



Processing of turmeric (*Curcuma longa*) by different curing methods and its effect on quality

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Received: 9 April 2012; Accepted: 8 March 2016

Key words: *Curcuma longa*, Curing, Drying, Quality, Turmeric

Turmeric (*Curcuma longa*) is an important spice and cash crop of India. Currently, India is the largest producer and consumer of turmeric in the world. During 2010-2011, the country produced 232 022 tonnes of turmeric from an area of 1 268 280 ha. Andhra Pradesh, Tamil Nadu, Odisha, Karnataka, West Bengal, Gujarat, Meghalaya, Maharashtra, Assam, are some of the important states cultivating turmeric, of which, Andhra Pradesh alone occupies 35.0% of area and 47.0% of production. During 2009-10, India exported 88 513 tonnes of turmeric worth ₹55 487.7 lakhs to UAE, Japan, Iran, Malaysia, Bangladesh, Sri Lanka, USA, UK and other countries (Spices Board 2014). Turmeric is used in many culinary preparations to add flavour and colour to foodstuffs. It is the principle ingredient of curry powder. The colour curcumin extracted from turmeric is used as colourant and as a dye in textile industry.

Curing of turmeric involves cooking of fresh turmeric rhizomes in boiling water for approximately about 60 minutes and is an essential unit operation to be done before drying. Curing in boiling water destroys the vitality of fresh rhizomes, avoids the raw odour, reduces the drying time and yields uniformly coloured product. The curing of turmeric is done by different methods in different places and the time varies from 1 to 12 hr. The objective of the present paper was to compare the curing of turmeric by cooking in boiling water, steam cooking, water dipping, slicing and to determine its effect on drying time and quality of cured turmeric rhizomes.

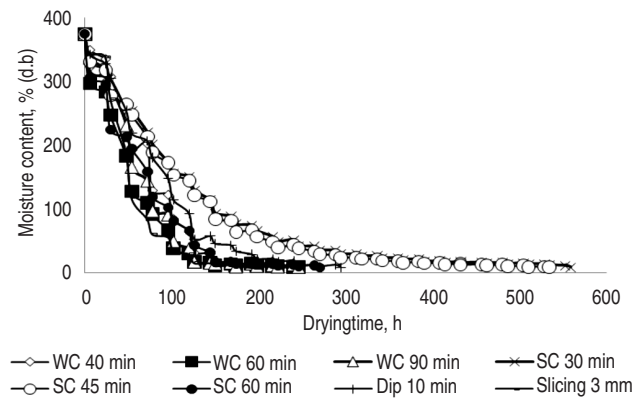
Curing studies of freshly harvested Prathiba variety turmeric rhizomes obtained from the Experimental Farm of Indian Institute of Spices Research (IISR), Kozhikode were conducted during April 2010 at IISR Farm. Eight treatments of curing fresh were followed using 25 kg of fresh turmeric rhizomes per treatment. Curing treatments included cooking in boiling water (WC) as traditional method (40, 60 and 90 min), steam cooking (SC) using TNAU model turmeric boiler (Viswanathan *et al.* 2002) (30, 45 and 60 min), dipping the rhizomes in boiling water (Dip) for 10 min and

slicing the fresh turmeric rhizomes manually to 3 mm thick and then sun drying. The cured rhizomes from different curing methods were sun dried in cemented drying yard between 9 AM to 3 PM and the mass loss during drying was recorded periodically till the rhizomes obtained constant weight. The maximum ambient temperature recorded during the day was 37°C.

The cured turmeric were analysed for its biochemical qualities. Essential oil was determined by reflux distillation method and oleoresins by acetone extraction method both as per the procedure described in ASTA (1997), starch (Sadasivam and Manickam 2008) and curcumin was quantitatively extracted by refluxing the material in alcohol and estimated spectrophotometrically at 425 nm as described by Sadasivam and Manickam (2008). Moisture content of the fresh turmeric samples were determined by toluene distillation method (ASTA 1997). The experiments were replicated thrice and quality parameters of turmeric rhizomes obtained by different curing methods were analyzed by AGRES (Version 7.01, Pascal Intl software solutions) statistical software.

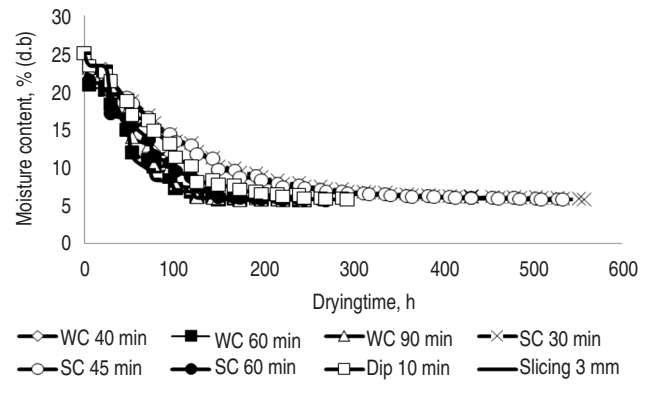
The drying characteristic curves of turmeric rhizomes cured by different methods and dried by natural sun drying, indicated that the moisture content during drying decreased continuously with time. The time required to dry turmeric rhizomes from an initial moisture content of around 373.71% (db) (dry basis) to a final moisture content of around 10% (db) varied from 9 days to 24 days for different initial curing processes followed (Fig 1). Turmeric rhizomes cured by traditional water boiling for 40, 60, 90 min, took 11 days for complete drying. While turmeric rhizomes cured in steam boiler for 30 min took 24 days for complete drying, 18 days when for 45 min of steam treatment and 12 days for 60 min of initial steaming. The drying time reduced significantly (9 days), when the rhizomes were sliced to 3 mm thick and then dried. The process of dipping in boiling water for 10 min and then drying took 13 days to reach a final moisture content of 10%. It was thus observed that curing time significantly affected the drying time. Curing for a longer duration softens the tissues and enhanced the removal of

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WC - Water curing, SC - Steam curing, Dip - Dipping in boiling water

Fig 1 Moisture loss during drying of turmeric rhizomes after curing by different methods



WC - Water curing, SC - Steam curing, Dip - Dipping in boiling water

Fig 2 Loss in mass during drying of turmeric rhizomes after curing by different methods

Table 1 Quality parameters of cured turmeric rhizomes obtained by different curing methods

Treatment	Dry Recovery (%)	Drying time (hr)/(days)	Curcumin (%)	Essential oil (%)	Oleoresin (%)	Starch (%)
Cooking in boiling water boiling for 40 min.	22.8	66.33 (11)	5.91	3.60	13.33	66.96
Cooking in boiling water boiling for 60 min.	22.76	65.83(11)	5.85	3.60	13.30	63.32
Cooking in boiling water boiling for 90 min.	22.72	65.33(11)	5.12	3.33	13.08	62.44
Steam cooking for 30 min.	23.18	144.5(24)	6.00	3.33	13.96	63.33
Steam cooking for 45 min.	22.98	137.5(23)	5.76	3.20	12.60	62.18
Steam cooking for 60 min.	22.73	71.5(12)	5.12	2.93	12.22	61.38
Dipping in boiling water for 10 min.	23.10	77.5(13)	5.18	3.20	11.54	66.86
Slicing to 3 mm thickness	22.60	53.5(9)	5.71	3.07	12.76	69.53
CD (0.05)	3.47	1.10	0.21	0.37	1.18	5.10
SE		0.52	0.10	0.18	0.56	2.41

water at a faster rate thus reduced the drying time. The loss in mass during drying of turmeric is indicated in Fig 2.

The curve of drying rate verses drying time, showed no constant rate period during drying of turmeric and indicated that the drying process occurred in the falling rate period. In the falling rate period, the material surface was no longer saturated with water and drying rate was controlled by diffusion of moisture from the interior of solid to the surface. The phenomenon of drying was in agreement with the results of the study on sun drying of figs (Doymaz 2005).

Studies on quality aspects of cured dried rhizomes indicated that as the curing time increased a reduction in quality parameters like curcumin, starch, essential oil and oleoresin content was observed. Maximum retention of curcumin (5.91%), essential oil (3.6%), oleoresin (13.33%) and starch (66.96%) was obtained for rhizomes cured by water boiling method for 40 min (Table 1). In case of steam cooking also the maximum retention of curcumin (6.0%), essential oil (3.33%), oleoresin (13.96%) and starch (63.33%) was obtained for rhizomes cured for 30 min. However, as the curing time increased from 30 to 60 min there was significant reduction in all the quality parameters. In case of slicing, the quality parameters like curcumin, essential oil, oleoresin and starch varied as 5.71%, 3.07%,

12.76% and 69.53%, respectively. Suresh *et al.* (2007) reported significant loss in spice active principles when subjected to heat processing. Curcumin loss during heat processing of turmeric varied from 27 to 53% with maximum in pressure cooking for 10 min.

SUMMARY

The results of the study on curing Prathiba variety turmeric by eight different curing methods indicated that slicing significantly reduced the drying time to 9 days. Turmeric cured by cooking in boiling water for 40, 60, 90 min, took 11 days for complete drying. While turmeric rhizomes cured by steam cooking for 30, 45 and 60 min took 24, 23 and 12 days for drying. Increase in curing time of turmeric rhizomes resulted in significant reduction in curcumin, starch, essential oil and oleoresin content. In case of water boiling method, maximum retention of curcumin (5.91%) and essential oil (3.6%) was obtained for rhizomes cured for 40 min. While in the case of steam boiling method, the maximum retention of the quality parameters was obtained at 30 min steaming when the curcumin content (6%), essential oil content (3.33%), oleoresin content (13.96%) and starch content was highest (63.33%). But, the drying time was longest (24 days) at this curing level.

However, the steam cooking had several advantages over traditional cooking by water boiling in terms of fuel consumption and the quantity of rhizomes that could be cured per batch and also reduction of labour.

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