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DRYING CHARACTERISTICS OF KESAR MANGO STONE

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Abstract

Mango (Mangifera Indica L.) fruit belongs to the family of Anacardiaceae. Aroundone thousand mango varieties are available worldwide. Mango is cultivated on an area of 3.7 million ha worldwide. India produced 18431.33 MT of mangos from 2515.97 thousand ha area. India is the largest producer of mango in the world, contributing to nearly 46% of the total world production. Mango stone is a single oblong fibrous seed of mango. Mango seed consists of a hard seed coat encloses the kernel inside. The kernel size is 40 -70 mm long and 30-40 mm wide. The seed represents about 10 to 25 per cent of the whole fruit weight. The kernel inside the seed represents about 45 to 75 per cent of the seed and about 20 per cent of the whole fruit. Mango kernel is a soft and nutritious element of mango stone. It is a source of polyphenols, phytosterols, campesterol, sitosterol and tocopherols. It can be used as an ingredient for functional food. The fat extracted from the kernel being used in pharmaceutical industry. The kernel contains useful protein and antioxidants. Depending on the variety, mango kernel contains 6.0% protein, 11% fat, 77% carbohydrate, 2.0% crude fiber and 2.0% ash, based on the dry weight basis. A high moisture content in the stone affects its self-life. To remove the moisture content to a safe level, the drying study was undertaken in the tray dryer. The temperature of the dryer was set to 50 ºC, 60 ºC and 70 ºC. The time required for drying the stone at 50 ºC, 60 ºC and 70 ºC was 65, 56 and 50 h respectively.

Keywords: Tray dryer, Mango Stone, Initial moisture content, Drying, Kesar

I. INTRODUCTION

Mango (*Mangiferaindica L.)* fruit belongs to the family of *Anacardiaceae* and it is grown in many parts of the world, particularly in tropical countries. Over 1000 mango varieties are available worldwide. Presently, mango is cultivated on an area of approximately 3.7 million ha worldwide. India produced 18431.33 MT of mangos from 2515.97 thousand ha area. India is the largest producer of mango in the world, contributing to nearly 46% of the total world production. In India, Maharashtra is the potential state for mango production. In the Maharashtra, various famous mango varieties are produced like Alphanso, Kesar, Totapuri, Pairi etc., Maharashtra rank 6th in mango production in India. Maharashtra produces 1212.50 MT mangoes from 485 ha area with productivity 2.5 MT/ha. Konkan region in the Maharashtra is very popular for mango production. The mango varieties produced in Konkan region are Alpohanso, Kesar, Pairi, etc. The production of mangoes in Konkan region in the year 2012 was 3.3 lakh MT from 1.84 lakh ha area.

Mango seed is a single flat oblong seed that can be fibrous or hairy on the surface, depending on variety. Inside the seed coat 1-2 mm thick is a thin lining covering a single embryo, 4-7 cm long and 3-4 cm wide. Mango seed consists of a hard coat enclosing the kernel. The seed content of different varieties of mangoes ranges from 9 % to 23 % of the fruit weight and the kernel content of the seed ranges from 45.7 % to 72.8 %.Mango kernel is a soft and nutritive element of mango stone. Mango kernel is good source of polyphenols, phytosterols, campesterol, sitosterol and tocopherols as well as it may be used as an ingredient for functional food. The fat of the kernel is used in cosmetic

materials. The kernel has useful protein and antioxidants property. Depending on the variety, mango kernel contains 6.0% protein, 11% fat, 77% carbohydrate, 2.0% crude fiber and 2.0% ash, based on the dry weight basis. The drying characteristics of mango stone is for determine the drying rate and initial moisture content. The knowledge of drying characteristics helps in designing of structures and equipmentsused to handle mango stone. We are interested in how properties of mango stones are changes with temperature. We are mostly interested in decortications of mango kernel from mango stone.

II. MATERIALS AND METHODS

2.1 Materials

The materials used for the experiment were Mango stone, Hot air oven, Tray dryer (heated air) and Weighing balance.

2.1.1 Raw material and sample preparation

The Kesar mango stones were brought from the Department of Horticulture, Dr. B. S. K. K. V., Dapoli, Dist. Ratnagiri. The stones were washed thoroughly with the help of clean moving water.

2.2 Method

The following method was followed while performing the experiment.

2.2.1 Determination of Moisture Content

The moisture content of the washed sample was determined by Air-Oven method. The standard procedure was followed to determine the moisture content. First of all the empty weight of the sample box was measured with the help of digital balance (W_1). Then the mango stone sample was put into the sample box and measured weight (W_2). The temperature of Air oven was set to 105^{o}C. Then the unlid sample box was put into the air oven for 24 h. (Mohsenin, 1998). After 24 hours, the box along with sample are taken out from the oven and put into desiccator for 30 minutes. After that measured the weight of the sample along with the sample box (W_3). The moisture content of the mango stone was calculated by using the following formula.

$$\text{Moisture content} = \frac{(W_2 - W_3)}{(W_2 - W_1)} \times 100$$

Where, W_1 = Weight of sample box (g),
W_2 = Weightof sample box with lid and Kesar mango stone (g),
W_3 = Weightof sample box with lid and Kesar mango stone after drying (g).

2.2.2 Drying of Kesar Mango Stone

The drying of the stones was performed at three different temperatures viz. 50, 60 and 70 ^{o}C. The mango stone to be dried were placed in the stainless steel trays(size: 20.7 cm x 14.7 cm) of the tray dryer. The initial weight of the stones was 0.980 kg. The desired temperature of drying air was set in the dryer. Once the temperature is reached, the trays along with stones were placed in the drying chamber. To trace the moisture loss, the weight of the stones was measured at pre-determined time intervals. For all the treatments, the initially, the weights of the trays were measured at 15 minutes interval for couple of hours, thereafter it was taken at the interval of an hour.

2.2.3 Drying rate

To find the effect of drying air temperature on the rate of drying following formula was used.

$$R = \frac{W_r}{T \times W_d} \times 100$$

Where, R = Drying rate (g/min)
W_r = Amount of moisture removed (g)
T = Time taken (h)
W_d = Total bone dry weight of sample (g)

III. RESULT AND DISCUSSION

3.1 Moisture content of Mango Stone

The moisture content of mango stone was determined with the help of air oven method. The average initial moisture content was 33.33% (w.b.).

3.2 Drying of Alphonso Mango stone

The mango stones were dried in the tray dryer at temperature of 50, 60 and 70 ˚C. The observations of weight loss were recorded, initially; at 15-minute interval for first couple of hours thereafter an hour interval. The experiment continued until getting the constant weight. Total three replications were taken for experiment. As shown in Fig. 1, the average time required for drying of mango stone was 65, 56 and 50 h respectively for temperature 50, 60 and 70˚C.

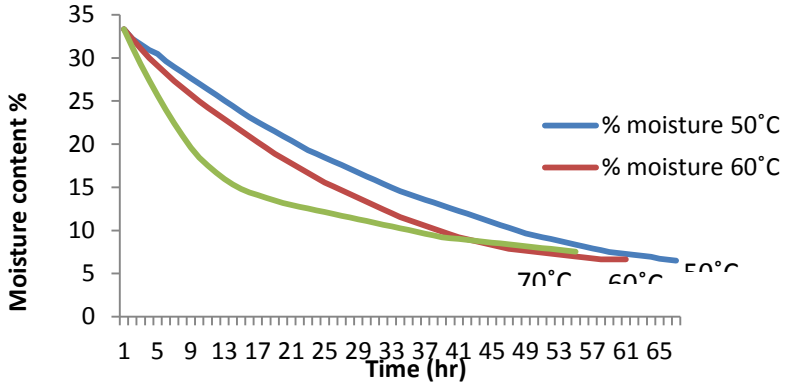

Figure 1. Effect of temperature of drying air on time required for drying

3.3 Effect of drying air temperature on drying rate:

The drying rate was determined with the help of above formula. The graphs were plotted between drying rate and moisture content.

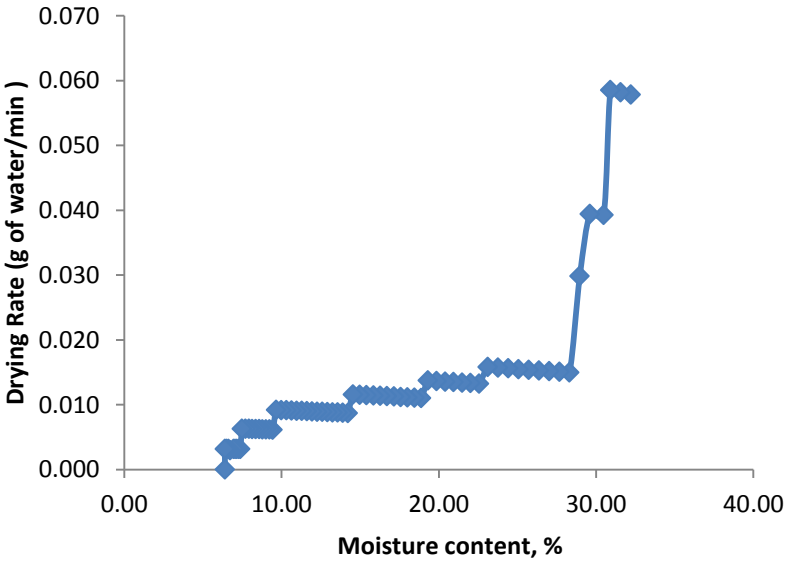

Figure 2. Drying rate of mango stone at 50˚C air temperature.

The Figure 2 shows that for drying air temperature 50^{o}C, rate of drying was initially 0.059 g/min where moisture content was 33.33 % (w.b.). The rate of drying decreased with a slower space compared to other treatments. The rate of drying depends on the driving force created by heated air. As the temperature of air was slightly higher than the stone temperature and lower than the remaining treatments, driving force due to temperature difference between sample and heated air was comparatively lower. Due to lower driving force, the rate of drying was slower.

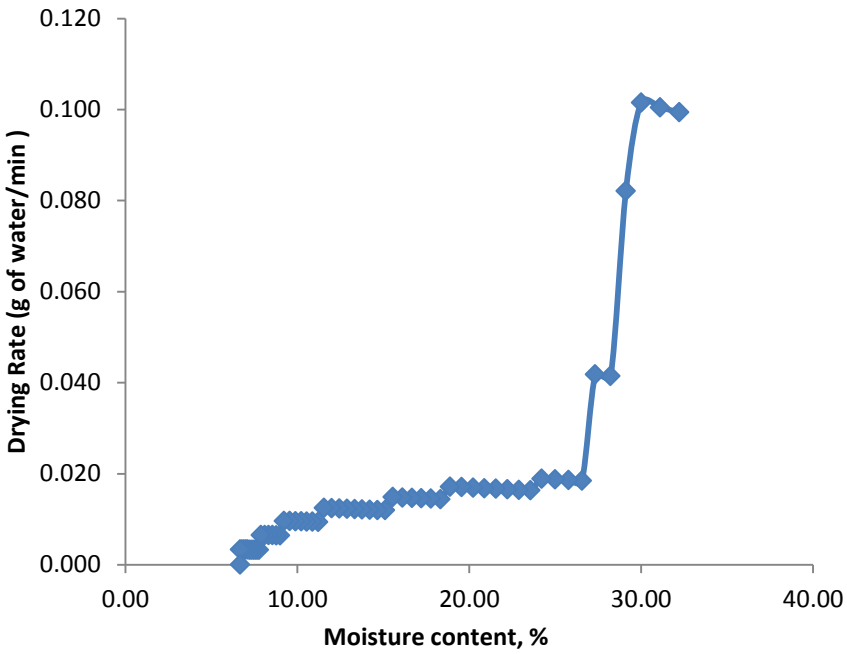

Figure 3. Drying rate of mango stone at 60˚C air temperature

The Figure 3 shows that for drying air temperature 60^{o}C, rate of drying wasinitially0.099 g/min where moisture content was 33.33 % (w.b.). The rate of drying was higher initially compared to previous treatment. Moreover, it was decreased with slightly faster space compared to previous treatment. As the temperature of air was higher than the stone temperature, driving force due to temperature difference between sample and heated air was comparatively higher. Due to this driving force, initially, the rate of drying was faster then become almost constant. The rate was faster until the moisture content of the stone was reached to 27 % (w.b.).

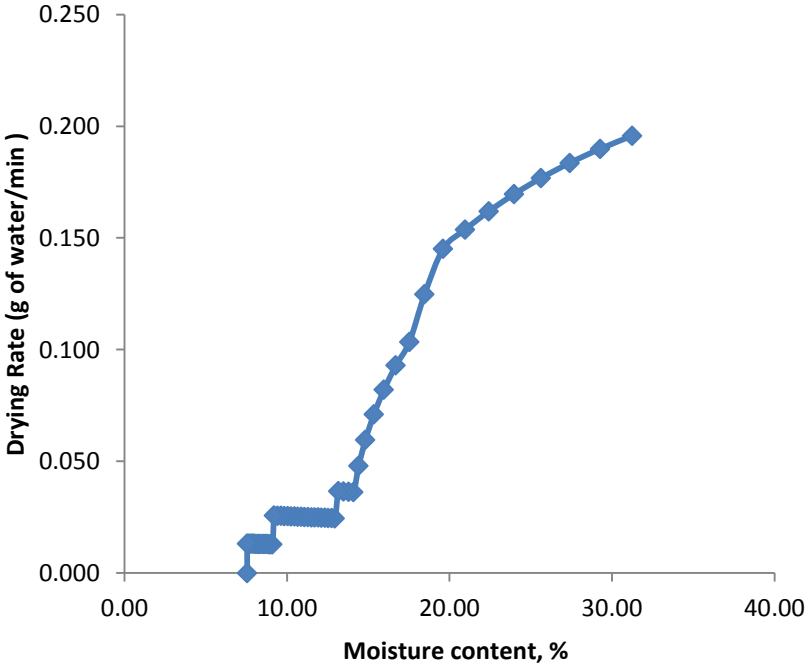

Figure 4. Drying rate of mango stone at 70˚C air temperature

The Figure 4 shows that for drying air temperature 70^{o}C, rate of drying wasinitially0.19 g/min where moisture content was 33.33 % (w.b.). It was higher until M. C. 30% compared to previous treatments. In addition, it was decreased with slightly faster space compared to previous

two treatments. As the temperature of air was higher than the stone temperature, driving force due to temperature difference between sample and heated air was comparatively higher. Due to this driving force, initially, the rate of drying was faster then become almost constant after 16 % M. C.

IV. CONCLUSIONS

1. The average initial moisture content of Kesar mango stone was found 33.33% (w.b.)
2. The time required for drying of mango stone at treatment 50 °C was 65 h, at 60 °C was 56 h and at 70 °C was 50 h.
3. At treatment 50 ^{o}C, rate of initial drying was 0.06; At 60 ^{o}C, initial rate of drying was 0.09 and at 70 ^{o}C, rate of drying was initially 0.19.
4. There was abrupt increase in drying rate initially at treatment 50 ^{o}C and 60 ^{o}C whereas in case of treatment 70 ^{o}C the drying rate was decreasing steadily throughout the experiment.

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