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# Effect of pre-treatments and drying temperatures on the quality of dehydrated mango slices

**D.B. Singh*** **and R.K. Goyal**
Central Institute of Post Harvest Engineering and Technology, Abohar 152 116, Punjab

## ABSTRACT

**The present investigation was undertaken to study the effect of pretreatments, drying temperatures and to optimize the thin layer drying of raw mango slices in the tunnel dryer. The pretreatments were control, blanching in hot water (50°C for 2 min.) and blanching with 1% KMS and with drying temperature of 55, 60 and 65°C. Pretreatment and drying temperature significantly affected time taken for drying, color and quality of dried slices. Minimum time (180 min.) for drying was recorded in mango slices pretreated with 1% KMS and dried at 60°C Desirable colour, ascorbic acid (vitamin C) and carotene retained better in pretreated slices dried at 60°C. Drying at high temperature of above 60°C with 1% KMS pretreatment reduced the level of non-enzymatic browning.**

**Key words:** Mango, pre-treatments, dehydrated slices, quality evaluation.

## INTRODUCTION

Mango (*Mangifera indica* L.) is one of the most important fruit crops of India and is very much liked for its succulence, exotic flavour and excellent taste throughout the world. The fruit is a good source of carbohydrates, vitamin C and a very rich source of pro vitamin A (Bhatnagar and Subramanyam, 2). India is also largest exporter of processed mango products like mango juice and pulp, whereas export of fresh mango is marginal. The recent attention towards the protective effect of β-carotene as an antioxidant is gaining momentum. The reason why this β-carotene has come into the limelight is because of new discoveries that imply its benefits and heavy commercial promotion. Evidence supporting beta-carotene's anticancer properties comes from epidemiological studies on cultural cells, tissues and organs (Shekelle *et al*., 13; Colditz *et al*., 5).

In India raw mango has been dried historically to produce *amchur* being used in preparation of pickles, chutneys and sauces (Kesarwani *et al*., 9). It is need to give a slightly sour and tangy taste to the dishes. Usually the dropped immature mangoes are dried in direct sunlight for preparation of *amchur*. Sun drying takes 16-18 h for complete drying (Teaotia and Pruthi, 14). Pretreatments like blanching and sulphitation (Dabhade and Khedkar, 6) enhances drying rates and prevents fruits from darkening. Dehydration of raw mango slices after sulphitation in KMS has helped in better retention of $SO_2$ during storage (Mehta and Tomer, 10). Therefore, in the present investigation dehydration of mango slices was done to study the effect of air temperature and pretreatments on drying behavior of mango slices and quality retention of product.

## MATERIALS AND METHODS

The experiment was conducted at CIPHET, Ludhiana, Punjab. For experimentation, raw mangoes of variety Dashehari of uniform size, shape and maturity were procured. The mangoes were peeled and sliced uniformly with average thickness of 2.8±0.3 mm. The initial moisture content of the mango was 80-90% (w.b.) as outlined by AOAC (1). The thin layer drying experiments were performed in pilot plant tunnel dryer (NSW-600, Narang Kinetic Works, New Delhi). The samples were dried in multiple passes in the dryer. It took 8 min. for the trays to complete a simple passage in the tunnel. Analysis of fresh mango slices was done before tunnel drying (Table 1). Prior to drying, mango samples were blanched in hot water (50°C) for 2 min., blanched and dipped in 1% KMS solution for 1 min. and kept untreated as control. The samples were dried at 55, 60 and 65°C. After reaching the dryer to set condition, sliced raw mango slices (150 g) were uniformly set in tunnel for drying. All the treatments were executed on randomized block design with three replications for each treatment. Moisture loss was calculated in 30 min. interval by a digital balance of 0.01 g accuracy. The drying was continued until there was no large variation in the moisture loss and constant weight was obtained. Dehydrated slices of mango (50 g) were packed in 200 g polyethylene bags, sealed and stored in dry cool place. The product was analysed

*Corresponding author's present address: Central Institute of Temperate Horticulture, Old Air Field, Rangreth, Srinagar 190007 (J&K); E-mail: deshbsingh@yahoo.co.in

**Table 1.** Composition of fresh mango slices var. Dashehari.

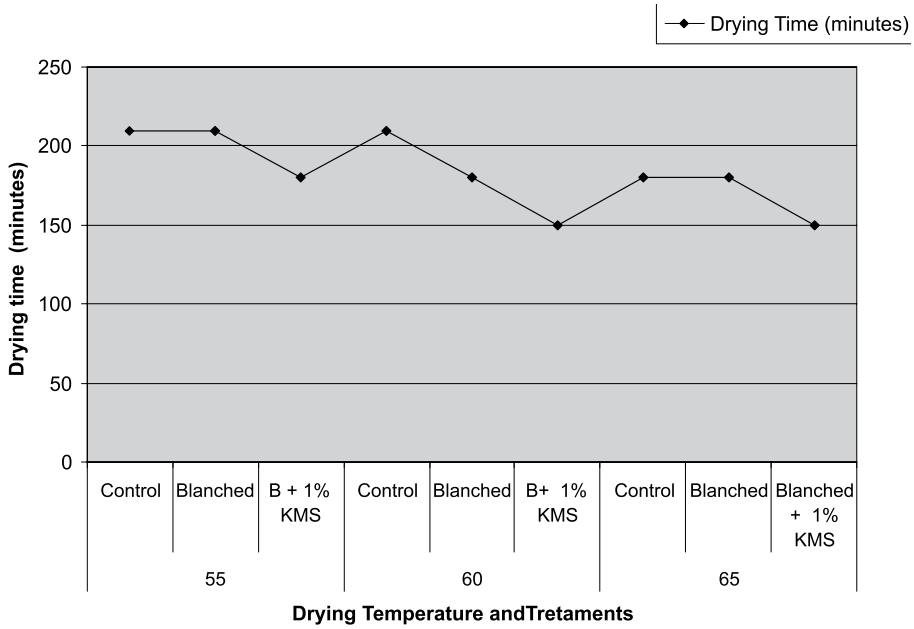
| Parameter | Value |
|---|---|
| Moisture | 85 ± 2% |
| Total soluble solids | 19 ± 0.5°Brix |
| Total sugars | 14.5 ± 0.5% |
| Reducing sugar | 3.4 ± 0.5% |
| Acidity | 2.25 ± 0.05% |
| Ascorbic acid | 55 ± 1.0 mg/100 g |
| β-Carotene | 5.8 ± 0.7 mg/100 g |

for colour characteristics ('L', and 'a' values) and physico-chemical parameters such as ascorbic acid (vit. C), acidity and β-carotene. The colour of mango slices in terms of 'L', and 'a' values were determined using HunterLab miniScan XE plus colorimeter (HAL, USA, Model 45/0-L). 'L' value indicates the lightness or darkness and 'a' red or green. Titrable acidity (%), carotene, ascorbic acid and non-enzymatic browning were determined as described by Ranganna (11). The data were subjected to LSD test and ANOVA for estimating the coefficient of variance at 95% confidence level.

## RESULTS AND DISCUSSION

Time taken for reaching the final moisture content is presented in Fig. 1. The final moisture content of the samples dried under different conditions/ modes ranged from 8 to 12% (d.b.). In all the drying temperatures selected, the samples blanched with 1% KMS had shorter drying time than the control and blanched samples. The data also indicates that drying air temperature has also an important effect on drying of raw mango slices. At high temperature of 65°C the drying time was less for control and blanched samples. However comparing blanched samples drying at 60°C time taken was equal to that of 65°C.

Drying temperature and pre treatments significantly affected the colour of dried mango slices (Table 2). Initially 'L' value indicating brightness ranged from 31.385 in case of blanching and drying at 55°C to 36.011 in blanching + KMS and drying at 60°C. At the end of drying (180 min.). 'L' value was higher (42.521) in case of slices blanched and treated with KMS and dried at 60°C. It indicates that products dried at low temperature (55°C) or at higher temperature (65°C) could not retain brightness of dehydrated slices. Positive 'a' value indicating red colour of product was again affected significantly by pretreatment and drying temperature. Simple hot water blanching for 2 min. (50°C) was more effective to retain redness when compared to other treatments in case of dehydrated mango slices. Drying of slices at 60°C after blanching was found to record maximum 'a' value (2.653) at initial (0 min.) and 7.05 at final stage (180 min.) of




B: Blanching, KMS: Potassium metabisulphite

**Fig. 1.** Effect of drying temperature and pre-treatments on time taken for drying of mango slices (8-12% moisture).

**Table 2**. Change in colour values of mango slices during drying.

| Drying temp. (C°) | Pre-treatment | Drying time (180 min.) | L | a |
|---|---|---|---|---|
| 55 | Control | Initial | 35.633 | 0.206 |
| | | Final | 20.105 | 4.255 |
| | Blanching | Initial | 31.385 | 2.603 |
| | | Final | 21.075 | 5.085 |
| | B + KMS | Initial | 36.001 | 0.438 |
| | | Final | 16.140 | 3.110 |
| 60 | Control | Initial | 35.633 | 0.206 |
| | | Final | 24.900 | 1.695 |
| | Blanching | Initial | 31.385 | 2.653 |
| | | Final | 24.900 | 7.055 |
| | B + KMS | Initial | 36.001 | 0.438 |
| | | Final | 42.520 | 1.695 |
| 65 | Control | Initial | 35.633 | 0.206 |
| | | Final | 21.535 | 2.755 |
| | Blanching | Initial | 31.385 | 2.653 |
| | | Final | 22.035 | 3.320 |
| | B + KMS | Initial | 35.009 | 0.438 |
| | | Final | 23.170 | 1.930 |
| CD at 5% | | | | |
| Drying temp. (T) | | | 0.213 | 0.544 |
| Pretreatment (P) | | | 0.213 | 0.544 |
| Drying temp. × pretreatment | | | 0.370 | 0.942 |
| Drying time × drying temperature | | | 0.174 | 0.444 |
| Storage time | | | 0.302 | 0.769 |
| Pretreatment × drying time | | | 0.302 | 0.769 |
| Drying time × pretreatment × drying temp. | | | 0.523 | 0.133 |

B: Blanching; KMS: Potassium metabisulphite; Initial time: 0 min. Final: 180 min.

drying. The colour study indicates that desirable colour of 'L' and 'a' is better retained in pretreated slices and drying at 60°C. Similar results indicating high score for pre-treated dehydrated products are given by Teaotia *et al.* (15) in mango, and Gajanana *et al.* (7) in *aonla*.

The data of ascorbic acid, carotene, acidity and non enzymatic browning is given in Table 3 indicated that pre-treatment and drying temperature significantly affected the protein level of the dehydrated product. Ascorbic acid showed instability due to heat, oxygen and light, which is reversibly oxidized to dehydro ascorbic acid and later is converted irreversibly into diketoglutanmic acid (Birch *et al*., 3). Ascorbic acid content in mango slices was significantly affected by drying temperature, duration of exposure and pre treatments. It was maximum in blanching + KMS treated slices and dried at 55°C (59.0 mg/100 g) closely followed by 60°C (52.0 mg/ 100 g). The data indicates blanched mango slices dried at 55 and 60°C after pretreatment with KMS retained maximum ascorbic acid. Similar results were also noted by Gajanana *et al.* (7) for *aonla* slices. Drying temperature and pre treatment both affected the β-carotene content of the mango slices. It was maximum 5.2 mg/ 100 g in the slices dried at 60°C and pretreated with blanching + KMS. Similar results showing powder prepared from ripe mango slices in cabinet drier at 50-60°C had maximum β-carotene as reported by Sagar *et al.* (12).

With respect to non-enzymatic browning there was significant effect in measurement of OD of browning among the drying temperature and pre-treatments. The mango slices treated with blanching + KMS and dried at 60 and 65°C had less value (1.79). The study indicates that high temperature (60 to 65°C) drying of

**Table 3.** Ascorbic acid, β-carotene, acidity and non-enzymatic browning of dehydrated mango slices (8-12% moisture).

| Drying time | Sample pre-treatment | Ascorbic acid (mg/100 g) | ß-carotene (mg/100g) | acidity (%) | Non-enzymatic browning (OD at 440 nm) |
|---|---|---|---|---|---|
| 55°C | Control | 45.0 | 3.8 | 0.62 | 1.97 |
| | Blanching | 49.01 | 4.3 | 0.59 | 1.88 |
| | B + KMS | 59.0 | 5.0 | 0.55 | 1.83 |
| 60°C | Control | 42.2 | 3.7 | 0.59 | 1.96 |
| | Blanching | 48.3 | 4.8 | 0.58 | 1.80 |
| | B + KMS | 52.0 | 5.2 | 0.53 | 1.79 |
| 65°C | Control | 42.0 | 3.5 | 0.60 | 1.95 |
| | Blanching | 47.2 | 4.7 | 0.59 | 1.88 |
| | B + KMS | 51.0 | 4.9 | 0.58 | 1.79 |
| CD at 5% | | | | | |
| Drying temp | | 0.489 | 0.538 | 0.687 | 0.112 |
| Pre-treatment | | 0.789 | 0.538 | 0.687 | 0.114 |
| Temperature × pre-treatment | | 0.106 | 0.933 | 0.118 | 0.115 |

B: Blanching; KMS: Potassium metabisulphite

mango slices with pretreatment of blanching + KMS reduces the incidence of browning. Similar trend was reported by Hymavati and Khader (8) for mango powder, Choudhary *et al.* (4) for *aonla* powder and Tripathi *et al.* (16) for dried *aonla*.

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