

TECHNIQUE OF DRYING CHILLI FRUITS TO PROTECT FROM MICROBIAL DAMAGE DURING STORAGE

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On sun drying of freshly harvested chilli fruits for 10,15,20 and 25 days, the moisture level of the fruit was found to be 18.67,12.52, 7.28 and 4.05% respectively. There appeared positive correlation with the moisture level of the fruit and its loss (%) in dry wt and that of capsaicin content on storage. Thus, maximum loss was recorded at 18.67% moisture and minimum at 4.05%. As the temperature of storage was raised, the loss in dry wt and capsaicin proportionately increased. The maximum loss was recorded at 30°C and minimum at 10°C. The value of O.D of pigments decreased with rise in the temperature of storage from 10 to 30°C, and at a fixed temperature, their value decreased with rise in moisture level of the fruit. The loss in dry wt, discoloration and capsaicin content and spore dust formation in the fruit stored in the laboratory were slightly less than that stored at 30°C. As the temperature rose from 50 to 90°C in case of oven drying, there was gradual decrease in moisture level, the pigment and capsaicin. The fruit lot smeared with oils possessed more pigment than without them. The effect of smearing the fruit lot with mahua and mustard oil appeared similar. The fruit lot drying for 15 days period possessed maximum concentration of these pigments and capsaicin.

Keywords: Chilli fruits; Decay in storage; Drying.

Introduction

The decay of chilli fruits during storage in India has earlier been reported¹ showing the symptoms of decay due to storage fungi. As it is a country wide problem, the method of drying of the harvested fruit lot for the control of decay during storage has been worked out and suitable measures have been suggested in the present paper. The chemical method of control for vegetables and fleshy fruits² has been suggested which cannot be applied with chilli as it is not used in the manner as the forme are used. The methods to discourage the growth of mycoflora, suggested^{3,4} earlier by drying food grains and dehumidifying the store house seem the appropriate for chilli. The irradiation treatment though effective in destroying the viable fungal spores on the surface, also seems hesitantly adoptable due to suspected alteration of the natural chemical composition of the commodity by ionizing radiation.

Material and Methods

Storage of chilli fruits after sun drying : After the harvest of the fruit lots in January 2007, it was spread thinly and uniformly in clear sun on the cemented floor for a period of 10,15,20 and 25 days by shuffling everyday. At sunset the lot was shifted to the room and spread again in the sun

in the next morning. The moisture level of the fruit was determined after expiry of the drying period keeping 20 g lot in triplicate at 60°C for 8hr and desiccating over fused calcium chloride to their constant weight. The moisture content was determined as,

$$\text{moisture content (\%)} = \frac{w_1 - w_2}{w_1} \times 100$$

Where w_1 = mean of the weight of sun dried fruit, w_2 = mean of the weight of incubator dried fruit. The moisture (%) content of the fruit was recorded as 18.67, 12.52, 7.26 and 4.05%, respectively for the four increasing periods of drying.

Storage of sun dried fruits: One hundred g of the sundried fruit in triplicate was packaged in polyethylene pockets for storing at 10,20, and 30°C and in the laboratory for 12 months period. At the time of setting for storage, the pigment level in the pericarp and capsaicin content in the placenta were determined. These particulars besides discoloration of the fruit, loss in dry wt and formation of spore dust of fungi inside the fruit, a common symptom of decay during storage, were worked out. The loss in dry wt was determined on drying the fruit as noted earlier. Discolored fruits were counted. The spore dust in the fruits

(%) was observed by breaking them manually. The loss in pigment was measured by taking patches of ten discolored pericarp of the fruit from each pocket, mixed, dried and powdered with mortar and pestle. one g of the powder was used for extraction of the pigment with 100 ml of petroleum ether, B.P. 60-80°C for 3 hr in Soxhlet extractor warming on sand bath. The pigment extract was concentrated by evaporating the solvent and separated on TLC modifying the column chromatography⁵. The pigments were identified by their colour (Red - HRf 26: Capsorubin, Pink - HRf 36: Capsanthin, Orange - HRf 53: Carotene, and Yellow - HRf 91: Xanthophyll). The pigment spots were eluted using solvent^{6,7} and the concentration of the pigment was read and recorded as O.D. Capsaicin was extracted from 100 mg of dried placenta and quantitatively read⁸ with the help of calibration curve using standard solution of capsaicin.

Methods of drying chilli fruits: During drying operation of freshly harvested chilli fruits, these have been reported to be destroyed by *Colletotrichum capsisi*, *Alternaria alternata*, *Curvularia lunata*, *C. pallescens*, *Cladosporium cladosporioides*, *C. oxysporum*, *C. chlorocephalum* and *Drechslera biseptata* when the process of drying prolongs due to cloud or rains. The decay by the noted fungi becomes serious, therefore, quick drying operation of the harvested fruit without the loss of lustre and brightness of the colour of the pericarp and amount of capsaicin are essential. For this purpose, the feasibility of sun drying and oven drying procedures was sought. For sun drying, 100 g of freshly harvested fruit in five replicates was spread in the sun keeping in glass troughs in the month of January 2007. Two other sets were prepared, one conventionally smeared with 1g mustard (*Brassica campestris*) oil per 100 g freshly harvested fruit and another with mahua (*Madhuca indica*) oil in the same ratio. All the fifteen lots were spread in the sun for 15, 20, 25 and 30 days (duration of sunlight 10hr 35 min to 11 hr 02 min). At night the lots were shifted in the room. After expiry of the drying period, moisture content, pigment and capsaicin of the fruit were determined as noted earlier.

For oven drying of fruits, other things remaining the same except the maintenance of the temperature at 50, 60, 70, 80, and 90°C in the incubators to reduce the moisture content of the fruit below 4%. The period of drying at the noted temperatures was maintained variable as 18, 12, 09, 06 and 02 hr, respectively to find out suitable temperature of drying and maintaining the marketability of fruits. The pigment and capsaicin were determined.

Results and Discussion

There appeared positive correlation with the moisture level

of the fruit and loss (%) in dry wt and capsaicin content (Table 1, Fig 1,2). Thus, maximum loss was recorded at 18.67% moisture and the minimum at 4.05%. As the temperature of storage was raised, the loss dry in wt and capsaicin proportionately increased. The maximum loss was recorded at 30°C and minimum at 10°C. The value of O.D. of the pigments decreased with rise in the temperature of storage from 10 to 30°C, and at a fixed temperature, their value decreased with rise in moisture level of the fruit. The loss in dry wt, quantitative value of discoloration and capsaicin content and spore dust formation in the fruits stored in the laboratory were slightly less than that stored at 30°C. As the temperature increased from 50 to 90°C in case of oven drying, there was gradual decrease in moisture level, the pigments and capsaicin (Table 3). The fruit lot smeared with oils possessed more pigments than without them. The effect of mahua and mustard oil appeared similar. The fruit lot drying for 15 days period possessed maximum concentration of the pigments and capsaicin (Table 2).

It is unequivocal that the storage of high moisture seeds and grains would lead their considerable microbial decay. The discoloration of more than 60% of moisture fruit at room temperature was associated with the presence of spore dust (Table 1) indicating unsuitability of storage of moisture chilli fruit probably due to favouring the growth of mycoflora reaching during agricultural operations. 14.5% moisture level and temperature between 25 - 30°C have been reported to permit the growth of fungi and consequent considerable microbial spoilage¹⁰. 12.52% moisture (Table 1) too, proved harmful for the safe storage of chilli fruits. Slow microbial invasion of sunflower seed has been observed at 6.5% moisture¹¹. The high moisture fruit of chilli can be stored at 10°C or preferably below this to protect from microbial spoilage. The storage of the fruit possessing 4.0% moisture level approx, at 10°C seems the best condition but the process of reducing the moisture level to the noted extent appears to damage the quality of fruit.

The appearance of discoloration couple with the presence of spore dust in moisture chilli fruits was minimum at 10°C and the maximum at 30°C and at room temperature suggesting that even low temperature storage of moisture fruit is not very congenial instead storage of low moisture fruit at any of the temperature. Insignificant loss in dry wt of the low moisture fruit was observed probably due to discouraging microbial growth. Slight loss of the pigment and capsaicin in this procedure would hardly affect the marketability of the commodity. Therefore, this sort of storage seems the promising attempt.

Table 1. Effect of storage of sundried moisture chilli fruit at varying temperature and the laboratory condition on the symptoms of decay, loss in dry wt, capsaicin content and the pigment.

Storage temperature	Moisture content (%)	Symptoms of decay (%)	Loss in dry wt (%)	Loss in capsaicin (%)	Pigments (O.D)
Before Storage	18.67	DC 0.0 SD 0.0	0.0	0.0	CR 0.080 CS 0.052 CT 0.026 XP 0.019
	12.52	DC 0.0 SD 0.0	0.0	0.0	CR 0.079 CS 0.051 CT 0.026 XP 0.019
	7.28	DC 0.0 SD 0.0	0.0	0.0	CR 0.078 CS 0.050 CT 0.026 XP 0.018
	4.05	DC 0.0 SD 0.0	0.0	0.0	CR 0.078 CS 0.049 CT 0.024 XP 0.017
10	18.67	DC 35 SD 20	10.12	5.17	CR 0.070 CS 0.045 CT 0.020 XP 0.015
	12.52	DC 25 SD 15	7.25	4.95	CR 0.074 CS 0.046 CT 0.021 XP 0.016
	7.28	DC 11 SD 9	3.43	4.78	CR 0.075 CS 0.047 CT 0.022 XP 0.017
	4.05	DC 0.0 SD 0.0	0.52	4.62	CR 0.076 CS 0.048 CT 0.023 XP 0.018
20	18.67	DC 52 SD 40	31.18	9.25	CR 0.052 CS 0.032 CT 0.011 XP 0.009
	12.52	DC 43 SD 32	15.15	8.62	CR 0.056 CS 0.035 CT 0.014 XP 0.010

Storage temperature	Moisture content (%)	Symptoms of decay (%)	Loss in dry wt (%)	Loss in capsaicin (%)	Pigments (O.D)
30	7.28	DC 22 SD 11	10.05	7.82	CR 0.059 CS 0.036 CT 0.015 XP 0.012
	4.05	DC 0.0 SD 0.0	4.16	7.25	CR 0.064 CS 0.038 CT 0.017 XP 0.013
	18.67	DC 95 SD 78	55.63	22.82	CR 0.029 CS 0.018 CT 0.009 XP 0.002
	12.52	DC 82 SD 69	30.45	21.23	CR 0.033 CS 0.020 CT 0.010 XP 0.003
	7.28	DC 30 SD 21	19.87	20.45	CR 0.036 CS 0.022 CT 0.011 XP 0.004
	4.05	DC 02 SD 00	5.82	19.66	CR 0.038 CS 0.022 CT 0.012 XP 0.005
Stored in the laboratory	18.67	DC 90 SD 72	51.65	21.57	CR 0.031 CS 0.020 CT 0.010 XP 0.002
	12.52	DC 76 SD 63	28.73	19.82	CR 0.034 CS 0.021 CT 0.011 XP 0.003
	7.28	DC 25 SD 17	17.26	18.88	CR 0.038 CS 0.023 CT 0.013 XP 0.004
	4.05	DC 02 SD 00	4.68	16.68	CR 0.040 CS 0.024 CT 0.014 XP 0.005

* DC = Discoloration, SD = Spore dust formation, Figures were rounded to their whole number.

** CR = Capsorubin, CS = Capsanthin, CT = Carotene, XP = Xanthophyll

Table 2. Effect of sundrying of freshly harvested and oil smeared chilli fruit for varying periods on the moisture level (%), capsaicin (CSC) and pigments*.

Periods (in days)	Moisture level (%)	Pigments capsaicin (CSC)	Without oil	Smeared with oil	
				Mustard oil	Mahua oil
15	12.52	CR	0.072	0.082	0.083
		CS	0.047	0.055	0.055
		CT	0.022	0.028	0.031
		XP	0.016	0.020	0.021
		CSC	2.536	2.540	2.541
20	7.28	CR	0.070	0.080	0.082
		CS	0.046	0.054	0.054
		CT	0.021	0.027	0.030
		XP	0.015	0.019	0.020
		CSC	2.533	2.535	2.535
25	4.05	CR	0.068	0.078	0.081
		CS	0.045	0.052	0.053
		CT	0.020	0.025	0.028
		XP	0.014	0.018	0.019
		CSC	2.512	2.573	2.514
30	3.32	CR	0.066	0.74	0.078
		CS	0.43	0.50	0.051
		CT	0.019	0.024	0.026
		XP	0.013	0.016	0.017
		CSC	2.492	2.493	2.494

* CR = Capsorubin, CS = Capsanthin, CT = Carotene, Xp = Xanthophyll. (expressed as O.D.)

Table 3. Oven drying of freshly harvested fruits at varying temperature for varying periods to reduce the moisture level (%) below 4% *vis- a-vis* the capsaicin (=CSC) (% wt of dry placenta) content and pigments*.

Temperature (°C)	Duration (in hr)	Moisture level (%)	Pigments capsaicin	Without oil	Smeared with oil	
					Mustard oil	Mahua oil
50	18	6.85	CR	0.046	0.048	0.049
			CS	0.038	0.041	0.041
			CT	0.014	0.018	0.019
			XP	0.008	0.010	0.010
			CSC	1.960	1.962	1.963
60	12	4.93	CR	0.037	0.039	0.040
			CS	0.031	0.033	0.033
			CT	0.011	0.014	0.014
			XP	0.006	0.009	0.010
			CSC	1.916	1.918	1.917
70	09	3.87	CR	0.033	0.035	0.036
			CS	0.028	0.030	0.030
			CT	0.009	0.011	0.011
			XP	0.004	0.008	0.008
			CSC	1.802	1.804	1.805
80	06	2.64	CR	0.029	0.032	0.033
			CS	0.023	0.026	0.027
			CT	0.007	0.010	0.010
			XP	0.003	0.007	0.008
			CSC	1.513	1.516	1.517
90	02	1.12	CR	0.022	0.025	0.026
			CS	0.019	0.021	0.022
			CT	0.005	0.007	0.007
			XP	0.001	0.002	0.002
			CSC	0.868	0.869	0.872

* CR = Capsorubin, CS = Capsanthin, CT = Carotene, Xp = Xanthophyll. (expressed as O.D.)

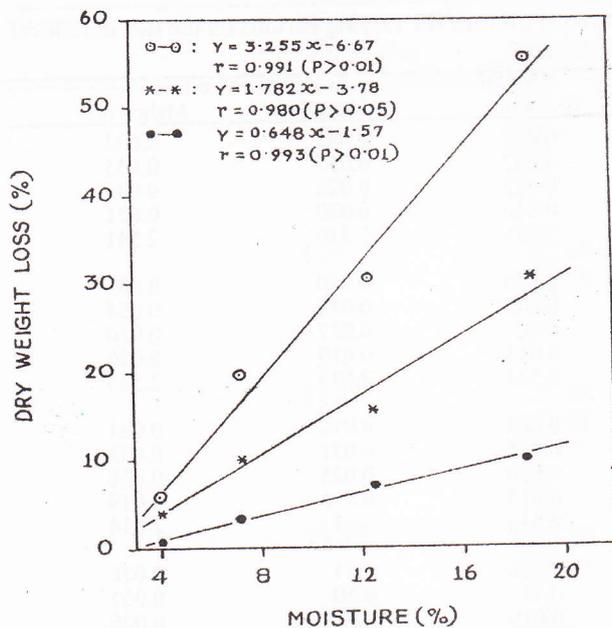


Fig. 1. Relationship between moisture level (%) and loss in dry weight (%) of chilli fruits on storage 10 (solid circles), 20 (crosses) and 30°C (open circles)

Such change can be implicated for domestic purpose using small polyethylene containers for 100 or 200 g of chilli fruits or so planned for a month, keeping one dozen pockets for one year in a family. The dry fruits can also be packaged in air tight polyethylene lined bags on commercial scale. Best storage technique would be the storage of dry breakable fruits with silica gel as dehumidifier in plywood boxes internally covered with polyethylene sheet. High temperature for quick drying should be avoided. The sun drying on cemented floor is advisable.

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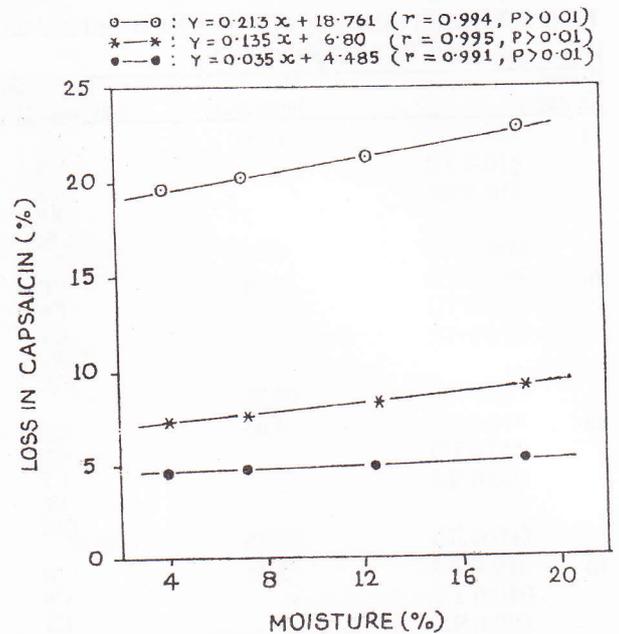


Fig. 2. Relationship between moisture level (%) and loss in capsaicin (%) of chilli fruits on storage 10 (solid circles), 20 (crosses) and 30°C (open circles)

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