

DRYING OF ADHATODA VASICA: PERFORMANCE EVALUATION OF A CONVECTIVE TYPE SOLAR DRYER

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ABSTRACT

This paper presents a comparative study of convective type solar drying and open sun drying of useful medicinal plant leaves viz, *Adhatoda vasica*. The study involves analysis of drying characteristics of *Adhatoda* on the basis of variation of moisture content, moisture ratio, drying rate, critical moisture content, drying time and total energy required for drying. *Adhatoda vasica* was dried from 72% to 0.32 % moisture content (wet basis) and has been observed that convective solar dryer reduced drying time by 10 hours in comparison to open sun drying. Critical moisture content was achieved in 10 hours and 17 hours in convective solar dryer and open sun drying respectively. Total useful energy required for drying the product has been found to be 0.84 MJ. The performance of dryer is evaluated by some parameters viz. temperature variation inside the dryer, efficiency and economic accessibility of dryer. The average efficiency of the dryer was 52 % more compared to open sun drying and the annual cost of drying per kg of product has been found to Rs 16.99.

Keywords: Convective solar dryer, *Adhatoda vasica*, open sun drying, drying performance.

Nomenclature

A	Aperture area of the dryer (m ²)
d	Final weight of the dried product (gm)
I	Hourly average solar radiation on the aperture surface (kWh/m ² /day)
i	Rate of interest
L	Latent heat of vaporization (J/Kg),
m	Initial weight of the drying product (gm ²)
M _{ci}	Initial moisture content (decimal)
M _{cf}	Final moisture content (decimal)
M _e	Equilibrium moisture content
M _{sd}	Mass of solar dried product (kg)
m _w	Amount of evaporated water (kg)
n	Life period of solar dryer (year)
P	Initial capital investment of the fabricated solar dryer
P _f	Energy consumed by the fan (kwh or J)
s	Salvage of the system
T _a	Ambient temperature (°c)
T _d	Drying temperature(°c)
W _{DWB}	Moisture content (dry weight basis, decimal) at time θ hours.
Y	Annual product yield

INTRODUCTION

Drying is an important aspect to improve the quality of produce and their storage for long-term duration. This is also helpful in conservation and best utilization of the produce. The method of open sun drying is enormously in use. However, by making adoption of suitable drying conditions there can have several advantages in the drying the produce viz. drying time, manual burden, removal of integrants of heat sensitive produce etc [1]. Controlled drying is helpful to dry any produce to the desired moisture content and reduce energy consumption factor. Extensive work has been done to develop different type of dryers during last three decades and also to get better performance [2-10].

Uttarakhand is endowed rich in medicinal plants. One evergreen plant species found in mountains area of Uttarakhand region grown up to 1600 metres is *Adhatoda vasica* Nees, which contains a lot of useful bioactive compounds. It is evergreen, unreserved shrub 3-6 m long, having large leaves; flowers are white or purple [11]. Zaman (1970) reported that all parts of the *Adhatoda vasica* Nees may be used for medicinal purpose, however, the extracts of leaves and roots of this plant are more effective against the diabetic infection, liver jaundice, cough, chronic bronchitis, and tuberculosis [12]. It is also recommended for various ailments like bronchitis, fever, and consumption. It was reported by Claeson et al. (2000), *Adhatoda vasica* Nees has been used for respiratory tract ailments since past [13]. In the present study we have used a locally built convective type solar dryer. The thermal performance and economic feasibility have been studied using *Adhatoda vasica* leaves. It is anticipated that under controlled drying conditions (temperature less than 500) it would be possible to acquire better quality of dried produce which would be commercially beneficial.

2. Experimental Section

2.1 Sample

Fresh leaves of locally grown *Adhatoda vasica* were separated from whole plant and washed to remove dust have been used for the study. Equal amount of leaves of 500gm has been taken in the dryer and open sun for experiment.

2.2 Open sun drying

The traditional way of drying of medicinal plants in Uttarakhand is open sun

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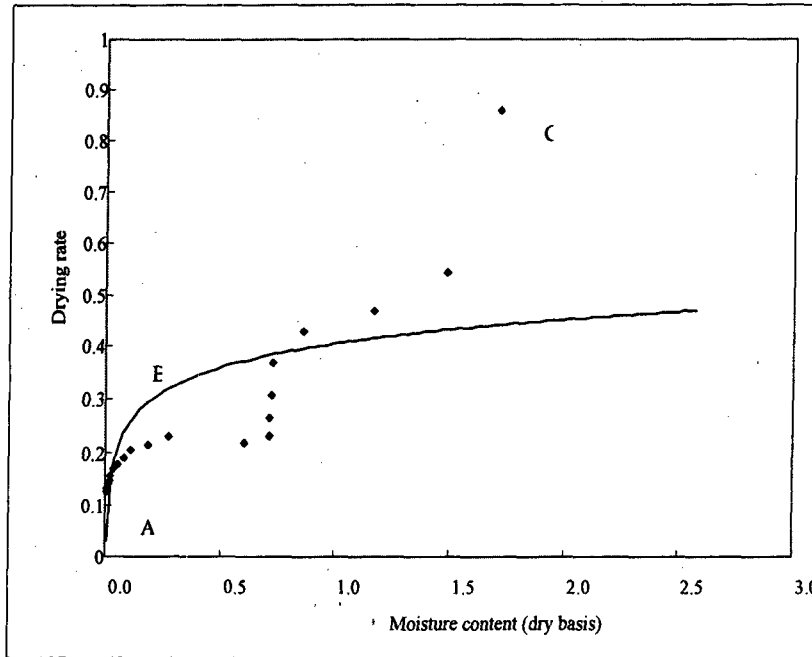


Fig. 4

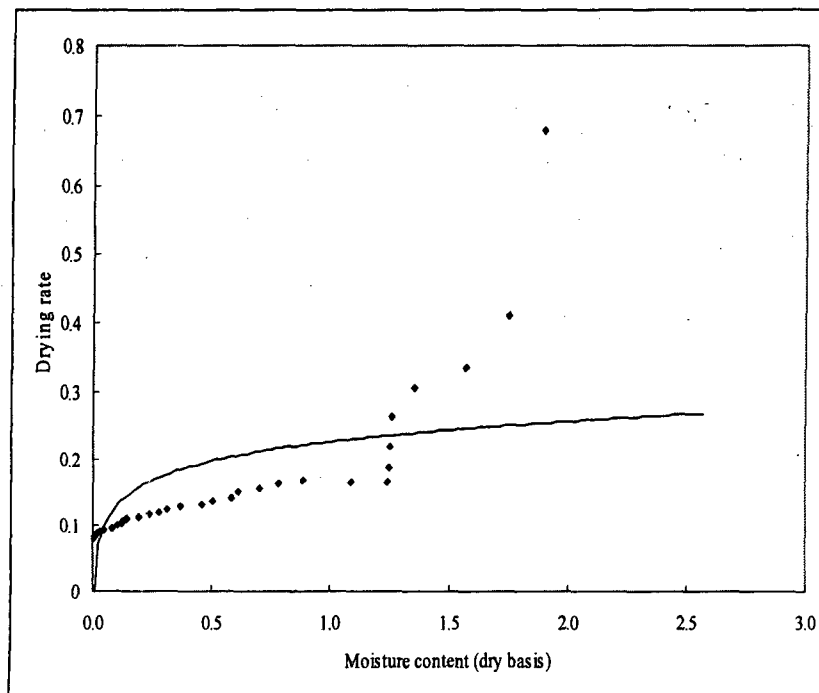


Fig. 5

7. Conclusions

Use of solar dryers for drying herbs and other produce can play an important role as the dried products will have better quality compared to open sun drying. These dryers are locally built, and low cost and have very little maintenance requirements. Drying effects on plant extract in dryer should be further investigated so that the ingredients useful for the medicinal values of plants are not destroyed in the process of drying. More study is required to find suitable temperature range for this kind of sensitive costlier produce.

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Figure Caption.

Figure 1 (a). Systematic diagram of a fabricated cabinet type solar dryer.

Figure 1 (b). Photograph of a fabricated Convective cabinet type solar dryer.

Figure 2. Variation of inside temperature and solar intensity with time during experiment

Figure 3. Experimental variation of moisture content of *Adhatoda vasica* leaves with time in a cabinet type solar dryer and open sun drying.

Figure 4. Experimental variation of drying rate of *Adhatoda vasica* leaves with moisture ratio in a cabinet type solar dryer.

Figure 5. Experimental variation of drying rate of *Adhatoda vasica* leaves with moisture ratio in open sun drying.

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