Lucangeli, 2007). Liu et al. (2012) reported that heat treatment for 5 min followed by immersion in 40 °C water for 10 min inhibited the growth of brown rot and improved defense mechanisms during fruit storage. In 'Valencia' oranges, heat treatment of 37 °C for 48 h induced stress response-related proteins (Perotti et al., 2011). Zhang et al. (2011) reported that heat treatment improved the self-defense capability of peach fruit.

There is little detailed information about how fruit proteins change after heat treatment and storage. This paper is the concerning about relationship between the change in proteins and CI after different heat treatments, and the effect of these treatments on fruit quality.

Materials and Methods

Plant materials. Fruit of 'Hujingmilu' [*Prunus persica* (L.) Batsch] honey peach (a total of 1800) were harvested from Nan-Hui Honey Peach Institute in Shanghai on 22 July 2013. Maturity was assessed on a sample of fruit that were similar in size, skin color, and absence of mechanical damage, and then randomly divided into four groups in the field. Each group was packed with bubble nets and put into plastic crates. The fruits were moved back to the experimental laboratory at the Shanghai Academy of Agricultural Sciences within 30 min, and precooled at 4 °C for 24 h and then stored at 0 ± 1 °C. Upon arrival at the laboratory, fruit was immediately transferred to 20 °C for 2 h to evaluate initial quality indices: firmness, TSS, TA, reducing protein, and respiratory rate.

Experimental design. The pre-cooled fruits were divided into four groups, and one group was stored at 0 ± 1 °C and used as the control; and the other three groups were used for heat treatment under hot air (46 °C) for 10, 20, and 30 min (treatments I–III, respectively). During the hot-air treatment period, a layer of gauze with sufficient moisture covered the surface of fruit to prevent water loss from evaporation. The heat-treated fruit in each group were farther sub-divided randomly into three samples, and samples of 120 fruit were packed into a plastic bag, kept in a plastic box and stored at 0 ± 1 °C with humidity of 85% to 90%. All samples from each treatment during storage of up to 30 d were taken out randomly for determination of soluble and HSP contents at 3-d intervals for the first four measurements and 6-d intervals for the three later measurements, and for simultaneous determination of fruit firmness, TSS content, TA, weight loss, and decay rate. The tissue used for determining TA and reducing sugar was stored at –80 °C in an ultra-low temperature freezer. Treatments had three replicates and the total number of fruit was 1440.

For a more detailed investigation of the change in contents of soluble and HSP during the heat-treatment period, the following experiment was designed. Three samples, each containing 20 peach fruit, that were the same as described above were treated with 46 °C hot air continuously for a total of 44 h, and another three samples were kept at 20 °C also for 44 h. During the heat-treatment period, the contents of soluble and HSP were determined by taking one sample randomly from each group at the following determination points: every 10 min up to 1 h from the beginning of heat treatment; every 1 h for the next four determinations until 5 h; and every 5 h for later determinations up to 44 h. The tissue used for determining protein

Received for publication 12 June 2015. Accepted for publication 14 Aug. 2015.
This work was supported by the China Agricultural Research System of Peach (CARS-312011-2015), Shanghai Fruit Industry Technology System (SASI2014-2018), and No. 1-3, Shanghai rural youth talent growth plans (2015–17).
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was stored at –80 °C in an ultra-low temperature freezer. Treatment had three replicates and the total number of fruit was 360.

Measurements. Soluble and HSP contents were determined using the method of Bradford (1976). To each of three samples of 2.5 g of pulp was added 5 mL of 0.05 M phosphate-buffered saline (PBS) extraction buffer (pH 7.0) and they were ground uniformly, making the capacity of liquid supernatant to 10 mL with PBS. After sample homogenization in extraction buffer, the vials were shaken for 5 min and then centrifuged at 12,000 *g* for 15 min. Each treatment had three replicates (i.e., three samples). To 1 mL of supernatant was added 5 mL of Coomassie brilliant blue G-250, and left standing for 2 min, then the liquid was scanned at 595 nm using a Shimadzu ultraviolet-1200 spectrophotometer (Shimadzu, Japan).

For HSP, 1 mL of supernatant was incubated in 100 °C boiling water for 10 min, and then 5 mL of Coomassie brilliant blue G-250 was added, and left standing for 2 min; then the liquid was scanned at 595 nm using a Shimadzu ultraviolet-1200 spectrophotometer.

Weight loss was calculated according to the weight of each sample before and after heat treatment or storage, and expressed as the percentage weight loss with respect to the initial weight: Weight loss = [(original weight – the survey weight)/original weight] × 100. The weight loss of each fruit ($n = 3$) (in grams) was determined using a digital electronic balance (T500; G&G Measurement Plant, Changshou, People's Republic of China).

TSS was determined in the undiluted decanted juice from the macerated mesocarp of individual fruit at 20 °C using an alpha handheld refractometer (ATAGO-1; Atago Co. Ltd., Tokyo, Japan), calibrated using distilled water.

The texture of the fruit flesh was measured using a FTA-XT Plus texture analyser (Stable Micro-Systems; Texture Technologies Corp., Scarsdale, NY) fitted with an 8 mm diameter probe. Firmness tests were conducted on 10 fruit with a pretest probe speed of 1 mm·s^{-1}, a test speed of 2 mm·s^{-1}, and a distance of 5 mm; the firmness values are expressed in kilograms.

TA was determined by titrating fruit juice to pH 8.2 with 0.05 mol·L^{-1} NaOH, and results were expressed as g of malic acid equivalent per 100 g of fresh weight. Reducing sugar was determined by the 3,5-2 nitrosalicylic acid method at a wavelength of 540 nm. Using 40 g of flesh, 40 mL of distilled water was added and then homogenized. Then 5 g of homogenate was transferred to a test tube, four times the volume of distilled water was added and extraction was performed for 30 min in 80 °C water; this was filtered and diluted with water to 100 mL. Learning 6 mL of filtrate, joining 4 mL of reagents which were blended with same volume of Fehling reagents A and B. This was incubated for 15 min in 100 °C boiling water and light absorption value was measured at 590 nm.

Respiratory rate was determined using the method of Zhou (2013). Thirty randomly chosen peach fruit were placed in an airtight container (of volume 40 L) at room temperature of 20 °C, and the change in carbon dioxide (CO_2) concentration within 10 min was measured and tested for 30 min with a nondispersive TES-1370 type CO_2 gas meter (TES Electrical Electronic Corp., Neihu District, Taipei, Taiwan, China), and results were expressed as mg CO_2/kg/h. The evaluation had three replicates.

Statistical analyses. All data were expressed as mean ± SD. Statistical analyses were performed using SPPS software Version 17 for Windows (SPSS Inc., Chicago, IL). Treatments were compared using Duncan's new multiple range test after analysis of variance. Means separation at $P \leq 0.05$ was taken as significant.

Results

Change in soluble and HSP contents during storage. The contents of soluble and HSP were measured during refrigerated storage (Fig. 1). The soluble protein content after 30 min of heat treatment increased up to 6 d and then decreased; the soluble protein content decreased during storage after 3 and 6 d until the end of storage in control and heat-treated fruit, respectively (Fig. 1A), possibly due to protective mechanisms. Heat treatment also had a remarkable effect on the change in soluble protein in fruit (Fig. 1A). Heat treatment not only elevated the protein

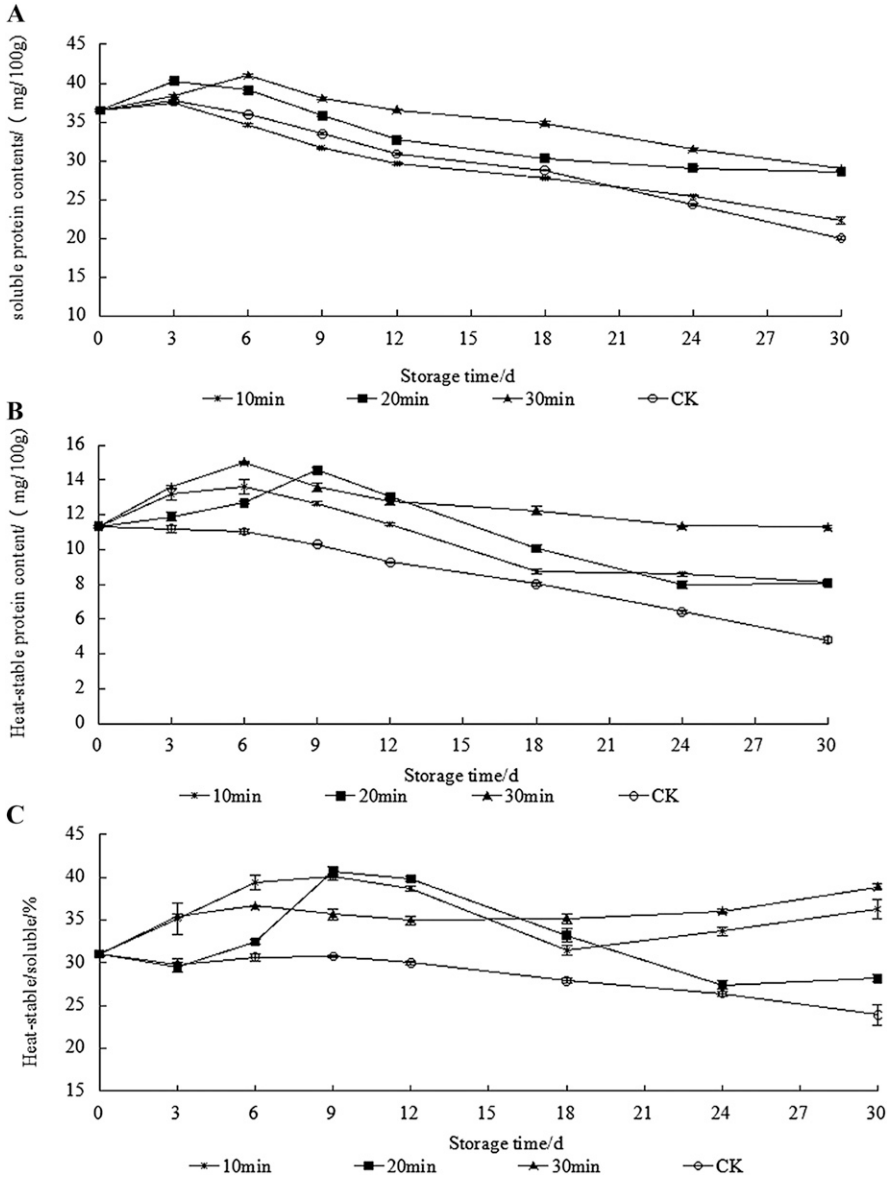

Fig. 1. Changes in contents of soluble and heat-stable protein (HSP) and their ratio in honey peach fruit during refrigerated storage. Both soluble and HSP are means of all three replicates. (**A**) Soluble protein content; (**B**) HSP content; (**C**) ratio of heat-stable to soluble protein. 10 min, treatment under hot air (46 °C) for 10 min before storing at 0 ± 1 °C; 20 min, treatment as for 10 min but with hot air for 20 min; 30 min, treatment as for 10 min but with hot air for 30 min; control (CK), stored at 0 ± 1 °C without hot-air treatment.

content at the beginning of refrigerated storage, with the elevated level positively related to the duration of heat treatment, but also resulted in a slower decrease of protein content during refrigerated storage, especially for fruit subjected to longer treatment. After 30 d of refrigerated storage, the protein content difference between fruit heat treated for 30 min and control fruit was >10 mg/100 g. These results suggested that heat treatment may result in upregulation of protein synthesis that acts as a protective mechanism for low-temperature storage, and the effectiveness of heat treatment lasted until the end of storage. The comparison of soluble protein contents in peach fruit heat treated for different durations showed that 30 min of heat treatment had the highest level followed by 20 min at the same time point, and 10 min had similar protein contents to control fruit, indicating that 10 min of heat treatment was insufficient for peach fruit to respond in this experiment.

The content of HSP in control fruit during refrigerated storage decreased gradually, and there was no obviously increase at beginning 3 d interval investigation during three heat treatments (Fig. 1B). HSP in heat-treated fruit during refrigerated storage had similar and simultaneous change trends to soluble protein content—HSP increased during early refrigerated storage and then decreased (Fig. 1B) but with little difference for times of heat treatment, i.e., 10 min of heat treatment was more effective in increasing content of HSP than of soluble protein. The protein content difference between heat-treated and control fruit was significant ($P \leq 0.05$). After 12 d of refrigerated storage, the content of HSP was higher in 30 min heat-treated fruit than for 10 or 20 min (Fig. 1B). These results suggested that heat treatment stimulated stabilization of proteins in fruit through protein synthesis during refrigerated storage, which may improve cold resistance.

The ratio of HSP to soluble protein was constantly higher ($P < 0.05$) in heat-treated fruit than in control fruit (Fig. 1C), indicating that heat treatment was more effective on HSP than soluble protein, and could elevate the importance of HSP during peach fruit storage. The 30-min heat treatment resulted in a more stable change in the ratio of HSP to soluble protein during refrigerated storage than the other treatments (Fig. 1C), indicating that longer heat treatment was more effective in alleviating CI of peach fruit.

Soluble and HSP contents under heat treatment. The change in soluble and HSP contents in peach fruit during heat treatment of up to 44 h was measured (Fig. 2). The content of soluble protein in heat-treated fruit increased less at the beginning, decreased earlier and was continuously lower than in control (Fig. 2A). The heat treatment significantly ($P < 0.05$) suppressed the increase (up to 40% inhibition) of soluble protein in fruit, and this was rapid—occurring in as little as 1 h (Fig. 2A). The content of soluble protein in control fruit increased sharply within 2 h, and this was not seen in Fig. 1A, indicating that the protein increase may result from environmental change with storage.

The content of HSP in heat-treated fruit increased immediately and sharply, and was almost stable within 1 h and thereafter slightly increased. This was significantly higher ($P < 0.05$) than in control fruits (Fig. 2B). This result combined with the change in soluble and HSP indicated that HSP had increased and that new HSP was induced in fruit by heat treatment.

The content ratio of HSP to soluble protein confirmed about result (Fig. 2C) and was again significantly ($P < 0.05$) higher in heat-treated fruit than in control fruit.

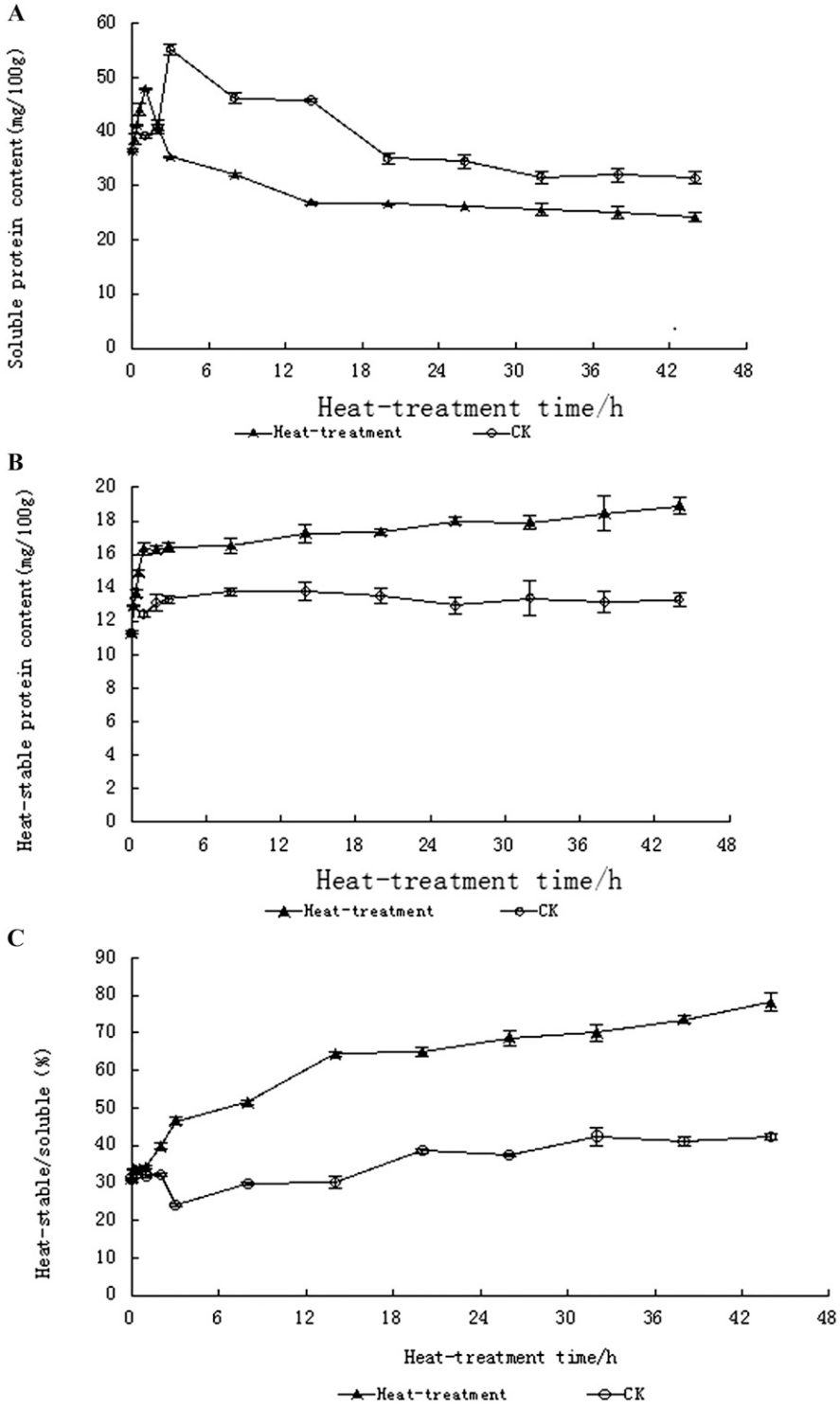

Fig. 2. Changes in contents of soluble and heat-stable protein (HSP) and their ratio in peach fruit under heat treatment. Both soluble and HSP are means of all three replicates. (**A**) Soluble protein; (**B**) HSP; (**C**) ratio of heat-stable to soluble protein. 10 min, treatment under hot air (46 °C) for 10 min before storing at 0 ± 1 °C; 20 min, treatment as for 10 min but with hot air for 20 min; 30 min, treatment as for 10 min but with hot air for 30 min; control (CK), stored at 0 ± 1 °C without hot-air treatment.

Effects of heat treatment on respiratory rate during storage. There was an obvious respiratory peak (43.26 mg CO_2/kg/h) at 18 d in control fruit during refrigerated storage, indicating that honey peach fruit was climacteric (Fig. 3). The respiratory peak was inhibited in heat-treated fruit, and the inhibition degree was related to heat-treatment duration, i.e., the greatest inhibition effectiveness was for the 30 min treatment and was significant ($P \leq 0.05$). Since respiration is related to quality loss, a lower respiratory rate is favorable for quality maintenance of heat-treated fruit.

Effect of heat treatment on fruit quality during storage. The initial firmness of peach fruit was 5.08 kg·cm^{-2}. With the extension of storage, firmness of heat-treated fruits decreased while that of control fruits increased and eventually remained constant. Since toughening is a typical CI phenomenon in peach fruit, firmness increase in control fruit indicated CI and would likely not ripen normally with softening and edible quality development. The firmness of fruit under 46 °C hot-air treatment decreased normally, and there were no significant differences between heat treatments of 10, 20, or 30 min during refrigerated storage. The TSS content in all groups of fruit during refrigerated storage showed the same change tendency, i.e., an initial increase followed by a decrease. The biggest difference among all treatments within 30 d of storage was <1.0% (13.10% and 14.08%; Table 1), suggesting that TSS (and so sweetness) was little affected by heat treatment. Weight loss increased with refrigerated duration, and the total loss was <3.0% in all groups of fruit after 30 d of storage (Table 1), indicating that weight loss was also little affected by heat treatment. The percentage of TA of fruit under 46 °C hot-air treatment for 10, 20, and 30 min was 31.69%, 20.42%, and 23.24% higher, respectively, than for control after storage for 30 d; correspondingly, the percentage of reducing sugar was 33.69%, 27.17%, and 22.83% higher than for control after storage for 30 d. Heat treatment, especially for 30 min, inhibited the reduction of TA ($P < 0.05$) as well as content of reducing sugar in fruit. Overall, heat treatment reduced the CI of peach fruit and maintained better eating quality during refrigerated storage.

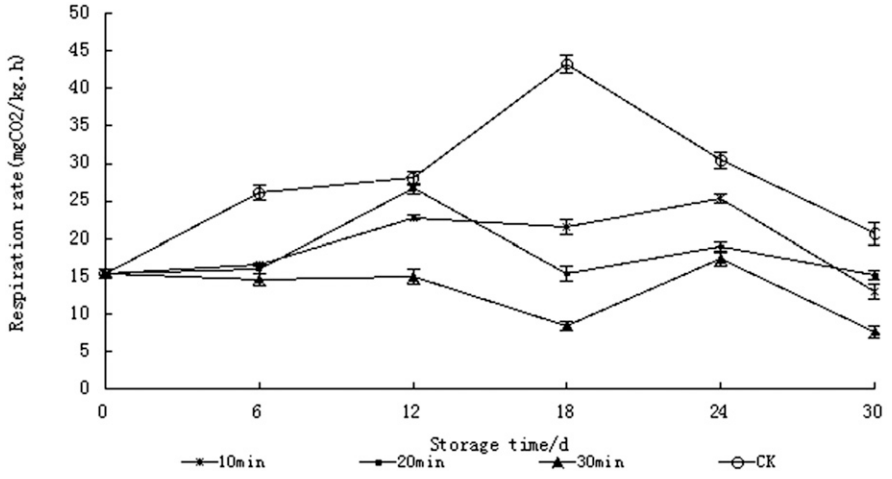

Fig. 3. Effect of heat treatment on respiratory rate of peach fruit during refrigerated storage. Respiratory rates are means of all three replicates. 10 min, treatment under hot air (46 °C) for 10 min before storing at 0 ± 1 °C; 20 min, treatment as for 10 min but with hot air for 20 min; 30 min, treatment as for 10 min but with hot air for 30 min; control (CK), stored at 0 ± 1 °C without hot-air treatment.

Discussion

Heat treatment inhibits soluble-protein anabolic processes (Lurie et al., 2005). In this study, soluble protein content after 46 °C heat treatment for 44 h was significantly lower than that in control at room temperature, indicating that heat treatment significantly inhibited synthesis of soluble protein and reduced its content. These results are consistent with the findings of Lurie et al. (2005), who found that heat treatment inhibited protein synthesis in Granny Smith apples by 50% to 80%. The soluble protein content in all heat-treated fruit after harvest increased during the first 3 d and then decreased continuously until the end of storage, and in control fruit decreased during refrigerated storage, which might be due to protective mechanisms. The study showed that heat treatment may have resulted in upregulation of protein synthesis, which acted as a protective mechanism during low-temperature storage, and the effectiveness of heat treatment remained until the end of storage, which may be related to endogenous reactions in fruit (Hu et al., 2005). These results were in accordance with the study by Zhou et al. (2013), who reported some protein synthesis in heat-treated loquat fruit during room-temperature storage.

Heat treatment can induce resistance of crops to low temperatures (Jin et al., 2009). The HSP content in control fruits remained constant, whereas that of heat-treated fruit increased during heat treatment (44 h). The HSP content of control fruits declined during refrigerated storage; whereas, in fruit heat treated for 30 min, this increased initially and subsequently decreased during refrigerated storage, consistent with the report of Sapitnitskaya et al. (2006), in which the increase in protein level occurred with a delay of 1–2 d after treatment of grapefruit. Both ascorbate peroxidase and dehydroascorbate reductase were higher in protein abundance 1 and 3 d under 39 °C heat treatment, as were

Table 1. Effect of heat-shock protein on fruit quality during refrigerated storage.

Storage time/d	Heat treatment (min)	Firmness (kg·cm^{-2})	TSS/(%)	Wt loss (%)	TA (%)	Reducing sugar (%)
	Control	5.69 ± 0.32 a[z]	13.10 ± 0.12 a	0.71 ± 0.01 a	0.194 ± 0.002 c	1.37 ± 0.04 a
	10	5.61 ± 0.31 a	13.23 ± 0.45 a	0.62 ± 0.01 b	0.237 ± 0.002 b	1.26 ± 0.05 c
	20	5.20 ± 0.17 a	13.82 ± 0.36 a	0.53 ± 0.02 c	0.233 ± 0.002 b	1.34 ± 0.06 b
6	30	5.80 ± 0.58 a	13.94 ± 0.54 a	0.45 ± 0.01 d	0.246 ± 0.003 a	1.39 ± 0.16 a
	Control	6.32 ± 0.36 a	13.30 ± 0.11 a	1.95 ± 0.01 a	0.169 ± 0.004 c	1.44 ± 0.03 c
	10	5.98 ± 0.14 b	13.78 ± 0.26 a	1.74 ± 0.01 b	0.194 ± 0.006 bc	1.46 ± 0.02 c
	20	4.95 ± 0.08 b	13.98 ± 0.81 a	1.53 ± 0.02 c	0.191 ± 0.005 b	1.73 ± 0.04 a
18	30	5.02 ± 0.14 b	14.08 ± 0.38 a	1.37 ± 0.01 d	0.198 ± 0.002 a	1.62 ± 0.05 b
	Control	6.46 ± 0.27 a	13.42 ± 0.04 a	2.81 ± 0.01 a	0.152 ± 0.004 c	1.79 ± 0.05 b
	10	5.65 ± 0.14 b	13.38 ± 0.46 a	2.39 ± 0.03 b	0.182 ± 0.083 a	2.03 ± 0.11 a
	20	4.69 ± 0.13 c	13.74 ± 1.22 a	2.07 ± 0.02 c	0.179 ± 0.004 a	1.88 ± 0.13 b
24	30	5.05 ± 0.08 b	13.06 ± 0.55 a	1.82 ± 0.04 d	0.184 ± 0.004 a	1.80 ± 0.07 b
	Control	6.09 ± 0.29 a	12.58 ± 0.04 a	2.81 ± 0.03 a	0.142 ± 0.002 c	2.24 ± 0.04 a
	10	5.44 ± 0.09 b	12.8 ± 0.41 a	2.39 ± 0.05 b	0.175 ± 0.054 b	2.26 ± 0.02 a
	20	4.42 ± 0.11 c	12.78 ± 0.45 a	2.07 ± 0.02 c	0.172 ± 0.004 b	2.34 ± 0.07 a
30	30	4.88 ± 0.14 bc	13.1 ± 0.23 a	1.82 ± 0.02 d	0.183 ± 0.004 a	2.46 ± 0.05 a

[z]Mean values ($n = 3$; ± SD) in each column followed by different lower case letters are significantly different at $P \leq 0.05$ by Duncan's new multiple range test.
TSS = total soluble solids; TA = titratable acidity.

two HSPs (Sapitnitskaya et al., 2006), which was in accord with the present study in which HSP increased and new HSP in peach fruit could be induced by heat treatment.

The times and temperatures of heat treatments differ widely between studies, ranging from 33 °C for days to 63 °C for seconds. However, in all cases similar changes at the molecular level were obtained (Lara et al., 2009). Some of the treatments were sufficiently long that changes in gene expression and protein accumulation and metabolic shifts occurred during the treatment. In the case of short exposure times to high temperature, the molecular changes may actually occur after heat stress has ended. The changes involve the accumulation of stress and defense proteins, including HSPs, dehydrins, and antioxidant enzymes and compounds (Zhang et al., 2011). All the above show that heat treatment activates many of the same genes that cold stress does, and that some confer fruit with resistance to CI.

The HSP content and the ratio of HSP to soluble protein content in heat-treated fruit were higher than those of control during heat treatment and storage, suggesting that heat treatment induced new protein synthesis (Li et al., 2014). The difference in the ratio of HSP to soluble protein in fruit between 30 min of heat treatment and control, as well as between 44 h of heat treatment and 20 °C treatment, became greater with increased duration of storage. This suggests that the ratio of HSP to soluble protein in peach fruit was probably more important to alleviate CI than increasing HSP or reducing soluble protein itself, through maintaining and/or increasing membrane integrity and protein function and so maintaining regular energy and substance metabolism. Therefore, appropriate heat treatment could be practically used to control CI in peach fruit.

As cold-storage time was prolonged, the protopectin, lignin, and cellulose contents increased, which are typical CI symptoms in peach fruit, and resulted in higher firmness. Firmness increase in control fruits indicated CI and that fruit would not ripen normally with softening and edible quality development; however, fruit treated with 46 °C air for 30 min could soften normally. This experiment also demonstrated that 46 °C treatment for 30 min could suppress the respiratory climacteric of peach fruit stored under refrigerated conditions, and that 46 °C treatment for 30 min could better maintain membrane integrity and reduce low-temperature damage. This suggests that heat treatment has great potential for peach quality maintenance and storage life extension.

The contents of TSS, TA, reducing sugar, and reducing sugar/TA ratio are all important parameters of fruit quality. It is crucial to inhibit reductions in TA content while maintaining a suitable sugar/acid ratio. Compared with control, heat-treated fruit had stable TSS and inhibited the reductions in TA and reducing sugar. This differed somewhat with the report of Perotti et al. (2011), in which citrate content was twice as high, while contents of 2-oxoglutarate, malate and glycerate were 50% lower, under 3 d of hot-air treatment compared with 3 d at 20 °C. Yun et al. (2013) reported that sugars and alcohol sugars increased with hot-air treatment and most remained high when fruit were transferred to 20 °C, as also found in the present study.

Heat treatment has become considerably more important in commercial practice, because of its post-harvest benefits such as control of insects and diseases (Karabulut et al., 2010), the modification of fruit responses to cold stress (Fallik, 2004) and improving fruit quality during storage (Tang et al., 2007). This study revealed that heat treatment could prevent CI and prolong storage duration of honey peach fruit. The body of knowledge gathered in these studies will help in developing more accurate treatments with less possibility of unwanted side effects to the commodity. It is important to note that these conclusions are applicable only to fruit with similar properties to those of honey peach cultivars.

Conclusion

Heat treatment significantly reduced soluble protein amount and maintained a higher level of HSP in peach fruit, and also a greater ratio of HSP to soluble protein. This may be beneficial in controlling CI for peach fruit through maintaining proteins' functions in energy and substance metabolism. Heat treatment, especially for 30 min, inhibited the reduction of TA ($P < 0.05$), reducing sugar in peach fruit and made the fruit soften normally during cold storage. Overall, heat treatment reduced CI of peach fruit and maintained better eating quality during refrigerated storage. Our study showed that low-temperature storage alone led to decreasing of TA and reducing sugar and to severe fresh mealiness; however, hot-air treatment before low temperature in combination with a plastic bag (thickness of 0.03 mm) could counteract this effect. Treatment for 30 min under 46 °C before low temperature in combination with a 0.003-mm thick plastic bag might be a useful technique to alleviate CI and maintain honey peach fruit quality during cold storage.

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