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Studies on Mechanical Drying of Chillies (*Capsicum annum*)

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ABSTRACT

India is the largest producer, consumer and exporter of chillies. Drying of chillies is a major problem leading to poor quality product and significant Post Harvest losses. The moisture content of chillies has to be reduced from an initial value of 70 to 80% (wb) to a safe level of about 10% (wb) to increase its shelf life and also for further processing. Generally farmers follow open yard sun drying (OYSD). But, chillies dried in this method become contaminated and also take about 15 to 20 days to dry depending upon the season. A cabinet type mechanical dryer was used to dry two varieties of ripe chillies LCA 334 and wonder hot and one variety of green chilli (Namdhari). Experimental results indicated that the drying time with this method drastically reduced compared to OYSD which took about 10 to 13 days to reduce the moisture content from 76 to 84% (wb) to 10 to 12% (wb).

KEYWORDS:Chillies, Mechanical Drying, Cabinet Dryer, Sun drying, Moisture

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INTRODUCTION

Chilli (*Capsicum annum*) is an indispensable condiment and common ingredient of Indian foods. It was introduced by the Portuguese in Goa about 400 to 500 years ago. In India, production of chillies is about 2106000tonnes. India contributes about 50 % of the total world production of chillies. In India, Andhra Pradesh has a contribution of 47% of the total production. Guntur region in Andhra Pradesh is the largest chilli producing area in India. Chilli is a rich source of Vitamin A and C. It imparts pungency and colour to the culinary dishes prepared at household. Chillies generally contains about 7% stalk and calyx, 53% pericarp and 40% seeds.

One of the important unit operations undertaken in the post-harvest processing of chillies is drying. Chillies at the time of harvest have an initial moisture content of about 70 to 80% (wb). The moisture content has to be reduced to about 10% for increasing the shelf life of chillies and also for further processing into products such as chilli powder, oleoresins etc. Most of the farmers practice open yard sun drying (OYSD) of chillies. By drying the chillies by this method, it takes about 15 to 20 days to bring the final moisture content of chillies to 10 to 12% (wb) [1, 2]. But, chillies dried by this method get contaminated due to insects, dirt, bird excreta etc. Colour of chillies is one of the important quality parameters. Open yard sun drying causes uneven drying of produce due to uncontrolled temperature conditions and also colour deterioration takes place due to alternate exposure to hot cold temperatures during day and night respectively. To overcome these drawbacks in OYSD, solar drying or mechanical drying can be adopted to dry the produce in controlled conditions [3]. A cabinet dryer was used to dry two varieties of ripe chillies (LCA 334 and wonder hot) and one variety of Green chilli (Namdhari).

MATERIAL AND METHODS

The experiments were conducted to find out optimum air temperature suitable to varieties and hybrids of chillies and to evaluate the quality of the final dried produce. The study was conducted at post-harvest technology center, ANGRAU, Bapatla. The details of materials used, experimental methodology and measurement techniques adopted during the study are follows.

Cabinet Dryer

Cabinet dryer consists of perforated trays which can be placed one above the other with equal space in between. An opening is provided at the top of the dryer to remove exhaust air. An electrical heater was provided to heat the air which enters at the bottom opening of the dryer. To circulate this hot air in the dryer, a fan is provided. The movement of air inside the dryer is cross-flow. The specifications of the cabinet dryer are given in Table 1.

Table 1. The specifications of the cabinet dryer

S. No.	Description	Specifications
1	Internal dimension, (L x W x H), cm	84 x 48 x 84
2	External dimension, (L x W x H), cm	126 x 62 x 111
3	Tray size dimension, (L x W x H), cm	81.8 x 40.64 x 3.3
4	Controller	Solid state digital electronic temperature indicator cum controller
5	Temperature range, °C	Ambient to 100°C
6	Power Supply, V	230 V AC, 50 Hz

Experimental Procedure

Two varieties of ripe chillies namely LCA 334, wonder hot and one variety of green chillies (Namdhari), were used to conduct the experiments. The selected varieties of chillies were procured from local farmers. The range of pod length of selected varieties of Namdhari, LCA 334 and Wonder hot varieties are 5-6 cm, 7-8 cm and 12- 13 cm respectively. Each variety was again sub divided into 3 groups namely with stem, without stem whole pod and without stem flakes (25 to 30 mm) to get a total of nine samples.

All these samples were weighed exactly 200 grams and placed separately in small trays fabricated with GI wire mesh as shown in Fig. 1. These trays were placed in the cabinet dryer in the perforated trays with about 5 cm spacing in between the small trays as shown in Fig. 2. Experiments were conducted at different drying air temperatures of 40°C, 50°C, 55°C and 60°C. Kuppuswamy, 1974 suggested that there was no darkening of chillies at temperatures up to 60 to 66°C. During drying, the weights of samples were taken for every two hours to determine the moisture content. Temperature and relative humidity were simultaneously recorded. Also, two samples (with stem and without stem) of each variety were kept in open yard to record drying time and quality of the dried produce as shown in Fig. 3. Average air velocities maintained inside the cabinet dryer at 40°C, 50°C, 55°C and 60°C are 0.7 m/s, 1.0 m/s, 1.3 m/s and 1.6 m/s respectively.

**Fig. 1. View of weighed samples placed in small GI wire mesh trays**



Fig. 2. View of trays were placed in the cabinet dryer in the perforated trays



Fig. 3. View of open yard sun drying of selected samples

Determination of Moisture Content:

One sample of each different variety of chillies were taken in moisture boxes. The boxes were kept in hot air oven at 105°C for 24 hours and the weights were measured in electronic digital balance having an accuracy of 0.01g. From the initial and final moisture box weights, the moisture content of samples was determined and expressed in present wet basis.

$$\text{Moisture content (w.b)} = \frac{W_2 - W_3}{W_2 - W_1}$$

W_1 = Weight of empty box

W_2 = Weight of moist sample + box

W_3 = Weight of dried sample + box

RESULTS AND DISCUSSION

The findings of the present study as well as relevant discussion have been presented under following heads:

Effect of drying air temperature on drying time of different forms of chillies:

During the study it was observed that Green chillies of Namdhari type (both with stem and without stem) took 56 h to dry from an initial moisture content of 89.56 per cent to a final moisture content of 9-13 per cent at 40 °C whereas it took only 30 h for green chilly flakes to attain a final moisture content of 9.2 per cent (Fig. 3.1). this may be due to the more exposure area of flakes compared to pods with stem and without stem. Similar observations are made with LCA 334 variety and Wonder hot hybrid chillies. (Fig 3.2 and 3.3). the relative drying times are shown in Table 3.1.

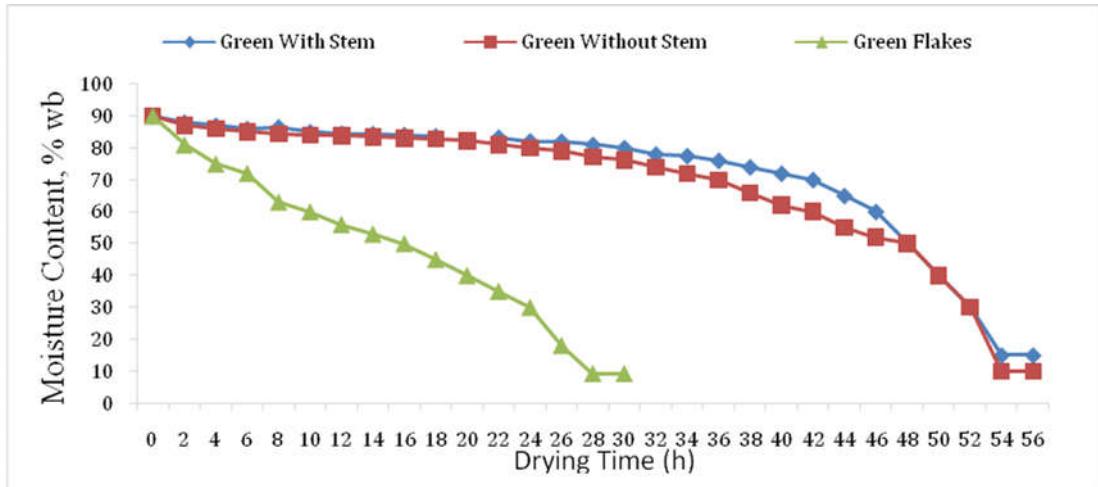


Fig 3.1: Effect of different forms of green chilli on drying time at 40°C

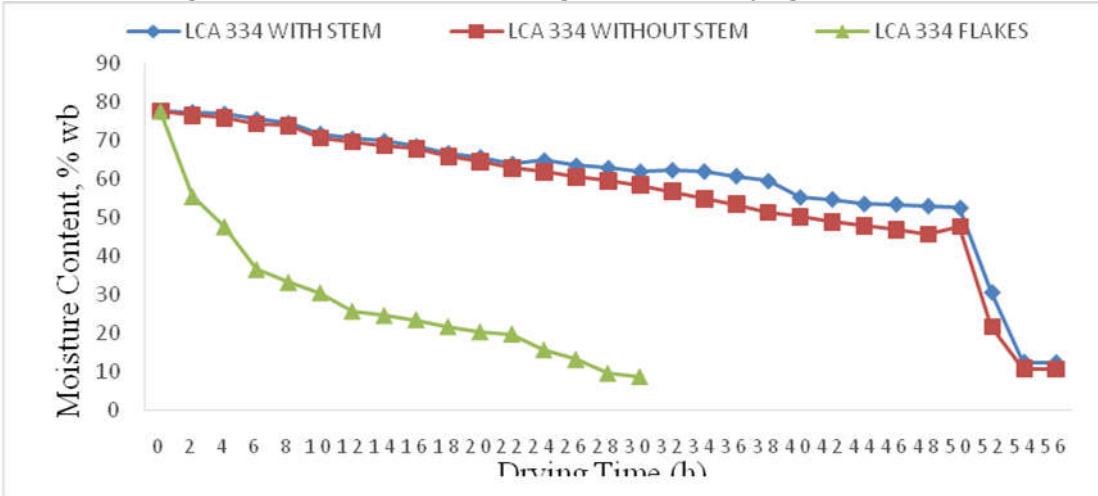


Fig 3.2: Effect of different forms of LCA 334 variety on drying time at 40°C

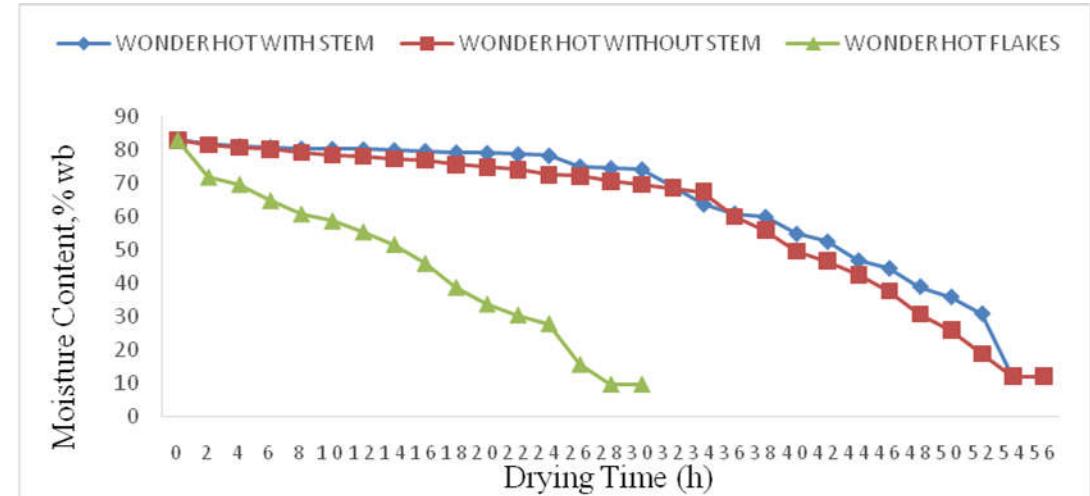


Fig 3.3: Effect of different forms of Wonder hot hybrid on drying time at 40°C

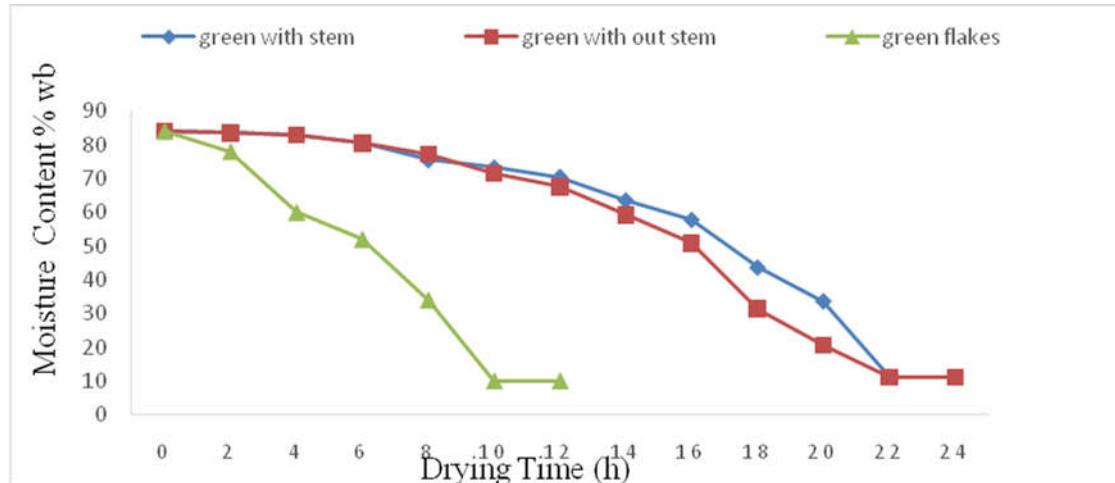


Fig 3.4: Effect of different forms of Green Chilli on drying time at 50°C

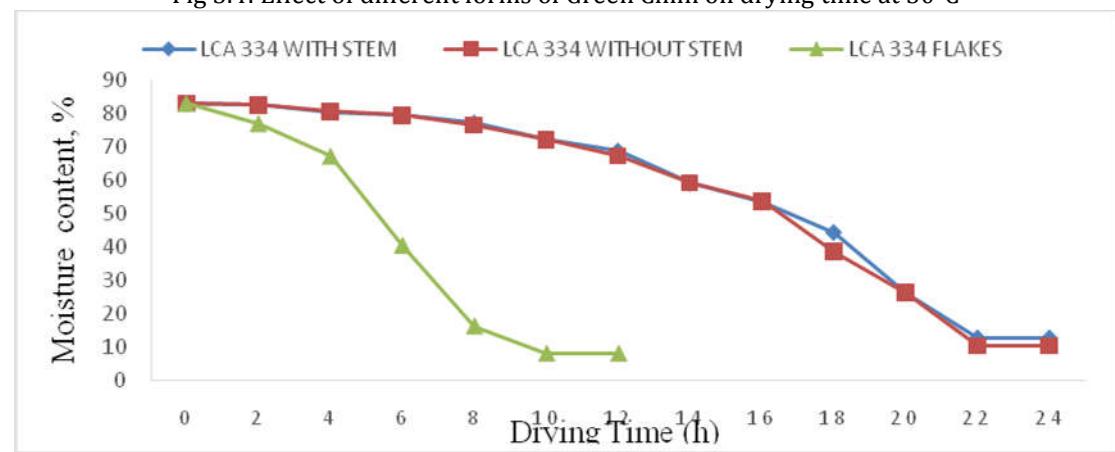


Fig 3.5: Effect of different forms of LCA 334 variety on drying time at 50°C

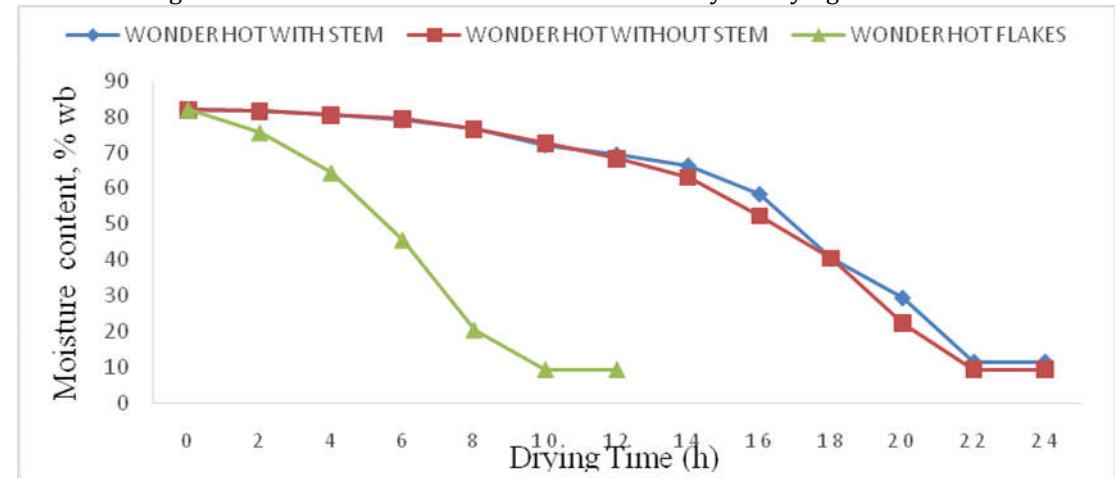


Fig 3.6: Effect of different forms of Wonder hot hybrid on drying time at 50°C

Green chillies both with stem and without stem) took same drying time of 24 h (Fig. 4.4) at 50°C whereas for flakes it took much less time of 12 h in comparison to stem and without stem forms of green chillies.

Table 3.1. Drying time of different forms of chillies at 40°C

S. No	Form of Chilli	Initial Moisture Content, % w.b	Final Moisture Content, % w.b	Drying Time
1	Green (with stem)	89.56	13	56
2	Green (without stem)	89.56	9.2	56
3	Green (flakes)	89.56	9.2	30
4	LCA 334 (with stem)	77.65	12.3	56
5	LCA 334 (without stem)	77.65	10.6	56
6	LCA 334 (flakes)	77.65	8.7	30
7	Wonder hot (with stem)	82.83	11.9	56
8	Wonder hot (without stem)	82.83	11.9	56
9	Wonder hot (flakes)	82.83	9.6	30

For green chillies (with stem and without stem) it took same drying time of 24 hours (Fig. 3.4.) at 50°C whereas for flakes, it took much less time of 12 hours in comparison to stem and without stem forms of green chillies. Similar drying behavior was observed with LCA 334 and wonder hot chillies at drying air temperature of 50°C (Fig. 3.5. and Fig 3.6.). The relative drying times are given in table 3.2.

Table 3.2. Drying time of different forms of chillies at 50°C

S. No	Form of Chilli	Initial Moisture Content, % w.b	Final Moisture Content, % w.b	Drying Time
1	Green (with stem)	84	11.1	24
2	Green (without stem)	84	11.1	24
3	Green (flakes)	84	8.5	12
4	LCA 334 (with stem)	83	12.8	24
5	LCA 334 (without stem)	83	10.5	24
6	LCA 334 (flakes)	83	8.1	12
7	Wonder hot (with stem)	81.9	11.7	24
8	Wonder hot (without stem)	81.9	9.5	24
9	Wonder hot (flakes)	81.9	9.5	12

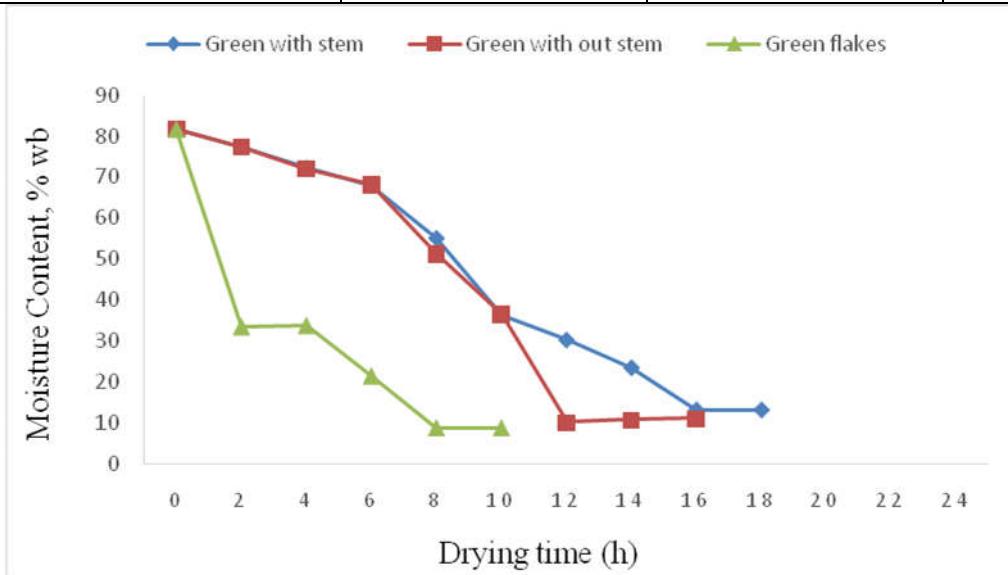


Fig 3.7: Effect of different forms of Green Chilli on drying time at 55°C

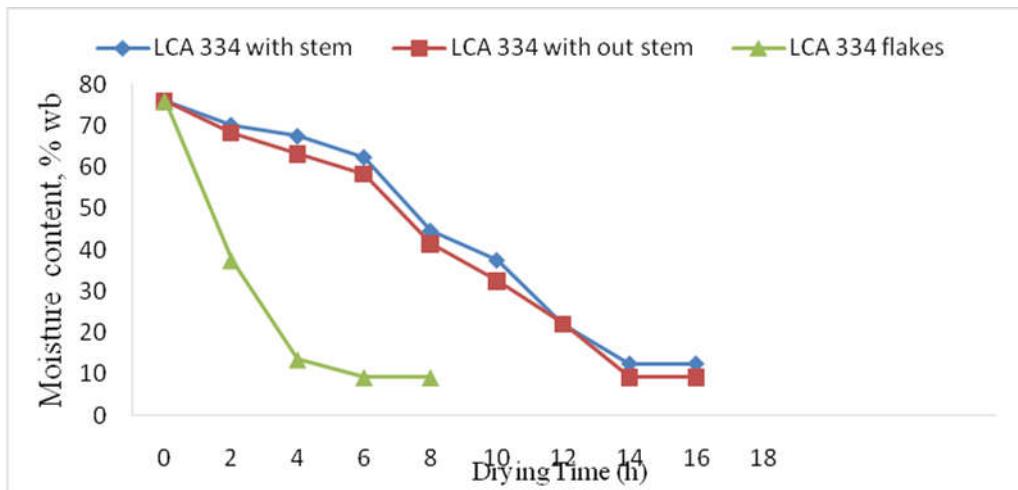


Fig 3.8: Effect of different forms of LCA 334 variety on drying time at 55°C

The reduction in drying time is due to flaking of chillies at 50°C is 50%. Similar trends were observed at drying air temperature of 55°C (Fig. 3.7. to Fig 3.9.and Table 3.3.) and at 60°C (Fig. 3.10 to Fig 3.12 and Table.3.4.). The reduction in drying time of flakes may be due to the reason that flakes are small in size (25 to 30 mm) compared to pods either stem and without stem and also flakes are exposed effectively to the hot drying air in the cabinet drier, leading to considerable reduction in drying time.

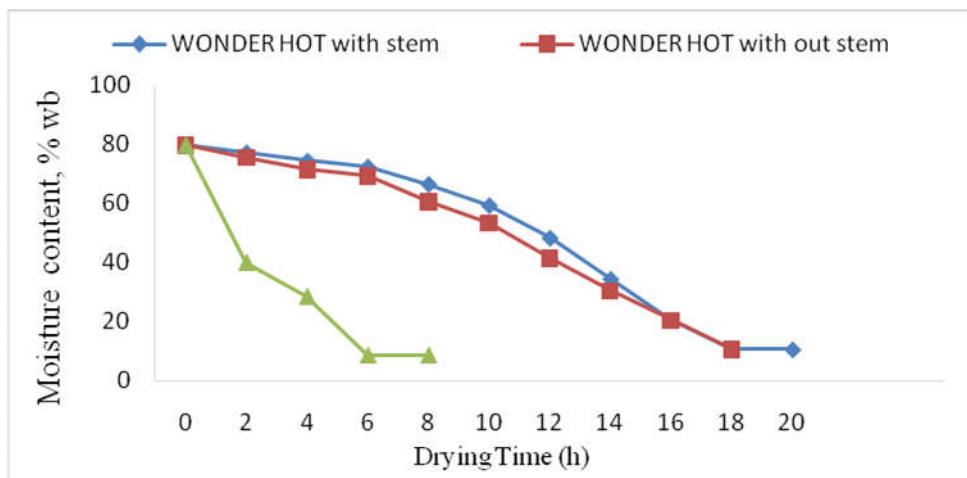


Fig 3.9: Effect of different forms of Wonder hot hybrid on drying time at 55°C

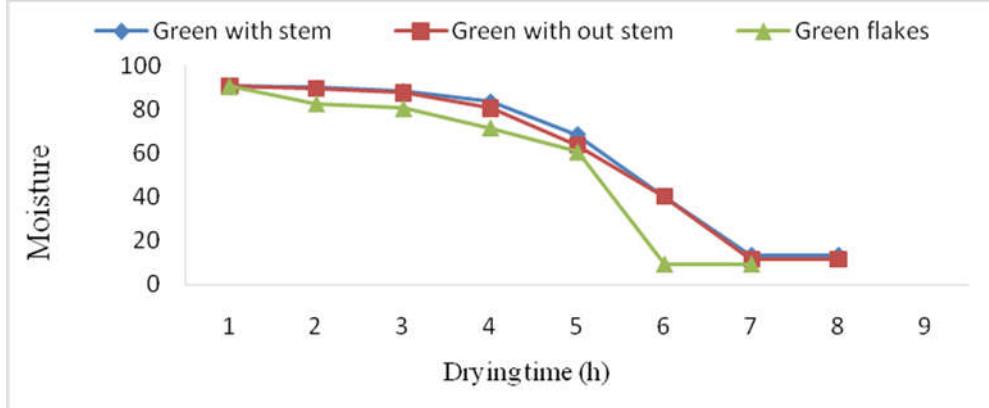


Fig 3.10: Effect of different forms of Green Chilli on drying time at 60°C

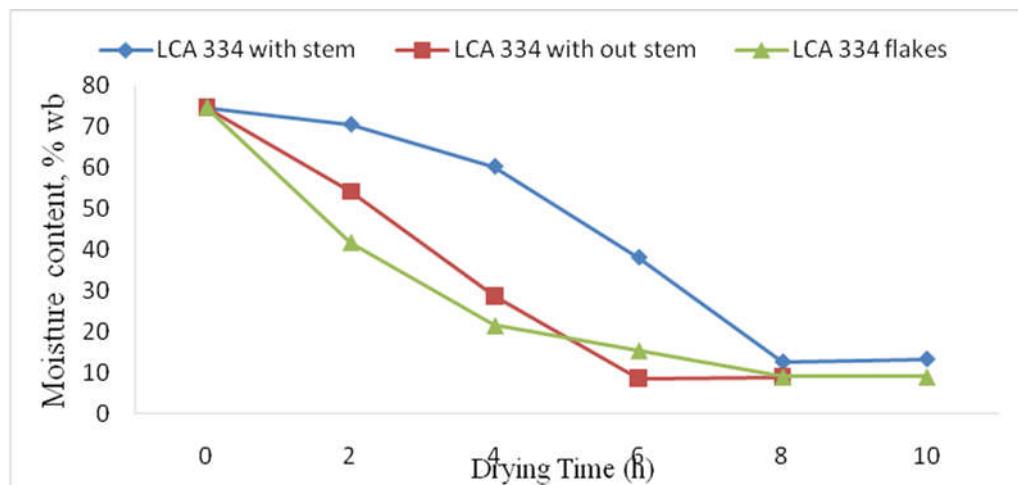


Fig 3.11: Effect of different forms of LCA 334 variety on drying time at 60°C

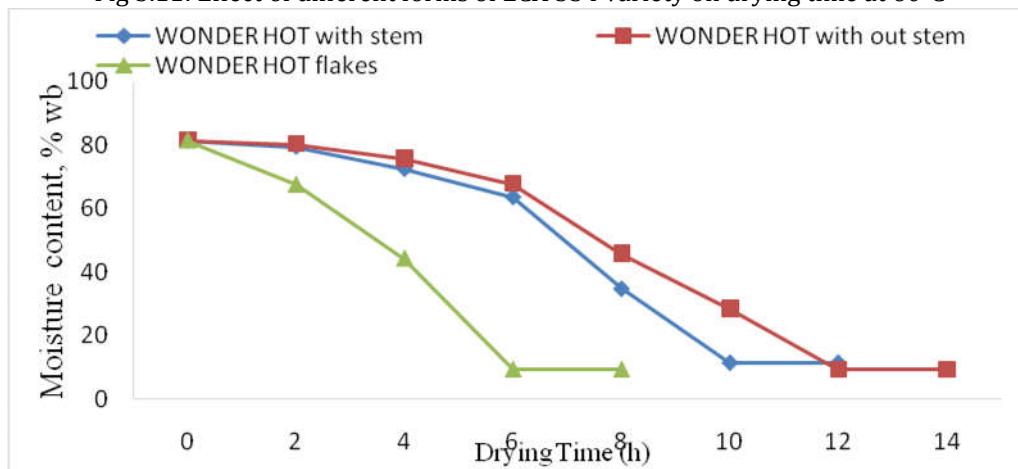


Fig 3.12: Effect of different forms of Wonder hot hybrid on drying time at 60°C

Table 3.3. Drying time of different forms of chillies at 55°C

S. No	Form of Chilli	Initial Moisture Content, % w.b	Final Moisture Content, % w.b	Drying Time
1	Green (with stem)	81.76	13.1	18
2	Green (without stem)	81.76	11	16
3	Green (flakes)	81.76	8.8	10
4	LCA 334 (with stem)	75.96	12.5	16
5	LCA 334 (without stem)	75.96	9.2	16
6	LCA 334 (flakes)	75.96	9.2	8
7	Wonder hot (with stem)	79.9	10.6	20
8	Wonder hot (without stem)	79.9	10.6	20
9	Wonder hot (flakes)	79.9	8.6	8

Table 3.3. Drying time of different forms of chillies at 60°C

S. No	Form of Chilli	Initial Moisture Content, % w.b	Final Moisture Content, % w.b	Drying Time
1	Green (with stem)	90.49	13.5	14
2	Green (without stem)	90.49	11.5	14
3	Green (flakes)	90.49	9.4	12
4	LCA 334 (with stem)	74.66	10.8	10
5	LCA 334 (without stem)	74.66	9.1	8
6	LCA 334 (flakes)	74.66	9.1	10
7	Wonder hot (with stem)	81.39	11.3	12
8	Wonder hot (without stem)	81.39	9.2	14
9	Wonder hot (flakes)	81.39	9.2	8

CONCLUSION

Flakes got dried faster in comparison to whole chillies at temperatures investigated in the study. For example, by 45% for green chillies at 40°C and 50% for LCA 334 at 50°C. Drying time decreased with increase in drying air temperature in all forms of the product. For example, 37.5% for LCA 334 when drying air temperature was increased from 55°C to 60°C. Variety like LCA 334 had relatively low drying time in comparison to hybrid like Wonder hot particularly at high temperatures (55 and 60°C) used in the study.

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