ISSN: 0975 -8542

Journal of Global Pharma Technology

Available Online at: www.jgpt.co.in

RESEARCH ARTICLE

Influence of Blanching Temperature and Time on Quality of Minimally-Processed Mango during Frozen Preservation

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Abstract

Mango (*Mangifera indica* L.) is one of the most important tropical fruits. It's excellent source of nutrients, soluble fibres, bioactive compounds such as carotenoid, ascorbic acid and phenolic. Mango pulp is very perishable with a short shelf life. It is very vulnerable to dehydration, discoloration, and decomposition. Objective of this study focused on the effectiveness of blanching (60°C in 4 minutes, 65°C in 3.5 minutes, 70°C in 3 minutes, 75°C in 2.5 minutes, 80°C in 2 minutes) to physico-chemical attributes of the minimally-processed mango during frozen storage for 6 months. Our results showed that minimally-processed mango should be blanched in hot water at 75°C for 2.5 minutes to maintain its shelf-life and physico-chemical characteristics during 6 months of frozen storage.

Keywords: *Mango; minimally-processed; blanching; physico-chemical; shelf-life; frozen storage*

Introduction

Mango *(Mangifera indica* L.*)* has a rich source of phytochemical nutrients with various potential health benefits [1, 2]. Mango could be produced into minimally-processed or fresh cut form to satisfy consumer's demand. Minimal processed fruits have experienced in great demand in consumption. Minimally processed fruits attract consumers because they are fresh, nutritious, low priced, and ready-to-eat [3].

Minimally processed fruits have a shorter shelf-life compare to whole ones. It is easily decomposed, turned brown and became soften because they lack protective pericarp [4]. Blanching is frequently applied before freezing of fruits to minimize sensory and nutritional degradation caused by internal enzymes such as ascorbic acid oxidase, polyphenol oxidase, peroxidase.

They negatively affect colour, flavour and nutritive component of fruit [5, 6]. Freezing is an effective way to inhibit deterioration and extend shelf-life of processed product. It can inhibit growth of microorganism as well as inactivate enzymatic reaction. Minimally-processed mango could be preserved for long usage by application of different methods such as coating [3, 7, 8, 9], blanching [10], low temperature storage [11], 1-Methylcyclopropene [12] etc. The production of minimally-processed mango fruit is becoming more popular because consumers pay more attention to healthy food with less time for preparation. Purposes of our study focused on the effectiveness of blanching to the physico-chemical attributes of the minimally-processed mango during frozen storage.

Material and Method

Material

Mango fruits at technical maturity were obtained from Vinh Long province, Vietnam. After collecting, they must be conveyed to laboratory for experiments. They were washed under tap water and drip-dried for 5 minutes. Chemical substances were all analytical grade supplied from Rainbow Trading Co. Ltd.

Researching Procedure

Mango fruits were peeled by sharp knife. Their pulp was chunk in square shape (2 cm x 2 cm). These samples were blanched in hot

water containing 0.2% citric acid in different time and temperature and duration (60°C in 4 minutes, 65°C in 3.5 minutes, 70°C in 3 minutes, 75°C in 2.5 minutes, 80°C in 2 minutes). Thereafter, it was deeply soaked in icing water. Thereafter, they were individually quick frozen at -18°C and kept storage for 6 months. In every 2 month-interval, samples were randomly analyzed to estimate weight loss (%), shrinkage (%), firmness (N), ascorbic acid (mg/100g)

Physico-chemical, Sensory and Statistical Analysis

Weight loss (%) was estimated by comparison of initial and final weight. Shrinkage (%) was estimated by comparison of initial and final diameter. Firmness (N) was evaluated by penetrometer. Ascorbic acid (mg/100g) iodometric titration [13].The experiments were run in triplicate with three different lots of samples. Statistical analysis was performed by the Stat graphics Centurion XVI.

Result & Discussion

Weight loss (%) of Minimally-processed Frozen Mango Fruits

The main mechanism of weight loss was mainly by the leakage of juice from the pulp, rather than by water loss. During frozen storage, weight losses also caused by ice crystal formation from water inside cells and lose during the thawing process.

Loss of water content will cause the turgidity decreasing, weight reducing [14]. Table 1 showed the weight loss of blanched minimally-processed mango during 6 month preservation. The highest weight loss occurred at temperature 60°C for 4.0 minutes due to degradation of the material. The lowest weight loss was noticed at 75°C for 2.5 min.

Table 1: Weight loss (%) of minimally-processed frozen mango fruits treated by different blanching condition during 6 months of storage

Storage (months)	60°C, 4.0 min	65°C, 3.5 min	70°C, 3.0 min	75°C, 2.5 min	80°C, 2.0 min
0	0	0	0	0	0
2	2.39±0.01^{a}	2.12±0.01^{ab}	1.86±0.03^{b}	1.34±0.01^{c}	1.69±0.03^{bc}
4	3.45±0.03^{a}	3.17±0.02^{ab}	2.92±0.01^{b}	2.21±0.02^{c}	2.59±0.02^{bc}
6	4.79±0.02^{a}	4.04±0.00^{ab}	3.77 ±0.01^{b}	3.12±0.00^{c}	3.46±0.00^{bc}

Note: the values were expressed as the mean of three repetitions; the same characters (denoted above), the difference between them was not significant (α = 5%)

Shrinkage (%) of Minimally-processed Frozen Mango Fruits

Lowest of diameter shrinkage (%) was recorded at 75°C for 2.5 min (see Table 2). It was closely associated with firmness indicated by wilted and soft. Storage in long duration in a low temperature leaded the fruit becomes wrinkled by cell and tissue texture damage.

Table 2: Shrinkage (%) of minimally-processed frozen mango fruits treated by different blanching condition during 6 months of storage

Storage (months)	60°C, 4.0 min	65°C, 3.5 min	70°C, 3.0 min	75°C, 2.5 min	80°C, 2.0 min
0	0	0	0	0	0
2	3.43±0.01^{a}	3.04±0.03^{ab}	2.95±0.04^{b}	2.39±0.02^{c}	2.68±0.00^{bc}
4	4.97±0.03^{a}	4.65±0.00^{ab}	4.11±0.01^{b}	3.51±0.03^{c}	3.89±0.02^{bc}
6	6.68±0.02^{a}	6.32±0.02^{ab}	5.98±0.03^{b}	5.06±0.00^{c}	5.47±0.03^{bc}

Note: the values were expressed as the mean of three repetitions; the same characters (denoted above), the difference between them was not significant (α = 5%)

Firmness (N) of Minimally-processed Frozen Mango Fruits

Fruit cell walls consist of pectin, hemicellulose, and cellulose polysaccharide polymers [15]. Fruits lose their firmness during storage by increasing of enzymatic hydrolysis of cell wall components relating to high polygalacturonase and pectin methylesterase activity which accelerated the senescence of minimally-processed fruit [16, 19]. In our research, texture firmness of blanched frozen minimally-processed mango decreased during preservation. The highest firmness maintained at 75°C for 2.5 minutes (see Table 3).

Table 3: Firmness (N) of minimally-processed frozen mango fruits treated by different blanching condition during 6 months of storage

Storage (months)	60°C, 4.0 min	65°C, 3.5 min	70°C, 3.0 min	75°C, 2.5 min	80°C, 2.0 min
0	7.24±0.01^{c}	7.39±0.00^{bc}	7.63±0.02^{ab}	7.86±0.00^{a}	7.48±0.04^{b}
2	7.02±0.04^{c}	7.13±0.04^{bc}	7.42±0.03^{ab}	7.69±0.02^{a}	7.29±0.02^{b}
4	6.86±0.03^{c}	7.04±0.02^{bc}	7.23±0.01^{ab}	7.45±0.01^{a}	7.11±0.00^{b}
6	6.42±0.02^{c}	6.75±0.01^{bc}	7.04±0.04^{ab}	7.13±0.03^{a}	6.91±0.03^{b}

Note: the values were expressed as the mean of three repetitions; the same characters (denoted above), the difference between them was not significant (α = 5%)

Ascorbic Acid (mg/100g) of Minimally-processed Frozen Mango Fruits

Ascorbic acid content was highly maintained at 75°C for 2.5 minutes. Meanwhile, the lowest ascorbic content was noticed on samples blanched at 60°C for 4.0 minutes. It could be explained by ascorbic acid soluble in water and easily damage in long duration of blanching. The longer duration in blanching was applied; the much more degradation of ascorbic acid was recorded. It was mainly owing to oxidation of ascorbic acid to dehydroascorbic acid [20]. It revealed that ascorbic acid was easily decomposed by thermal treatment. In another report, the effect of heat treatments applied to whole mango fruit on physical, physiological and biochemical quality of minimally processed mangoes was studied. Hot water dipping 50 °C/30 min was the less degrading condition of the heat treatments for ascorbic acid [10].

Table 4: Ascorbic acid (mg/100g) of minimally-processed frozen mango fruits treated by different blanching condition during 6 months of storage

Storage (months)	60°C, 4.0 min	65°C, 3.5 min	70°C, 3.0 min	75°C, 2.5 min	80°C, 2.0 min
0	21.19±0.04^{c}	21.67±0.02^{bc}	21.98±0.00^{b}	22.36±0.02^{a}	22.07±0.01^{ab}
2	21.07±0.01^{c}	21.44±0.04^{bc}	21.77±0.02^{b}	22.01±0.04^{a}	21.94±0.03^{ab}
4	20.74±0.03^{c}	21.02±0.03^{bc}	21.23±0.01^{b}	21.82±0.01^{a}	21.53±0.04^{ab}
6	20.25±0.02^{c}	20.85±0.01^{bc}	21.02±0.03^{b}	21.57±0.03^{a}	21.13±0.02^{ab}

Note: the values were expressed as the mean of three repetitions; the same characters (denoted above), the difference between them was not significant (α = 5%)

Conclusion

Production of minimally-processed products involves peeling, trimming, deseeding and cutting of fruit into specific sizes. They look fresh and have the sensory properties such as aroma, taste, texture and visual appeal. It is concluded that minimally-processed mango should be blanched in hot water at 75°C for 2.5 minutes to maintain its physico-chemical characteristics during frozen storage. It would be a suitable approach to extend the quality of minimally-processed mango in commercial distribution in domestic and international market.

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