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Research Article

Influence of Curing Parameters on Quality and Yield of Turmeric (*Curcuma longa*)

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ABSTRACT

The study was conducted to investigate the effect of curing parameters i.e steam pressure and holding time on recovery and quality of turmeric powder obtained from raw turmeric rhizomes. The turmeric rhizomes were cured at different hydro thermal treatments using an autoclave. The effect of steam pressure and holding time was studied by varying the steam pressure from 10 psi to 20 psi and holding time from 0 minutes to 15 minutes. Each batch of rhizomes was cured by varying the curing conditions and another batch was kept as control sample. The rhizomes were dried by solar assisted dryer at a temperature of 60ºC. The boiled rhizomes were analyzed for moisture content and drying time. The final recovery of pulverized powder ranged from 17.93% to 21.32%. It was observed that heat treatment by steam application reduced the drying time and steam cured turmeric was much superior to the control (unboiled) sample in every respect of quality, recovery and color characteristics.

Keywords: *Turmeric, Curing, Steam, Drying, Curcumin.*

INTRODUCTION

Turmeric (Curcuma longa) plant belongs to Zingiberaceae family and is grown for its underground growing stem bearing shoots and roots. It is also referred to as haldi, gelbwurzsel, safran des Indes, dilau and yellow or golden ginger. Rhizomes of turmeric when dried and grinded produce a yellow luscious powder. Turmeric powder is one of most indispensable constituents of curry, used in religious celebrations, as cloth dying compound and in many customary health remedies and is famous as the 'Golden Spice of Life'. Turmeric has been respected globally as a functional food. It has been used as an antioxidant, digestive, anti- inflammatory and anti-carcinogenic agent. Turmeric contains 6% curcuminoid pigments and 5% of essential oils (Nunes, 1989).

Turmeric is admired for its deep yellow color and fragrant flavor. The core of turmeric is red colored which after boiling turns into uniform yellow color. Post harvest processing practices like washing, boiling, drying, polishing and grinding are followed to convert turmeric rhizomes into stable final turmeric powder.

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After cleaning and washing is completed, turmeric rhizomes have to be boiled or cured.

Boiling or curing is the first post harvest operation to be performed at the farm level which involves cooking of fresh rhizomes in water until they become soft and are ready for drying. During boiling, the starch gets gelatinized which reduces the required drying time significantly and the color is homogeneously dispersed throughout the rhizomes. The starch gelatinization not only facilitates rapid drying but also provides shield against insect infestation throughout the storage (Gounder & Lingamallu, 2012). Boiling process also exterminates the vigor of fresh rhizomes along with the eliminating the raw turmeric odor. After the rhizomes are harvested from field, boiling should be finished within 10 days to achieve maximum final product. However conventional boiling in open vessels result in a product of poor quality so steam boiling or blanching of the rhizomes is more preferred as it leads to a product of higher quality and minimum losses. Therefore it is important to investigate the effect of boiling parameters i.e steam pressure and steam holding time on the quality of ground turmeric. The study was conducted to understand the effect of both the parameters on the product and be able to find the best curingparameters for turmeric rhizomes. The specific objectives were to investigate the effect of boiling parameters on the yield, curcumin content and the color characteristics of the polished rhizomes.

MATERIALS AND METHODS

2.1 Processing of turmeric

Raw mature rhizomes of turmeric (Curcuma longa) were procured from a local farmer. The procured raw rhizomes were cleaned and washed in running water to remove any sticking mud and residue. The cleaned and thoroughly washed rhizomes were graded by hand. The finger rhizomes were separated from the mother rhizomes.

Boiling or curing is the most important and complicated operation in the processing of turmeric and it was completed in an autoclave. The autoclave employs steam for curing the rhizomeswhich results in less wet rhizomes. The boiling/curing parameters i.e steam pressure and holding time were varied for different combinations. Each batch of rhizomes (5 kg) was loaded into the autoclave and the steam pressure increased to a desired value. Once the required pressure was reached it was retained for a particular holding time. The steam pressure was varied as 10-15-20 psi and the holding time as 0-5-10-15 minutes. The different combinations of steam pressure and holding time were abbreviated as $P_{10}T_{0,}$ $P_{10}T_{5,}$ $P_{10}T_{10,}$ $P_{10}T_{15,}$ $P_{15}T_{0,}$ $P_{15}T_{5,}$ $P_{15}T_{10,}$ $P_{15}T_{15,}$ $P_{20}T_{0,}$ $P_{20}T_{5,}$ $P_{20}T_{10,}$ $P_{20}T_{15}$ and control sample. The boiled samples were then dried in a solar dryer provided with auxiliary heating mechanism. During the sunshine hours heat from the solar tubes was sufficient to provide with required drying effect and the auxiliary heater helped during overcast weather conditions and during night. The dried rhizomes were then polished using a polishing machine and the polished rhizomes were ground into powder using a hammer mill. The polished rhizomes and powder obtained were then analyzed for curcumin content.

Fig. 1: Dried rhizomes, unpolished and polished rhizome and feeding of polished rhizomes in the grinding machine

2.2 Evaluation of quality parameters and drying parameters

Moisture content of the boiled rhizomes was determinedusing the oven drying method. The samples dried to bone mass in the oven and were then kept in the desiccators. The total time taken for drying the rhizomes from initial moisture content to the final moisture content condition of bone dryness was noted down. Color of the turmeric rhizomes is vital as it controls the marketable value and recognition of the product in the market. Color was measured using the Hunter Lab Miniscan XE Plus Colorimeter. The final recovery of the turmeric obtained after processing represented the ground turmeric powder obtained in comparison to the initial weight of raw turmeric processed. The curcumin content of pulverized turmeric powder was estimated by method of Bagchi 2012.

2.3Statistical Analysis

Statistical analysis of the data recorded was done as per completely randomized block design (Cochranand Cox 1967), using CPCS1 software developed by the Department of Mathematics andStatistics, PAU, Ludhiana.

RESULTS AND DISCUSSION

3.1 Moisture content of boiled turmeric rhizomes (wb %)

The cured rhizomes were dried in a solar drier and moisture content (wb %) was recorded. It was observed that pressure or holding time had no significant effect on moisture content of the rhizomes (Table 1). The minimum moisture content (76.66 %) was observed when rhizomes were treated at a pressure of 20 psi for 15 minutes hold time ($P_{20}T_{15}$). The maximum moisture content was recorded in control sample (84.80 %) indicating that moisture content retention is decreased by blanching (Fig 2). This could be explained as instant pressure drop after steam treatment leads to quick evaporation which results in moisture loss from the rhizomes. Mafart, 1994 and Bambirra et al. 2002 conveyed similar loss of moisture from turmeric rhizomes after steam blanching.

Table 1: Effect of different combinations of steam pressure on quality and recovery of turmeric

Treatments	Moisture Content(wb%)	Drying Time (Hours)	Color Characteristics of Polished Rhizomes			Final Recovery (%)	Curcumin Content (%)
			L	a	b		
P_{10}-T_0	81.02±0.46	64.3±1.15	44.10±1.32	6.33±0.38	40.97±2.18	20.44±1.20	3.84±0.28
P_{10}-T_5	80.36±2.04	62.7±5.13	43.97±1.33	5.47±0.21	39.80±1.08	20.83±0.73	2.81±0.23
P_{10}-T_{10}	78.24±2.32	57.3±5.86	41.17±4.10	5.67±0.21	38.90±1.15	19.26±1.00	2.64±0.12
P_{10}-T_{15}	77.19±2.64	54.7±6.66	40.47±1.36	4.93±0.15	36.20±0.82	18.78±1.54	2.37±0.13
P_{15}-T_0	80.23±3.03	62.3±7.64	43.83±0.42	6.77±0.12	41.43±1.93	20.62±1.13	4.13±0.47
P_{15}-T_5	77.32±2.60	55.0±6.56	44.23±0.65	6.57±0.21	40.30±2.10	21.32±0.59	4.03±0.19
P_{15}-T_{10}	77.05±5.28	54.3±13.32	39.90±1.21	5.87±0.31	38.53±1.21	19.80±1.55	3.55±0.22
P_{15}-T_{15}	76.92±3.10	54.0±7.81	39.97±0.61	4.70±0.36	35.53±3.25	18.16±10.9	2.47±0.24
P_{20}-T_0	80.10±3.00	62.0±7.55	41.50±2.62	5.07±0.38	34.80±1.04	20.42±0.41	3.22±0.23
P_{20}-T_5	77.32±0.40	55.0±1.00	39.87±0.65	4.90±0.20	34.93±2.08	20.19±0.57	2.86±0.14
P_{20}-T_{10}	76.79±4.63	53.7±11.68	38.90±1.14	4.73±1.01	31.43±2.78	19.05±1.22	2.57±0.16
P_{20}-T_{15}	76.66±5.56	53.3±14.01	38.20±1.01	4.10±0.36	30.37±1.61	17.93±1.48	2.18±0.16
Control	84.80±1.05	160.0±5.00	41.12±0.93	4.97±0.40	31.60±2.15	19.14±1.64	2.81±0.26
C.D (0.05%)	NS	11.34	2.29	0.55	2.69	1.61	0.35

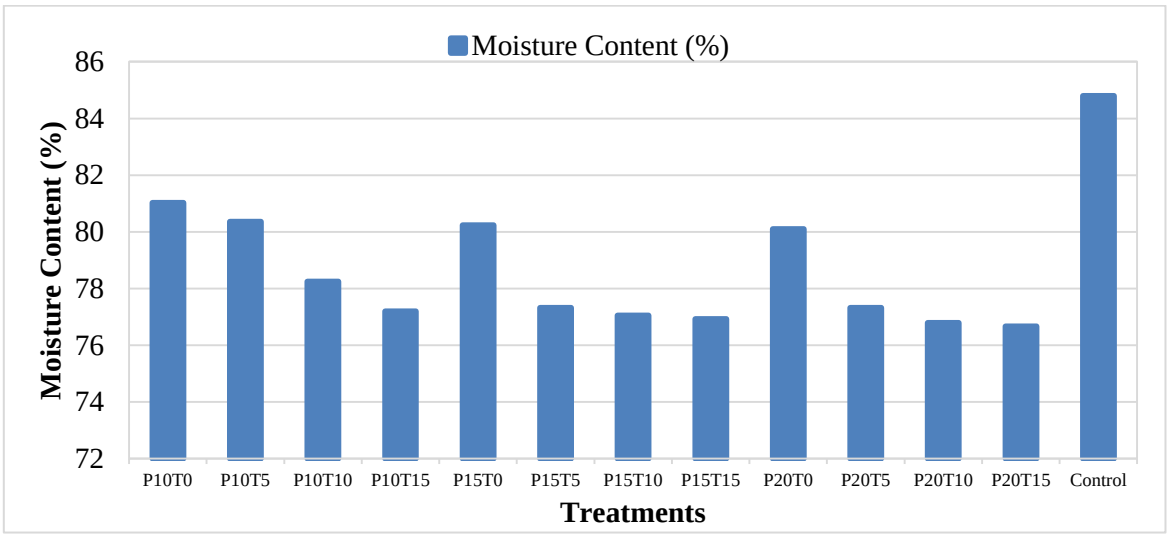

Fig. 2: Comparison of effect of different boiling treatments on moisture content of turmeric rhizomes

3.2 Drying time (hours)

Drying time (hours) was influenced significantly by different treatments. Maximum drying time (160 hrs) was taken by the control sample, which was significantly higher than all other treatments. Minimum drying time of 53.33 hours was observed when rhizomes were blanched for 15 minutes hold time at a pressure of 20 psi ($P_{20}T_{15}$); however the difference in drying time among treatments except control was not significant. It was observed that drying time taken by blanched rhizomes was almost similar irrespective of pressure or holding time. This contrasting difference among control and blanched rhizomes can be explained as blanching the rhizome before dehydration promotes gelatinization of starch which in turn facilitates rapid dehydration rate. Consequently, itresults in decreased drying time for blanched rhizomes as compared to control (non-blanched) samples (Govindarajan, 1980 & Sampathu et al., 1988).

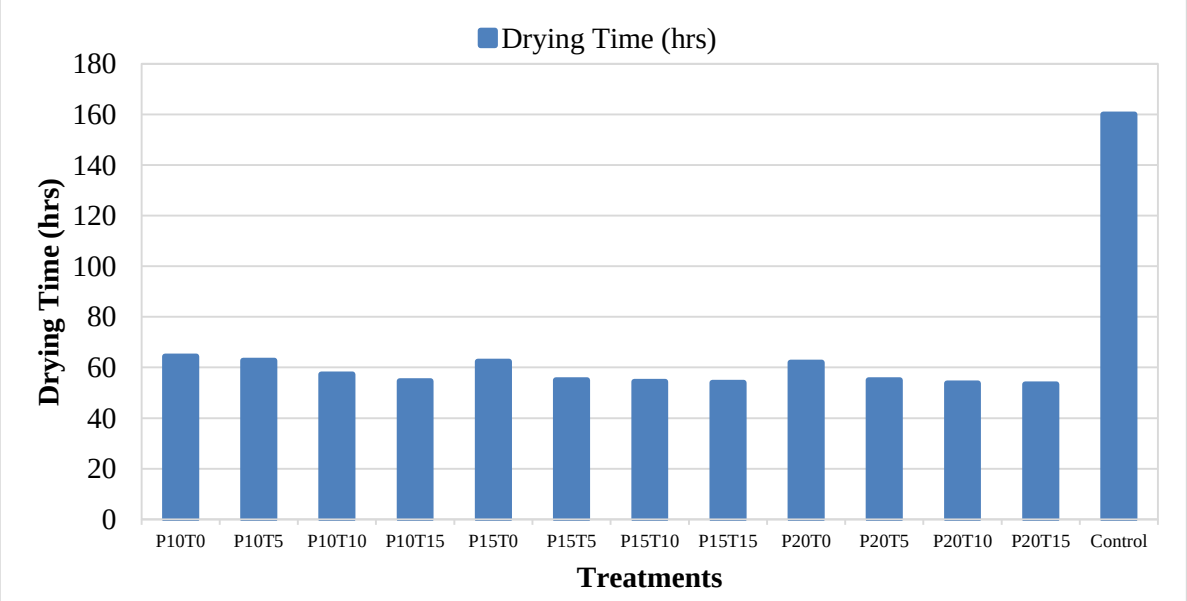

Fig 3: Comparison of effect of different boiling treatments on drying time of turmeric rhizomes

3.3 Colour (L, a and b) of polished turmeric rhizomes

The color (L, a and b) of polished turmeric rhizomes was significantly influenced by different treatments. The luminosity (L) of turmeric rhizomes varied from 38.20 ($P_{20}T_{15}$) to 44.23 ($P_{15}T_5$). It was observed that maximumluminosity (44.23) obtained while treating turmeric rhizomes at a pressure of 15 psi for 5 minutes holding time ($P_{15}T_5$) was significantly higher than the control treatment and $P_{20}T_0$, $P_{10}T_{10}$, $P_{10}T_{15}$, $P_{15}T_{15}$, $P_{15}T_{10}$, $P_{20}T_5$, $P_{20}T_{10}$, $P_{20}T_{15}$ while it was at par with $P_{10}T_0$, $P_{10}T_5$ and $P_{15}T_0$. It decreased drastically when steam pressure of 20 psi was applied for any time greater than zero minutes holding time.Thus, it can be concluded that optimum pressure and holding time is crucial for obtaining desirable luminosity (L) values. The luminosity of rhizomes will ultimately affect the color attributes of final ground product.

The intensity of redness (a) was significantly influenced by different treatments. Maximum intensity of redness (a) of 6.77 was recorded with $P_{15}T_0$ treatment which was significantly higher than control treatment (4.97) as well as all other treatments except $P_{15}T_5$ (6.57) and $P_{10}T_0$ (6.33). Lowest intensity of redness (4.10) was observed with $P_{20}T_{15}$ treatment, which was significantly lower than all other treatments. A sharp decline in intensity of redness with increase in pressure and holding time above certain limit was observed, indicating the importance of optimal pressure and holding time for obtaining desirable intensity of redness.

A significant effect of different treatments on the intensity of yellowness (b) was observed. Highest value of 41.43 was observed with $P_{15}T_0$ treatment, which was significantly higher than control treatment (31.60). Lowest value of 30.37 was recorded with $P_{20}T_{15}$ treatment which was at par with $P_{20}T_{10}$ (31.43) and control treatment. The observation that lower value of b (intensity of yellowness) was obtained when rhizomes were untreated (control) or when treated at a high steam pressure (20 psi) and holding time of 10 or 15 minutes made it evident that under cooking or over cooking both failed to obtain the desirable color (b) of turmeric rhizomes.

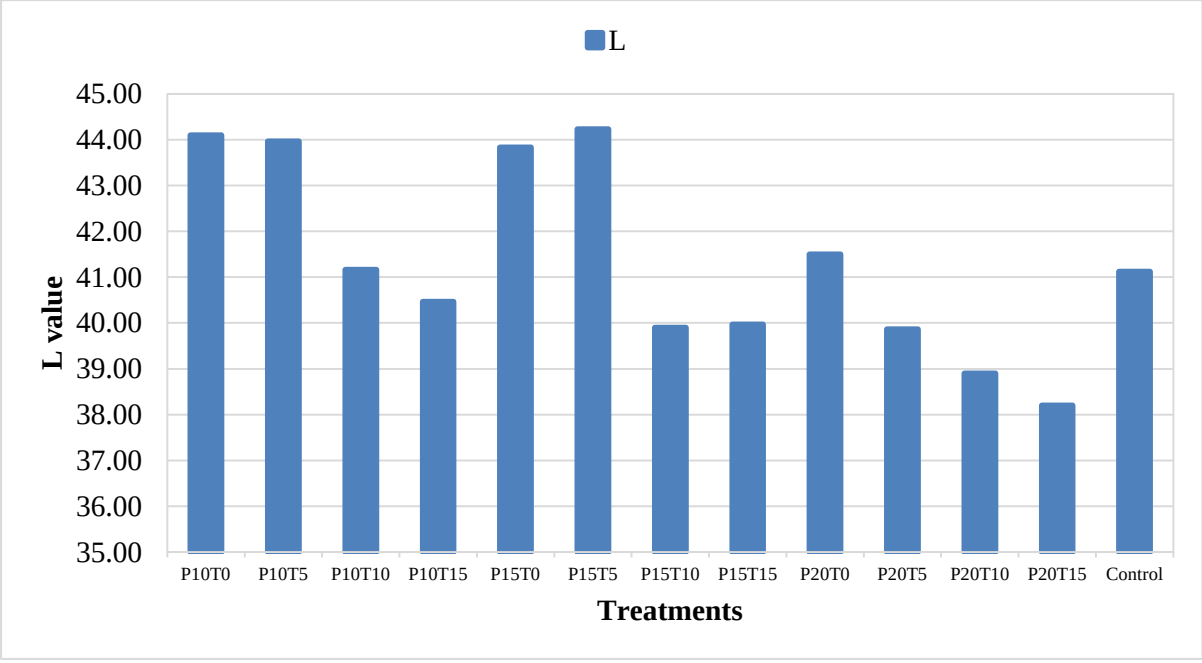

Fig. 4: Comparison of effect of different boiling treatments on 'L' values of polished turmeric rhizomes

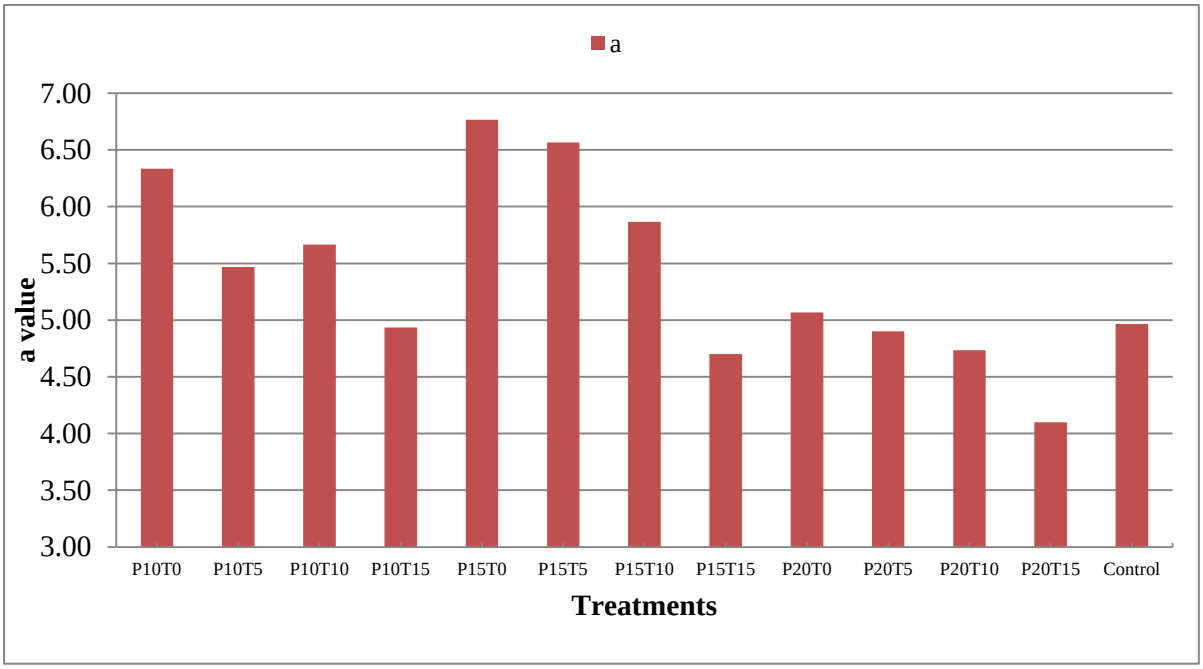

Fig. 5: Comparison of effect of different boiling treatments on 'a' values of polished turmeric rhizomes

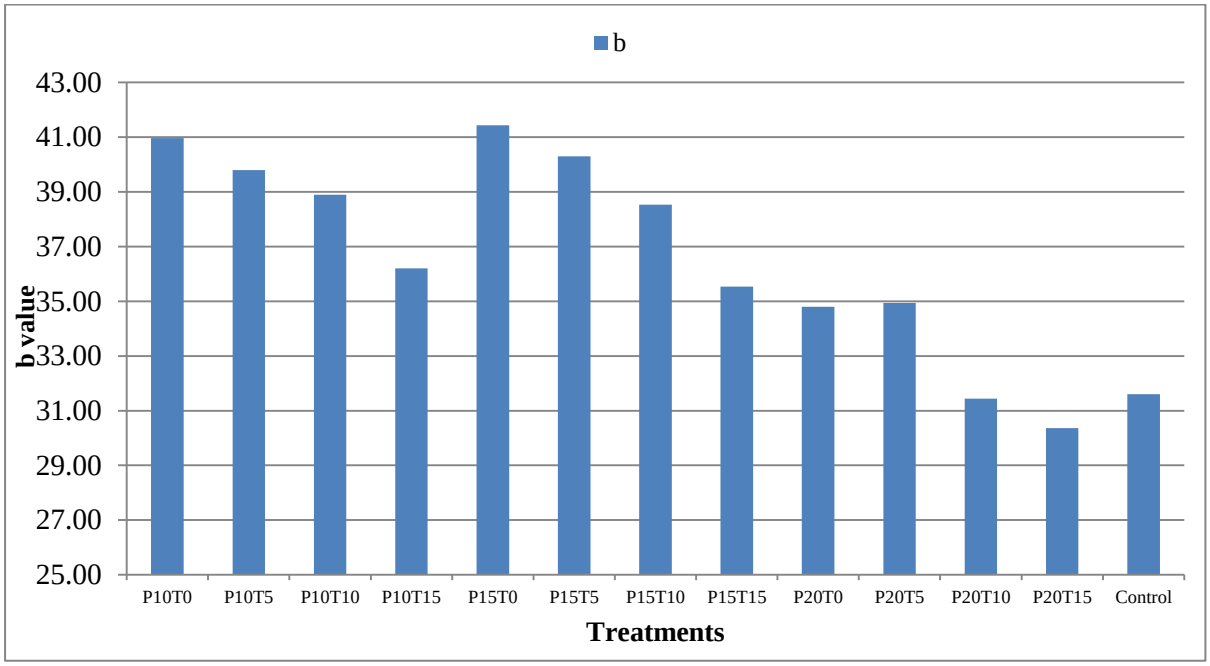

Fig. 6: Comparison of effect of different boiling treatments on 'b' values of polished turmeric rhizomes

3.4 Final recovery (%)

A significant effect of treatments on final recovery of turmeric powder was observed. Maximum recovery of 21.32 per cent was observed when turmeric was treated for 5 minutes at 15 psi steam pressure ($P_{15}T_5$). It was significantly higher than $P_{10}T_{10}$, $P_{10}T_{15}$, $P_{15}T_{15}$, $P_{20}T_{10}$, $P_{20}T_{15}$ and control treatments, but at par with all other treatments. Lowest recovery was observed at $P_{20}T_{15}$ (17.93 per cent), but it was at par with control treatment (19.14 per cent). It can be observed that treatment of turmeric with 15 or 20 psi steam pressure and 15 minutes holding time resulted in decreased final recovery, probably due to increased polishing loss which may be due to increase in brittleness of outer layer as a result of exposure to higher temperature for longer duration.

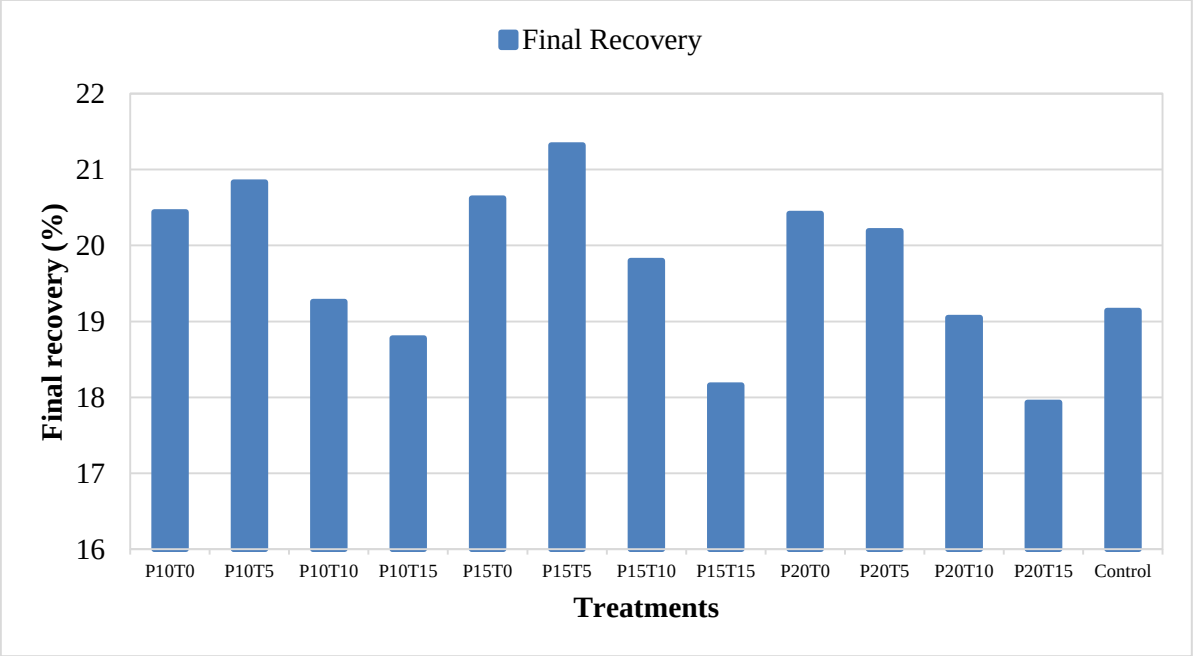

Fig. 7: Comparison of effect of different boiling treatments on final recovery (%) of turmeric powder

3.5 Curcumin Content (%)

Different treatments significantly influenced the curcumin content (%) of turmeric powder. Highest curcumin content of 4.13 per cent was observed with $P_{15}T_0$ treatment, followed with an insignificant difference by $P_{15}T_5$ and $P_{10}T_0$ treatments respectively. Lowest curcumin content of 2.18 per cent was recorded in $P_{20}T_{15}$ treatment, which was significantly lower than all other treatments except $P_{10}T_{15}$ treatment. Curcumin content in control treatment (2.81 %) was significantly lower by 1.32 per cent than $P_{15}T_0$ treatment (Highest content). Lokhande et al. (2013) reported that curcumin content was lower in unblanched samples, as compared to blanched samples of turmeric. Bambirra et al. (2002) also reported poor curcumin content (%) in control treatment samples as compared to blanched samples.

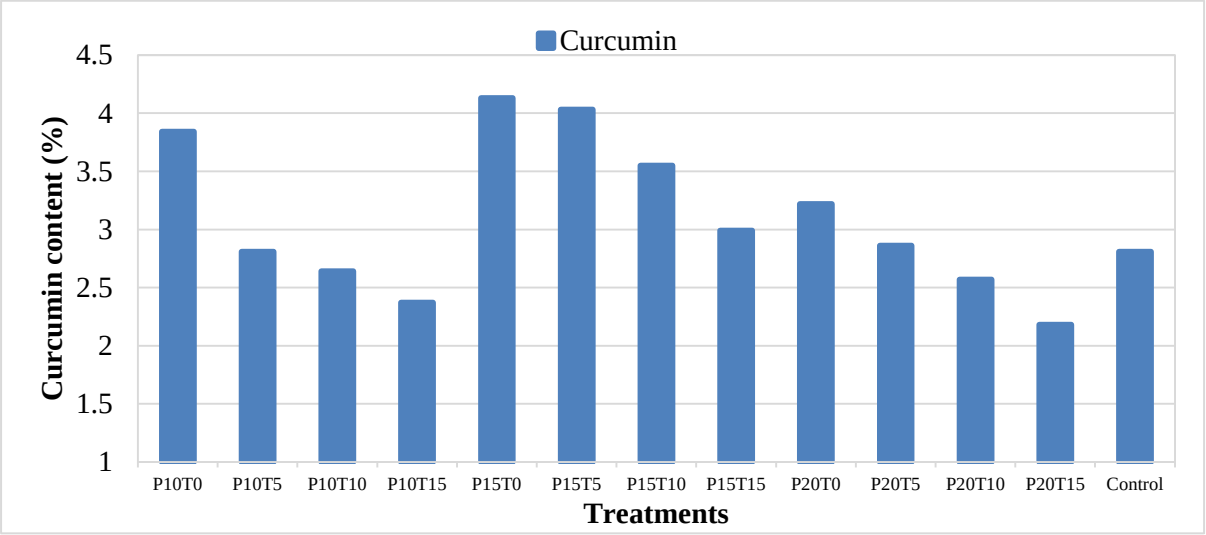

Fig. 8: Comparison of effect of different boiling treatments on curcumin content (%) of turmeric

CONCLUSIONS

Curing of turmeric rhizomes prior to drying resulted in reduction of drying time of cured rhizomes and better quality final turmeric powder in terms of curcumin content. It was observed that minimum drying time of 53.33

hours was observed when rhizomes were cured for 15 minutes holding time at a steam pressure of 20 psi ($P_{20}T_{15}$). The maximum luminosity was obtained (44.23) while treating turmeric rhizomes at $P_{15}T_5$ and maximum intensity of redness of polished rhizomes was 6.77 and maximum b value of polished rhizomes 41.43 was observed with $P_{15}T_0$ treatment. Maximum recovery of 21.32 per cent was observed when turmeric was treated for 5 minutes at 15 psi steam pressure and highest curcumin content of 4.13 per cent was observed with $P_{15}T_0$ treatment.

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