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Effect of 40˚C temperature and air velocities on variation in moisture content of curry leaves (*Murraya koenigii*) dried in fluidized dryer

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Abstract
Murraya koenigii is widely used in Indian cookery since centuries and has a versatile role to play in traditional medicine. Every part of the plant is used for certain nutritional and medicinal propose. Drying is the oldest method of preserving food. The main aim of drying is to reduce water content without substantial loss of flavour, taste, colour and aroma. Therefore the present research work was undertaken to study Effect of 40˚C temperature and air velocities on variation in moisture content of curry leaves dried in fluidized dryer. The fresh Curry leaves was procured from the local farm of CTAE, Udaipur for this investigation. The fresh and blanched leaves weighing 100 g were dried in fluidized bed dryer at air temperature of 40ºC in various air velocities of 2m/s,3m/s and 4m/s. Independent variable were drying temperature: 40 °C and Air velocities: 2m/s,3m/s and 4m/s with moisture content as dependent variable. Findings of the control sample shows that the initial moisture content was ranged from 253.10-6.81(db) in 40˚C temperature and air velocity of 4 m/s. The total time taken was 240 min. and the weight was reduced from 100g to 30.25 g. In case of the blanched sample of curry leaves at 40˚C and air velocity 4m/s the initial moisture content was 192.74-6.85 in 270 min. where the reduction in weight was from 100 g. to 36.5g. There was significant difference of Temperature and air velocities on moisture content of curry leaves dried by fluidized bed dryer.

Keywords: *Curry leaves (Murraya koenigii* is), fluidized bed dryer, initial moisture content

Introduction
Murraya koenigii is widely used in Indian cookery since centuries and has a versatile role to play in traditional medicine. Every part of the plant is used for certain nutritional and medicinal propose. Drying is the oldest method of preserving food. The main aim of drying is to reduce water content without substantial loss of flavour, taste, colour and aroma. Therefore the present research work was undertaken to study Effect of 40˚C temperature and air velocities on variation in moisture content of curry leaves dried in fluidized dryer. The Phyto constituents isolated so far from the leaves are alkaloids *viz*., Limited research work on dehydration of curry leaves has been documented. Khartoon *et al.* (2011) [8] and Gopalan and Sastri (2004) [6] reported some organoleptic and nutritive properties of dehydrated curry leaves. Das *et al.* (2011) [2] reported antioxidant effect of curry leaf powder. Dwivedy *et al.* (2012) [4] examined effect of drying methods on quality characteristics of medicinal Indian borage leaves. India is the second largest producer of vegetables in the world and contributes about 13 per cent of the world's production. The green leafy vegetables are rich sources of vitamins as well as minerals and fibers (Fathima *et al.* 2001) [5]. The leafy vegetables are highly perishable in nature and therefore have very short shelf life.

Methods and Materials
Sample
The fresh Curry leaves was procured from the local farm of CTAE, Udaipur for this investigation. The fresh and blanched leaves weighing 100 g were dried in fluidized bed dryer at air temperature of 40ºC in various air velocities of 2m/s, 3m/s and 4m/s

Initial moisture content of Curry leaves
The initial moisture content of Curry leaves was determined by hot air oven drying method (AOAC, 2010). An amount equal to 10 g of freshly and blanched sample was placed in thoroughly washed, dried and pre-weighed moisture boxes.

The initial weight of each sample was recorded. The moisture boxes were put in the oven at 105°C temperature for 24 hours. The sample was then taken out of oven and cooled in the desiccators and weighed using an electronic balance having capacity of 200 g and least count of 0.001 g. Initial and bone dried weights were used to calculate the initial moisture content which was expressed as g water per g dry matter. The initial moisture content of curry leaves by following formula,

$$\text{Moisture content (db), \%} = \frac{f - x}{W_d} 100 \qquad (3.1)$$

Wi = mass of original sample, g.
W2 = mass of the sample after drying, g.

Variables under Study
Variables selected for this study were classified in three major categories as independent variables and dependent variables.

Independent variables
1. Drying temperature: 40 °C
2. Air velocities: 2m/s,3m/s and 4m/s

Dependent variables
1. Moisture content
The drying for the present investigation was done in Fluidized bed dryer.

Fluidized bed dryer
A tabletop fluidized bed dryer (Make: Sherwood Scientific Ltd. Cambridge, England) was used in the present study. The dryer had the provision to vary air velocity as well as drying air temperature.
The fluidized bed dryer was simple, compact, portable and easy to operate. The cabinet contained the air distribution system and electrical controls. Air was drawn in through a mesh filter provided at the base of the cabinet and blown by the centrifugal fan over a 2 kW electrical heater. The tube unit consisted of a container with a fine mesh distributor and stainless steel support. A filter bag, which fitted over the top of the tube, retained any particles expelled from the fluidized bed. The fluid bed dryer had PID controller of the range of 0 - 200ºC; which regulated the operation of the heater to maintain the desired preset temperature of the drying air.

Fluidized bed drying process
The fluidized bed dryer was run idle for about 30min to achieve steady state in respect of preset experiment drying conditions like drying temperature and fluidization velocity. A sample size of approximately 100g of curry leaves were placed in the drying tube; and dried at temperature of 40°Cat varied fluidization velocities of 2m/s, 3m/s and 4m/s. The sample weight was taken every5, 10 and 15 minutes, using top-pan electronic balance (Adir Dutt, ± 0.001g), during drying process until the moisture content of the samples reduced to safe level corresponding to the moisture content of final moisture content. The dried curry leaves were then transferred into ziploc polythene pouches; and stored in desiccators at 4ºC. The moisture content at various times during drying process was calculated from weight of the sample recorded with respect to drying time and the initial moisture content, by using eqn. mentioned above. Drying experiments was repeated similarly for variation at different air velocities i.e. 2m/s, 3m/s and 4m/s.

Results and Discussions
The fresh curry leaves samples were blanched and taken as experimental whereas the unbalanced samples were taken as control. Both the samples dried in fluidized dryer. The curry leaves required 240 minutes to dry under fluidized dryer to bring down initial moisture content ranging from 244.82 to 6.93 per cent (db) to final moisture content for control sample of curry leaves at 40˚C air velocity 2m/s. During the reported time the initial weight of 100 g curry leaves was reduced up to 31.01g. Whereas the curry leaves required 270 minutes to dry under fluidized dryer to bring down initial moisture content ranging from 186.12 to 6.86 per cent (db) to final moisture content for blanched sample of curry leaves at 40˚C air velocity 2m/s. The initial weight of 100 g curry leaves was reduced up to 37.35g.
As shown if Fig.1 to 3 the control sample the initial moisture content was ranged from 246.82-6.41 (db) in 40˚C temperature and air velocity of 3m/s. The total time taken was 240 min. and the weight was reduced from 100g to 30.7 g. The findings were obviously vary in the blanched sample of curry leaves at 40˚C and air velocity 3m/s where the initial moisture content was 186.86-6.85 in 270 min. with a reduction in weight from 100 g. to 37.25 g.
Findings of the control sample shows that the initial moisture content was ranged from 253.10-6.81(db) in 40˚C temperature and air velocity of 4 m/s. The total time taken was 240 min. and the weight was reduced from 100g to 30.25 g. In case of the blanched sample of curry leaves at 40˚C and air velocity 4m/s the initial moisture content was 192.74-6.85 in 270 min. where the reduction in weight was from 100 g. to 36.5g.

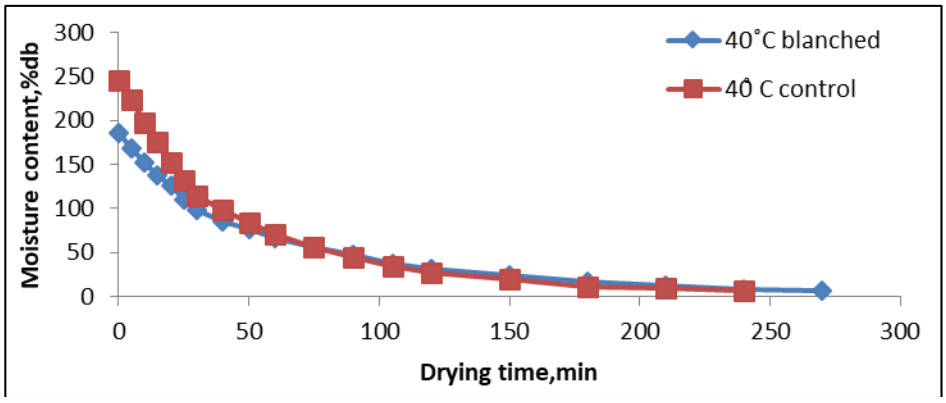

Fig 1: Variation in moisture content with drying time for 40˚C air temperature in Fluidized Drying 2m/s

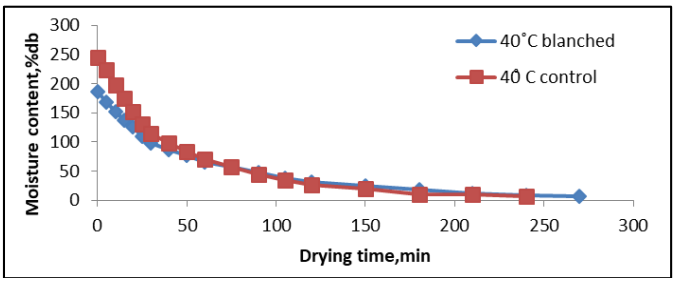

Fig 2: Variation in moisture content with drying time for 40˚C air temperature in Fluidized Drying 3m/s

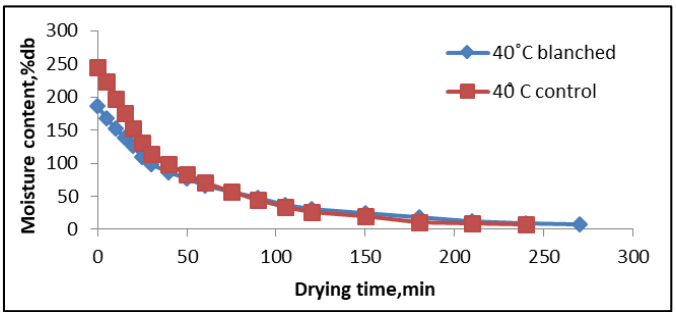

Fig 3: Variation in moisture content with drying time for 40˚C air temperature in Fluidized Drying 4m/s

Moisture reduction found to be temperature dependent and slow at lower temperature and took more time as compared to drying at higher temperatures. Similar behaviours were observed by Ankita and Prasad, (2013) [1] for drying of spinach leaves. It can also be observed from these curves that it is clearly evident that the drying time decreased with increase in drying air temperature. Hence, experimental results showed that the drying air temperature has pronounced effect on the removal of moisture content. Similar results were described by Doymaz (2006) [3], while studying the drying of mint leaves, Sharma *et al.*, (2005), while studying the drying kinetics of onion, Kadam *et al.*, (2011) [7] while drying of mint leaves. It can also be seen that minimum time for drying of blanched leaves was observed for higher air temperature 50ºC and maximum time was recorded for low air temperature 40ºC for the blanched sample. As the drying temperature increased from 40 ºC to 45 ºC, the drying time reduced from240 min.to 180 min. showing 25 % reduction in drying time. For controlled sample, similarly when drying temperature was further increased to 50ºC, the drying time reduced to 150 min. showing 18 % reduction in drying time. The effect of blanching was to the reduction of drying time. Similar reports have been supported by various researchers, e.g. Pal and Chakraverty (1997) [10] for mushrooms, Ramesh *et al.* (2001) [11] for drying paprika and Silva *et al.*, (2008) for coriander stem.

An investigation was carried out by Manchekar and associates (2008) to dry the curry leaves under shade (24-28°C), sun (29.7°C) and conventional method 40 100, 140 and 180°C. Time taken for drying and physiological loss in weight (PLW) was recorded. The results depicted that, conventional drying method was faster (8h) compared to sun drying (20h) and ambient drying (34h). Higher the temperature in conventional drying lower was the time taken for drying to a constant weight.

Conclusions

There was significant difference of Temperature and air velocities on moisture content of curry leaves dried by fluidized bed dryer.

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