Effect of drying temperature on proximate components of turmeric rhizome in tray dryer

Efecto de la temperatura de secado sobre los componentes proximales del rizoma de cúrcuma en secadero de bandejas

DOI: 10.53499/sfjeasv3n4-002

Received in: Aug 5nd, 2023
Accepted in: Sep 30th, 2023

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ABSTRACT
Freshly harvested turmeric rhizomes of Salem variety were procured from a farmer's field. Turmeric rhizomes were cleaned, peeled, and dried in a tray dryer at 60, 70 and 80 ^{o}C temperature. Effect of drying temperature on proximate content viz. moisture content, carbohydrate, protein, oil, crude fiber and ash were evaluated. Completely Randomized Design was used for statistically analysis. Drying of turmeric rhizome at 60 ^{o}C temperature in tray dryer resulted with moisture content 10.81 %, carbohydrate 46.54 %, protein 9.58 %, oil 6.70 %, crude fibre 4.51 % and ash content 6.94 % in the dried turmeric powder.

Keywords: Turmeric, drying, moisture content, proximate content

1 INTRODUCTION

Turmeric, also known as the 'Golden Spice of India', is an ancient spice derived from the rhizomes of Curcuma longa, a ginger family (Zingiberaceae) member. Turmeric is also known as "Indian saffron" and is often referred to as "Haldi" or "Haridra".

Drying is the most common and oldest method of preserving agricultural products and it is also the most energy-intensive. It's a crucial method for preserving farm produce utilised all around the world. It's based on lowering water activity values by removing moisture to achieve physicochemical and microbiological stability (Kondareddy et al., 2019). In general, the mechanism of drying entails two simultaneous processes: energy transfer and mass transfer. The main goal of drying turmeric is to reduce the moisture content from 70-80% at harvest to a safe level of 10% for grinding or 6% for storage (Singh et al., 2010).

The old method of using food drying is executed by spreading material on the ground and exposing the food to sunlight. This method is practiced until today for certain produces because of the advantages of simplicity and economy. Open sun drying has some draw back. Open sun drying requires a longer drying time, large space and the quality of product is difficult to control due to inadequate drying, high moisture, fungal growth, insects, birds and rodents and others. Sun drying is the most common method used to dry turmeric rhizome. The whole rhizome could be dried by direct sunlight for about 43 days to reach the final moisture content of 10% (Raza et al., 2018). Sliced turmeric rhizome required shorter time (3-5 days) to reach as low as 7% of moisture content under sun drying at 35-45°C.

The tray dryer is a common type of industrial dryer for drying food-type materials, in which air is introduced on one side of the dryer and then passed through the trays. The final moisture content of dried products can be affected by this geometrical configuration, which can cause problems of homogeneity (Amanlou and Zomorodian, 2010). However, by properly distributing and orienting air inside the drying space, the moisture content uniformity can be improved (Margaris and Ghiaus, 2006).

Turmeric is utilised in numerous food products as well as for culinary purposes. Commercially, turmeric is sold fresh or dried powder. Conversely, a dried turmeric powder is more commonly sold in all over the world, but the price varies depending on variety, including quality. It is imperative that the quick drying process that yields a high-quality product is always required. An improved drying is therefore essential to lower the moisture content with minimum time without affecting the quality parameters such carbohydrate, protein, oil, crude fibre and ash content.

2 MATERIALS AND METHODS

The fresh turmeric rhizome (var. salem) was purchased from the farmer of Village Sultanpur, District Rajkot and was used in the experiment. The fresh turmeric rhizomes were washed thoroughly in tap water to remove the adhering soil, hairs and extraneous matter. The foreign materials were removed manually and then the rhizomes were again washed, cleaned and peeled properly. This washed, cleaned and peeled fresh turmeric rhizomes were used for further study.

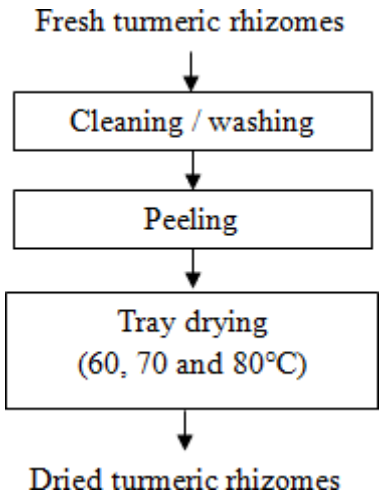
In order to remove the moisture from the turmeric rhizomes, the drying of rhizomes is needed to achieve the desired moisture level. The drying can be achieved by tray drying. Tray dryer available in the Department of Processing and Food Engineering was used for drying of turmeric rhizomes. Turmeric rhizome of 3 kg for un-blanched were taken and spread uniformly over the trays in single layer. When the drying mass reached the constant weight and no further drying takes place, drying was stopped.

Experimental plan

Drying of unblanched whole turmeric rhizomes by tray dryer

The details of the different steps followed in the drying of blanched sliced turmeric rhizomes are elaborated as under in the process flow chart (Fig. 1).

Fig 1 Process flow chart for drying of unblanched whole turmeric rhizomes by tray dryer



Experimental details

i. Statistical design: Completely Randomize Design

ii. No. of treatment combinations: 3

iii. No. of replications: 5

Table 1: Treatment combinations for drying of unblanched whole turmeric rhizomes using tray dryer

Sr. No.	Treatment No.	Parameter
		Drying Temperature (℃)
1	UTW1	60
2	UTW2	70
3	UTW3	80

***** UTW = Unblanched Tray drying of Whole rhizomes

Dependent Parameters

The moisture content (% w.b.) of dried turmeric rhizomes was determined by hot air oven method as described by AOAC (2012a). Carbohydrate content was determined by using phenol sulphuric acid method (Dubois *et al*., 1956). Quantity of protein content was evaluated by Folin-Lowry assay as per Lowry *et al*. (1951). Oil content present in the sample was measured by using automatic solvent extraction system as per AOAC (2012b). Quantity of crude fibre content was determined by using the method as described in AOAC (2005). Ash content was determined by using the method as described in AOAC (2012b).

3 RESULT AND DISCUSSION

Biochemical analysis of unblanched whole turmeric rhizomes

The data on effect of drying temperature on biochemical properties of unblanched whole turmeric rhizomes dried by tray dryer along with their statistical analysis is tabulated in the Table 2. The explanation on effect of different independent variables on response parameters are given under this section.

Table 2: Effect of drying condition on biochemical parameter of unblanched whole turmeric rhizomes dried by tray dryer

Effect	M.C. (w.b.)	Total carbohydrate %	True protein %	Total oil %	Crude fiber %	Total ash %
Drying temperature						
60	10.81	46.54	9.58	6.70	4.51	6.94
70	9.87	45.38	8.93	6.17	4.03	7.16
80	8.96	44.65	8.04	5.72	3.89	7.25
S. Em±	0.046	0.031	0.061	0.035	0.076	0.040
CD at 5%	0.142	0.139	0.188	0.109	0.153	0.140
C.V.%	1.05	2.13	1.54	1.28	2.34	2.51

Effect of drying temperature on moisture content

From Table 2, it can be observed that moisture content of unblanched whole turmeric decreased with increased in drying temperature. The maximum moisture content (10.80%) was observed at 60°C drying temperature and minimum moisture content (8.95%) was obtained at 80°C drying temperature. The effect of drying temperature on moisture content was found to be significant at 5% level of significance. The small value of coefficient of variation (1.05%) for moisture content explained that the experimental results were precise and reliable. Oke *et al.*, (2020) studied the effects of drying condition on moisture content by using response surface technique (box-behnken design) and reported that an increasing temperature decreased the moisture contents of the dried turmeric apparently.

Effect of drying temperature on total carbohydrate

Total carbohydrate of unblanched whole turmeric decreased with increased in drying temperature (Table 2). The maximum total carbohydrate (46.54%) was observed at 60°C drying temperature and minimum total carbohydrate (44.65%) was obtained at 80°C drying temperature. The effect of drying temperature on total carbohydrate was found to be significant at 5% level of significance. The small value of coefficient of variation (2.13%) for total carbohydrate explained that the experimental results were precise and reliable. Lokhande *et al.*, (2013) reported 65.8% carbohydrate for salem variety. The values of carbohydrate found in this work are slightly1ower than value reported by Lokhande *et al.*, (2013). The difference may be due to locality and different temperature ranges, which were affect the carbohydrate

Effect of drying temperature on true protein

True protein of unblanched whole turmeric decreased with increased in drying temperature (Table 2). The maximum true protein (9.57%) was observed at 60°C drying temperature and minimum true protein (8.03%) was obtained at 80°C drying temperature. The effect of drying temperature on true protein was found to be significant at 5% level of significance. The small value of coefficient of variation (1.54%) for true protein explained that the experimental results were precise and reliable. Oke *et al.*, (2020) studied the effect of drying temperature in protein and deduced that increase in drying temperature significantly decrease the protein of turmeric sample.

Effect of drying temperature on total oil

Total oil of unblanched whole turmeric decreased with increased in drying temperature (Table 2). The maximum total oil (6.70%) was observed at 60°C drying temperature and minimum total oil (5.72%) was obtained at 80°C drying temperature. The effect of drying temperature on total oil was found to be significant at 5% level of significance. The small value of coefficient of variation (1.27%) for total oil explained that the experimental results were precise and reliable.

Effect of drying temperature on crude fiber

Crude fiber of unblanched whole turmeric decreased with increased in drying temperature (Table 2). The maximum crude fiber (4.51%) was observed at 60°C drying temperature and minimum crude fiber (3.89%) was obtained at 80°C drying temperature. The effect of drying temperature on crude fiber was found to be significant at 5% level of significance. The small value of coefficient of variation (2.34%) for crude fiber explained that the experimental results were precise and reliable. Oke *et al.*, (2020) studied crude fiber content and deduced that increase in drying temperature reduces the crude fibre for a sample

Effect of drying temperature on total ash

Total ash of unblanched whole turmeric increased with increased in drying temperature. The maximum total ash (7.25%) was observed at 80°C drying temperature and minimum total ash (6.94%) was obtained at 60°C drying temperature. The effect of drying temperature on total ash was found to be significant at 5% level of significance. The small value of coefficient of variation (2.51%) for total ash explained that the

experimental results were precise and reliable. According to the FSSAI standards, Turmeric (Haldi) powder should not contain total ash of more than 9.0% by weight on a dry basis. Ikpeama *et al.* (2014) and Imoru *et al.* (2018) found 2.85 and 2.76 % ash content, which was lower than this finding.

4 CONCLUSION

Based on the tray drying of turmeric rhizome it was concluded that the drying temperature 60 ^{o}C resulted with moisture content 10.81 %, carbohydrate 46.54 %, protein 9.58 %, oil 6.70 %, crude fibre 4.51 % and ash content 6.94 % in the dried turmeric powder.

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