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Optimization of Process Parameters to Dry Different Hybrids and Varieties of Chillies in Barns

Ch V V Satyanarayana and C R Sukumaran
Post Harvest Technology Centre, Bapatla 522101, Andhra Pradesh

ABSTRACT

Experiments were conducted to establish optimum parameters to dry different varieties and hybrids of chillies in unutilized tobacco barns. Drying time required to reduce moisture from about 233.3 to 12.1% (d.b) varied depending upon whether the chilli is hybrid (thick pericarp type, eg. Wonder Hot, Indam-5) or variety (medium to thin pericarp type, eg. LCA-334). The hybrids require about 48 to 50 hours to dry whereas the varieties require about 38 to 40 hours. The temperatures ranging initially at 50^0C to a final value of about 55^0C were found to be appropriate to dry chillies. The percentage discolored pods were found to be only 0.5 to 2.5% in barn dried produce in comparison to 10 to 15% in open yard sun drying. The open yard sun drying takes 16 to 21 days in comparison to barn drying method. It has been observed that time, temperature and ventilator operation regimes are important to get good quality uniform dried produce. The operation schedules of bottom and top ventilators were optimized for both chilli hybrids and varieties.

Key words : Barns, Chillies, Drying,Process Parameters.

Drying of chillies in open yard takes about 15 to 20 days leading to poor post harvest quality. Large scale drying studies indicated that the existing unutilized tobacco barns could be converted for exclusive drying of chillies by incorporating minimal modifications such as providing wire mesh trays or bamboo trays and exposing chillies to hot air. (Anonymous, 2005). However, information about optimum drying parameters suitable to dry hybrids and varieties of chillies has been lacking. A study was undertaken with specific objectives, (i) to establish optimum drying parameters such as drying air temperature, ventilator operating regimes to produce quality dried chillies, (ii) to measure the quality parameters of dried chillies such as colour, capsaicin in comparison to produce dried in open yard sun drying.

MATERIAL AND METHODS

Experiments were performed at Dharanikota village in Amaravathi mandal of Guntur district, Andhra Pradesh using a single furnace type barn of size 3.6 x 6 m. The galvanized iron (G.I.) wire mesh trays of size 1.05 x 0.75 x 0.075 m were placed on the existing tiers and chillies were spread on them to expose to hot air. All of the existing tiers in the barns were loaded with chillies after leaving a central bay of 0.6 x 6 m for ease of loading as well as for circulation of hot air. Experiments were performed using 100 number of galvanized iron (G.I.) wire mesh trays. Popular chilli hybrids and varieties were procured from the local farmer. In all the experiments, fruits were harvested a day before and allowed to heap over night to facilitate uniform development of colour. Green, damaged fruits, leaves and any foreign material were separated out the next day morning as they are loaded using baskets. The pods were uniformly spread at a thickness of about 6.25 cm. Initial and final moisture contents of the produce were determined using AOAC method (AOAC, 1955).

Discoloured pods both in open yard and barn drying methods were separated and percentage out of total dried pods was calculated to assess the drying quality.

Biochemical quality parameters such as ASTA colour, capsaicin, ethyl dichloride extracted oleoresin content and total aflatoxin were determined as per the following procedures of official analytical methods of the American Spice Trade Association (ASTA, 1997).

Colour; ASTA method 20.1.1997, Capsaicin content (%); ASTA method 20.3.1997, Oleoresin, EDC Extractable (% by wt); ASTA method 11.0.1997, Aflatoxin (B 1, B2, G 1 & G2) in ppb; ASTA method 24.2.1997

RESULTS AND DISCUSSION

Experiments using bamboo mats of size 0.75 x 1.8 m as chilli holding material revealed that bamboo mats, although of low cost initially, can not be used on large scale and for drying in batches on a continuous basis (Anonymous, 2005). Experiments using G.I. and S.S. wire mesh trays

Table 1. Summary of experimental results of barn and open yard sun drying of popular hybrids

Parameter	Barn drying		Open yard sun drying	
	Wonder Hot	Indiam 5	Wonder Hot	Indiam 5
Initial moisture content (dry basis %)	233.3	233.9	233.3	233.9
Final *momordica*oisture content (dry basis %)	11.5	11.0	11.5	11.0
Drying temperature ^{0}C	50.55	50-55	-	-
Drying time(hrs)	48-50	48-50	21 days	20 days
Discolored pods%	1 to 2	0.5 to 1.0	12 to 14	13 to 15
ASTA colour	102 to 104	74 to 80	73 to 75	49 to 61
Oleoresin(%)	12.8 to 3.8	13.9 to14.9	12.3 to13.2	13.7 to 4.1
Capsaicin(%)	0.21 to 0.28	0.26 to 0.31	0.20 to 0.26	0.27 to 0.29
Aflatoxin(ppb/kg pod)	<0.5	<0.5	27	4.1 to 13.8

Table 2. Summary of experimental results of barn and open yard sun drying of popular straight varieties

Parameter	Barn drying		Open yard sun drying	
	LCA-334	S4	LCA-334	S4
Initial moisture content (dry basis %)	234.2	235.1	234.2	235.1
Final moisture content (dry basis %)	11.8	11.2	11.8	11.2
Drying temperature ^{0}C	50-55	50-55	-	-
Drying time(hrs)	38-40	38-40	16 days	17 days
Discolored pods%	1.5 to 2.5	1 to 2	12 to 14	11 to 14
ASTA colour	39 to 51	76 to 78	31 to 42	41 to 46
Oleoresin(%)	14.9 to15.4	15.9 to 16.8	14.5 to15.2	15.6 to16.1
Capsaicin(%)	0.39 to 0.42	0.42 to 0.46	0.37 to 0.42	0.40 to 0.45
Aflatoxin(ppb/kg pod)	<0.5	<0.5	27	5 to 11

Table 3. Time, Temperature and ventilator operating regimes to dry hybrid chillies in barns.

Time (hrs)	Temperature regimes$^{0(C)}$	Open yard sun drying	
		Bottom Ventilators	Top Ventilator
0 to 6	50	Full closed	Full closed
6 to 44	55	Half open	Full open
44 to 50	55	Full open	Full closed

Table 4. Time, Temperature and ventilator operating regimes to dry chillie varieties in barns.

Time (hrs)	Temperature regimes$^{0(C)}$	Open yard sun drying	
		Bottom Ventilators	Top Ventilator
0 to 6	50	Full closed	Full closed
6 to 36	55	Half open	Full open
36 to 40	55	Full open	Full closed

gave much lower drying time, 47.5 to 51 hours in comparison to drying using bamboo mats which took 70 to 80 hours (Anonymous, 2005). Experiments indicated that perforated G.I. trays reduced drying time considerably. Increasing drying air temperature is one way of reducing drying time. However, the effect of higher temperature on biochemical quality is important. Literature indicates that 60°C is critical temperature to avoid darkening/blackening of chilli in artificial drying (Lease and Lease, 1962 and Mishra, 1972). Experiments conducted at different drying air temperatures of 50, 55 and 60°C using Wonder Hot hybrid showed considerable variation ranging from 6 to 7.5° C in drying air temperature across the height of the barn. The temperature profiles and quality assessment of dried produce in different tiers indicated that the drying air at a temperature of 50 to 55°C is suitable to dry chillies with good colour retention.

Number of varieties such as LCA-334 (ANGRAU, Lam), Vinjanampadu variety (S4) and another hybrid chilli, Indam-5 (Indo American seeds Pvt Ltd) were dried in a series of experiments to investigate any variation in drying time, ventilator operation regimes and quality with type of chilli. The average bulk density of the ripe chillies varied from 200 to 230 Kg/m^3 depending upon the variety and initial moisture. Therefore, barn capacity varied from 9.84 to 11.32 quintals of ripe pods at a thickness of spread of 6.25 cm. Based on the experiments, chillies have been grouped into two types depending upon the nature and thickness of pericarp, 1. Thin pericarp type varieties (thin walled chilli, typically S4; and 2. Thick pericarp type hybrids (thick walled chilli, Wonder Hot). The summary of the experimental results is shown in Tables 1 and 2. Significant quality improvement in barn dried produce is observed in comparison to farmer's method. The color of barn dried product is higher than the product obtained in open yard method. Discoloured pods are only 1 to 2% in barn dried produce compared to 12 to 14% in open yard sun drying. The oleoresin and capsaicin contents are slightly more in barn dried produce in comparison to open yard dried produce. Similar observation of improved quality in artificial drying has been reported by Mangaraj *et al.,* (2001).

The percentage discolored pods are found to be only 0.5 to 2.5% in barn dried produce in comparison to 10 to 15% in open yard sun drying. The ASTA colour value of barn dried hybrid chilli is higher ranging from 74 to 104 units in comparison to 49 to 75 units in open yard sun drying method (farmers' practice). Similarly the ASTA colour value of barn dried straight varieties of chilli is higher ranging from 39 to 78 units in comparison to 31 to 46 units in open yard sun drying method. Total aflatoxin content of barn dried product is much lower, < 0.5 ppb in comparison to 4.1 to 27 ppb found in open yard sun dried method. The improved quality of the dried chilli in barn drying method suggests that barn drying is a good alternate method to mitigate post harvest drying problems and to get higher price particularly in the export market.

It was observed that moisture removal was faster in bottom tiers compared to top tiers during initial stages of drying. The variation is perhaps due to the movement of drying front from bottom to the top of the barn. The problem which exists in tobacco drying also is generally overcome by systematic operation of bottom and top ventilators. It is observed that systematic operation of both bottom and top ventilators to facilitate removal of moisture by fresh air is more important than simply maintaining a constant temperature in the system.

A suitable schedule of time, temperature, ventilator operation regimes to overcome the problem of partial drying particularly in top tiers during final stages for drying Wonder Hot hybrid chilli was established. The ventilator operating regimes for hybrid, Indam –5 are observed to be same as established for Wonder Hot hybrid. Based on the experiments with a typical range of different varieties (LCA-334, S-4) and hybrids (Wonder Hot and Indam-5), a procedure to systematically operate the barn ventilators is established to dry group of hybrids and varieties (Table 3 and 4). Frontline demonstration of the barn drying technology by exporter, ITC-ILTD, Guntur in technical collaboration with this project at Tullur confirmed that the quality of barn dried produce is excellent. Use of different size barns with a range of chillies indicated that about 100 to 120 G.I. wire mesh trays are required to load about 10 to 12 quintals of ripe fruits depending up on the barn size and type of chilli.Conclusions are as follows.

1. Ripe chillies can be dried in the existing unutilized tobacco barns with a loading capacity of barn is 10 to 12 quintals depending upon the variety and initial moisture content. Drying time in barns varies depending upon whether the pods are thin pericarp type varieties (thin walled chilli) or thick pericarp type hybrids (thick walled chilli). The hybrids can be dried in about 48 to 50 hours whereas the straight varieties can be dried in about 38 to 40 hours. The time, temperature and ventilator operation regimes are important to get good quality uniform dried produce.

2. ASTA colour of barn dried produce is higher in comparison to the colour of produce obtained by open yard sun drying. The discoloured pods are only 0.5% to 2.5% in barn dried produce compared to 10 to 15% in open yard sun drying. This is of significant economic value on the recovery of final dried chilli. The aflatoxin data indicated that the produce obtained by barn drying method contains <0.5 ppb of total aflatoxin in comparison to 4.1 to 27 ppb in open yard sun dried produce. This is a significant quality improvement, as chillies are not permitted for export to the European markets if the aflatoxin is more than 2 ppb.

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