PROCEEDING

Food Globalization:
New Technology in An Era of Change

The 10th National Student Conference on food science & technology

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Proceedings

The 10th National Student Conference

Food Globalization : New Technology in An Era of Change

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Preface 10th NSC – "Food Globalization: New Technology in An Era of Change"

This is a proceeding of the 10th National Student Conference on Food Science and Technology done by Food Technology Department, Soegijapranata Catholic University. Seeing that this conference is organized by only the students of the faculty, ten consecutive years of performance deserves quite praise. Thanks to their powerful motivation and energy, this event can be held in routine without skipping a single year.

In this year conference we focused on the development of food in globalization era. As we know it, since globalization has begun there has been lots of changes in many sectors of life including food. On the bright side, it can be seen that globalization has made food become highly varied, more "functional", and somewhat safer by using new material, more sophisticated technology, or even change the food source's genetic structure. Although there are a lot of advantages in the era of food globalization, there will be many risks that make people have to be aware in consuming the foods.

The conference was specifically designed to discuss all of these matters, where students of food technology department can share their research and opinion. This proceeding covers two sections of paper that are papers of the keynote speakers and also from the presenters. There are six platform themes that were used: *Food Product Development*, *Food Quality and Safety, Food Management and Business, Food Engineering. Food Microbiology & Biotechnology* and *Functional Food.* With the ongoing changes in food related to the current globalization, I am quite sure there will be more topics that can be discussed in other student's conferences or academic communities.

Semarang, January 7, 2010

Alberta Rika Pratiwi
Chairman of the Steering Committee

HOT WATER TREATMENT AS AN ALTERNATIVE TO PROLONGING SHELF LIFE AND IMPROVING THE QUALITY OF MANGO

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ABSTRACT

Mangoes plantation has been increasing rapidly over the last 30 years. Under the socio-cultural circumstances in Indonesia's farming system, the mangoes plantation is mostly managed by small farmers, who were generally low in neither educational nor economic background, as well as in cooperative network. As seasonal and climacteric fruit, mangoes is harvested seasonally. Therefore, in the harvesting season, mangoes were available abundantly. Consequently, the price was cheap, and even unsold. One of the factors which resulting unsold mango is the harvested mangoes take long rutes of farm gate to market display, as the consequences of small farm mangoes plantation owned by farmers. Regarding to this, an applicable, inexpensive, effective, environmentally friendly, and of course observable treatment is needed to overcome these mangoes post-harvested weaknesses. An explorative studies was made to review hot water treatment application on post-harvest management of mangoes over the last 30 years. The studies over the last three decades proved that hot water treatments effectively have been prolonging shelf-life up to 8 days after two weeks of storage among fruits of the three varieties. The treatments have also been reported no effects on fruit quality including total soluble salts and vitamin C contents. Therefore, hot water treatment is currently needed to be developed in large scale.

Key words: *mango, hot water treatment, shelf life and quality*

INTRODUCTION

Mango (*Mangifera indica* L.) is one of tropical fruit that has been widely planted, harvested, and sold worldwide, including in Indonesia. Because this fruit is seasonally, so amount of the productivity of this fruit can not be forced or inhibited. Of particular concern from that, when harvesting season arrives, the number of mangoes fruit are very abundant and can not be avoided by farmers. This condition can cause the selling price will cheap, even seems that some of them will unsold. Even, with the implementation of storage, it also did not apparently to help farmers to prevent the loss, because the nature of the mangoes itself, where they are as climacteric fruits. So that when it stored, this fruit will easily have over-ripening, softening, decay,

decline in quality and nutrients such as vitamin C. Moreover, added with the distribution and marketing of mango post-harvest which take long rutes, so the possibility of damage and losses will be bigger. Regarding to this, we need a post-harvest treatment of mangoes that are easy to apply, quite effective, environmentally friendly, but also must be inexpensive, considering the background of agriculture system in Indonesia, where they are still managed by small farmers with low education and economic level.

An explorative studies was made during the last 30 years to review the application of hot water treatment to solve the problems of post-harvest fruit is mango. Those studies have shown that hot water hot water (HW) was an effective heat transfer medium and, within a short time a uniform temperature profile will be maintained (Couey, 1989). Hot water treatments have been increasingly used as a quarantine treatment in several studies to retard postharvest fungal damage to fruits and vegetables. Their particular attraction is that they do not involve chemicals (Couey, 1989; Fallik *et al.*, 1996; Lopez *et al.*, 1998; Rodov *et al.*, 2000; Tohamy *et al.*, 2004). The mango is a sub-tropical fruit and thus tolerates heat treatment well (Jacobi and Giles, 1997; Opara and Nguyen, 1999). The additional benefit of HWT is that the HW can also control postharvest diseases such as anthracnose and stem end rot (Couey 1989; McGuire 1991). So that, this treatment is commonly used for disinfestation of mango from fruit flies (Sharp et al, 1984; Segarra-Carmona et al, 1990; Nascimento et al, 1992). This treatment is cheaper than any other heat treatment and is also effective on commercial scale in the USA. Recommended optimal temperature ranges are estimated between 43-50 °C; because if its above 50 °C, the fruit experiences excessive damage.

Positive results which have been reported from this method are either to extend shelf life, can maintain the quality of mango, postharvest disease control of fruit flies and attacks, and accepted as a feasible alternative technique when examined in terms of its relative advantage, compatibility, ease of application, health and environmental soundness. These also resulted in higher volume of fruits sales and purchases and thus affects increase of income and profit.

METHODOLOGY

Materials in this paper obtained from two aspects of studies. The first study was a qualitative one on mango cultivation system in Indonesia. Whereas the second one was literature research techniques focusing on the effect of hot water treatment on shelf life of mango fruit after harvest. The study

both these aspects, then used to conduct three phases of study as follows:

- Qualitatively overseeing the mango cultivation system in Indonesia
- Reviewing some researches on post harvest preservation technique, using hot water treatments, and the related heat treatments as controls.
- Analysing the most possible post harvest treatment for mangoes preservation relevant with mango production system in Indonesia.

The third phase of the study was basically analysis on the compliance with the conditions of mango cultivation in Indonesia and thus found in the literature review.

RESULTS AND DISCUSSION

From several references about mangoes research that we have got, it shows that during storage after harvesting, the mango physiology and its ripening naturally involves many physiochemical activities, such as cumulative physiological loss in weight (CPLW) and volume, pulp and skin color change, acidity, loss in firmness, increase in total solids and sugar concentration. That's all susceptible to several physical and physiological postharvest disorders, which affect fruit quality. Some disorders can include over-ripening, softening, decay, decrease in quality and nutrients such as vitamin C, and some postharvest diseases such as anthracnose, and stem end rot.

Several techniques have been developed to reduce the incidence of physiological disorders in mango fruit. In 1989, Couey reported that heat treatment can be used to control postharvest diseases and insect pests. This method is cheap and environmentally friendly; so the interest in heat disinfestation has been revived. Nowadays, two heating methods are commonly used for mangoes, i.e. Hot air-treatment (HAT) and Hot water-treatment (HWT). Both of them give a variety of physiological responses that occur on mango fruit due to heat treatment, some of them such as :

i) Affect the ripening of fruits either inhibit, promote or interfere with the maturation process, depending on the factors that influence it, such as environment, time, duration and type of application.
ii) Influence the internal and external quality of mango fruit, such as changes and uniformity in mango fruit skin, texture, and also related to increased vitamin C, and Total Soluble Salt (TSS).

Hot water treatment (HWT) considered as an more effective heat treatment for mango than hot air treatment (HAT). If the fruits like mangoes treated with HW before

storage, then treatment may reduce the incidence of decay, minimizes fruit fly damage, anthracnose, and stem-end rot infestations, so it can extend shelf life. A study showed that disease incidence in fruits decreased significantly when dipped in hot water (50°C for 5 minutes), where it resulted in the least disease. Anthracnose was reduced by 83% and stem-end rot by 100%. Fruit fly damage was reduced by 80% (Buganic; Lizada; de Ramos, 1993). Results further showed that there were no effects on fruit quality including peel color, texture, weight loss, total soluble solids, acidity, and fruit shriveling (McIntyre; Wickham; Wilson; Malins, 1993).

Regarding to the effectiveness obtained from hot water treatment (HWT), it needs further studies on the effect of hot water treatment to control a variety of postharvest diseases and physiological disorders, using a variation of temperature and time that is most appropriate. For comparison, another heat treatment (hot air treatment) can be used, so the level of effectiveness can be observed.

Research on the effects of heat treatment on mango studied by Mansour, et al (2006) using the following method :

Heat treatment. Healthy fruit from each variety (Keitt, Kent, and Tommy Atkins) was tested by settling for an infection naturally. After twenty-four hours, each lot was divided into three parts and each part into the target one of the following treatments:

1. Hot water (HW): The fruit is dipped into hot water at 50 ° C for 5 minutes, cooled at room temperature, and allowed to dry,
2. Hot Air (HA): Fruit exposed to hot air at a temperature of 40 ° C for 4 hours, then immersed in a plastic container filled with tap water (22-23 ° C) to lower fruit temperatures below 30 ° C. Fruit treatment are placed outside to dry at room temperature,
3. Untreated fruit for each treatment served as controls.

Each treatment was repeated three times, each repeat contains ten pieces. All treatment units (with or without treatment) packed in fiberboard cartons sterilized and stored at 12 ° C and 90-95% RH. After 4 weeks, shelf life and quality of mango samples were analysed.

Shelf life. After storage at 12°C for 2 or 4 weeks, samples were heat treated as described above, then kept at 20 ± 2 ° C. Shelf life was determined as the period (in days) through which the fruit remains healthy at 20 ± 2 ° C.

Quality analysis. Surface fruits of each cultivar uniform in size and color were treated with HW and HA, as mentioned above and stored at 12°C for 4 weeks. Each treatment was replicated three times, each replicate containing five fruits. At the end of storage period, total soluble salts (TSS) were determined using a hand refractometer and vitamin C was measured by the method of Jemey and Kovacs (1968).

Statistical analysis. The data were statistically analyzed using the completely randomized design in factorial arrangement method as outlined by Steel and Torrie (1980).

Results obtained from these studies can showed in the following below :

Effect of heat treatment on peel blackening.

Table 1. Effect of dipping in hot water on peel blackening of three mango fruit varieties treated with Hot Water (HW)

Temperature °C	Dipping time (min)	Mango variety		
		Keitt	Kent	Tommy Atkins
50	5	1	1	1
	10	2	2	2
	15	2	2	3
55	5	2	2	2
	10	3	3	3
	15	3	3	4

Table above shows that no blackening occurred in any variety of mango fruits dipped in hot water at 50°C for 5 min. While, the other treatments caused different degrees of blackening which increased with raised water temperature and/or dipping time to 10 and 15 min. The highest degree of blackening was observed at 55°C for 15 min, with slight blackening for Keitt and Kent and moderate blacking for Tommy Atkins.

Effect of heat treatments on shelf life of mango fruits.

Table 2. Effect of heat treatments on shelf life of mango fruits treated with Hot Water (HW) and Hot Air (HA). Shelf life was determined as the period (in days) through which the fruits remain healthy at 20°C after storage at 12°C for 2 or 4 weeks.

Mango variety	Heat Treatment	Temp °C	Time	Shelf life of mango fruits after storage for	
				2 weeks	4 weeks
Keitt	HW	50	5 min	7	5
	HA	40	4 h	5	3
	Control			2	0
Kent	HW	50	5 min	8	6
	HA	40	4 h	5	5
	Control			2	0
Tommy Atkins	HW	50	5 min	8	5
	HA	40	4 h	5	4
	Control			1	0

The shelf life at 20°C of fruits after 2 and 4 weeks of storage at 12°C is shown in Table 1. It was generally noticed that Hot Water (HW) treatment was the most favorable for increasing shelf life. In fact shelf life was higher after two weeks than four weeks of storage. The highest shelf life of fruits treated by HW after two weeks of storage was 8 days for cultivar Kent and Tommy Atkins. On the other hand, after four weeks of storage the longest shelf life of 6 days was obtained for cv. Kent treated by HW.

Effect of heat treatments and storage on quality characteristics of mango fruits.

Table 3. Effect of heat treatment and storage on quality characteristics (total soluble salts (TSS) and vitamin C) of mango fruits treated with hot water (HW) and exposure to hot air (HA) and stored at 12°C for 4 weeks.

Mango variety	Treatment			TSS*	Vitamin C
	Heat	Temp °C	Exposure time		mg 100g fru
Keitt	HW	50	5 min	13.9 bc	35.0 ab
	HA	40	4 h	13.4 c	37.4 a
	Control			14.5 a	33.0 ab
Kent	HW	50	5 min	16.2 b	35.3 ab
	HA	40	4 h	16.0 b	37.6 ab
	Control			16.9 a	31.9 abc
Tommy	HW	50	5 min	14.0 abc	32.2 abc
Atkins	HA	40	4 h	13.8 bc	33.0 ab
	Control			14.3 ab	25.7 ab

The same letters within a column are not significantly different (P≤0.05)

TSS and vitamin C contents in sample fruits of the three varieties treated with HW and HA, which stored for 4 weeks at 12°C are recorded in Table 2. There were no significant differences ($P \leq 0.05$) in TSS among fruits of the three varieties treated with HW and HA treatments as compared with untreated fruits. An exception was cv Kent, where TSS was higher and TSS/TA lower in the control than in heat-treated fruits. On the other hand, vitamin C content in all heat-treated fruits of the three varieties did not significantly differ from that in untreated fruits. Vitamin C content was slightly higher in fruits singly treated with HA than those treated with HW.

In our study, it was found that dipping in HW at 50°C for 5 min did not cause any peel blackening of the three varieties tested, and also increases the shelf life and quality of mango fruit. Similarly, Jacobi and Wong (1992), Jacobi et al. (1996) and Jacobi and Giles (1997) recommended 53°C for hot water dipping for 5 min as a successful treatment to lowered disease incidence. Results of Nguyen et al. (1998) indicated that HW treatment of Buoi mango at 52°C for 5 min had potential for reducing postharvest diseases with minimal fruit mass loss and shriveling compared with untreated fruits. Heat protocols have been successfully developed for treating a wide range of mango varieties, including Carabao from the Philippines (Merino et al., 1985), Nang Klangwan from Thailand (Unahawatti et al., 1986), Harumanis from Malaysia (Mohamed et al., 1994) Kensington from Australia (Jacobi et al., 1996) and Buoi from New Zealand (Nguyen et al., 1998).

From the results of these studies, it has found that hot water treatment is alternatively quite effective to extend the shelf life and maintain the quality of mango fruit from various cultivars or varieties. Thus, for further application of hot water treatment, it can be used to solving the problems of small farmers, especially in Indonesia, who require an effective post-harvest handling to control storage disease that may easily destroy the fruits. With application of hot water treatment prior to transport, potentially inhibit destroy the storage diseases entire consignments of fruits and resulting in higher volume of fruits sold and directly affected increase of income and profit for farmers. In addition, an inexpensive cost also become potential factor that supporting this treatment to be suitable for applied in Indonesia. Besides that, this treatment also essential for export mangoes, which take long rutes and has longer transit times. An increasing number of overseas markets are no longer permitting chemical dip treatments for fruit entering their countries. Therefore, physical treatment like hot water is currently needed to be developed in large scale.

Further research is urgently required to improve suitable non-chemical protocols for mangoes and other fruits, to minimize the postharvest diseases in line with international quarantine requirements and to ensure that fruit quality remains competitive. Therefor, regarding to the positive and negative aspects of hot water treatment and hot air treatment, both of them may complement each other. So that, when they combined, for example when HA exposure at 40°C for 4 hours was combined with dipping in HW at 50°C for 5 minutes or vice versa, efficacy of heat treatment in increasing shelf life and quality

may higher than HW or HA treatment alone. This is because the HWT likely to be effective in lowered disease infection, while the HAT tends to maintain the stability of nutrients. But so far, hot water treatment alone is effective to minimize post-harvest disease and to ensure that the quality of the fruit to remain competitive. This treatments was expected to be accepted as an applicable technique, which also inexpensive, quite effective, environmentally friendly, and of course observable treatment to overcome these mangoes post-harvested weaknesses.

CONCLUSION

Hot water treatment is quite effective to minimize post-harvest disease and to ensure that the quality of mango fruit to remain competitive, both during storage and until the time of marketing. In this study, found that dipping in HW at a temperature of 50°C for 5 minutes did not cause any peel blackening of the three varieties tested (Keitt, Kent and Tommy Atkins), and also increase shelf life up to 8 days after two weeks of storage and also maintain the quality of mango fruit including TSS and vitamin C.

Furthermore, this treatment is the most appropriate treatment to be applied by small farmers in Indonesia, because treatment is quite effective, environmentally friendly, but also cheap, so that farmers from low education and low economic possible to implement it, especially considering the mango production in Indonesia is vulnerable to loss due to production at times very abundant, but easily damaged if not handled properly. Moreover, this treatment does not involve chemicals, so effective on a commercial scale mainly for export at international level which have recently implemented the requirements of non-chemical treatments for mangoes and other fruits.

Thus, this treatment can be accepted as a feasible alternative technique to be developed on a large scale, because it can provide better results for the handling of mango in terms of relative advantage, ease of application, environmentally friendly, and importantly to increase trading volume and thus affects increase of farmers' incomes and profits.

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