ECP 2024 Conference
The 3rd International Electronic Conference on Processes
29–31 May 2024 | Online

Modeling of fluidized bed drying process of pirul (*Schinus molle* L.) leaves

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INTRODUCTION & AIM

The **pirul tree** (*Schinus molle* L.) is utilized for the recovery of the essential oil obtained from its bark, leaves, and fruits, and the phenolic compounds contained in its leaves have demonstrated antimicrobial activity [1]. For the extraction of these and other compounds of interest, a preliminary drying of the leaves is carried out, which promotes contact between the solvent and the vegetal material by maximizing the mass transfer area. Drying involves complex heat and mass transport phenomena, and a proper analysis of this process would allow the optimization of this energy-intensive operation [2]. The estimation of mass and energy transfer properties is required for the design of drying processes and equipment. The **objective** of this study was to estimate the diffusivity coefficients and activation energy during the fluidized bed drying process of **pirul tree leaves**.

METHOD

Pirul leaves

Fluidized bed drying

Air temperature: 50, 60, 70 °C. Air Velocity: 2.0 m/s

Modelling process

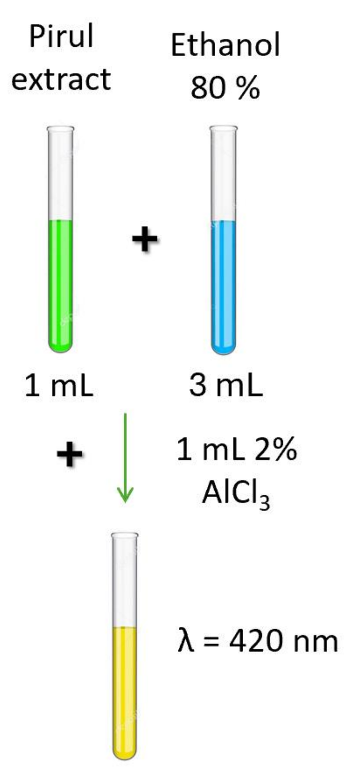
Mathematical solution of Fick's second law

$$\psi = \ln\frac{8}{\pi^2} - D_{ef}\left(\frac{\pi}{2L}\right)^2 t$$

Relationship of diffusivity and drying air temperature

$$lnD_{ef} = lnDo - \frac{Ea}{R}\frac{1}{T}$$

Total Flavonoids analysis



RESULTS & DISCUSSION

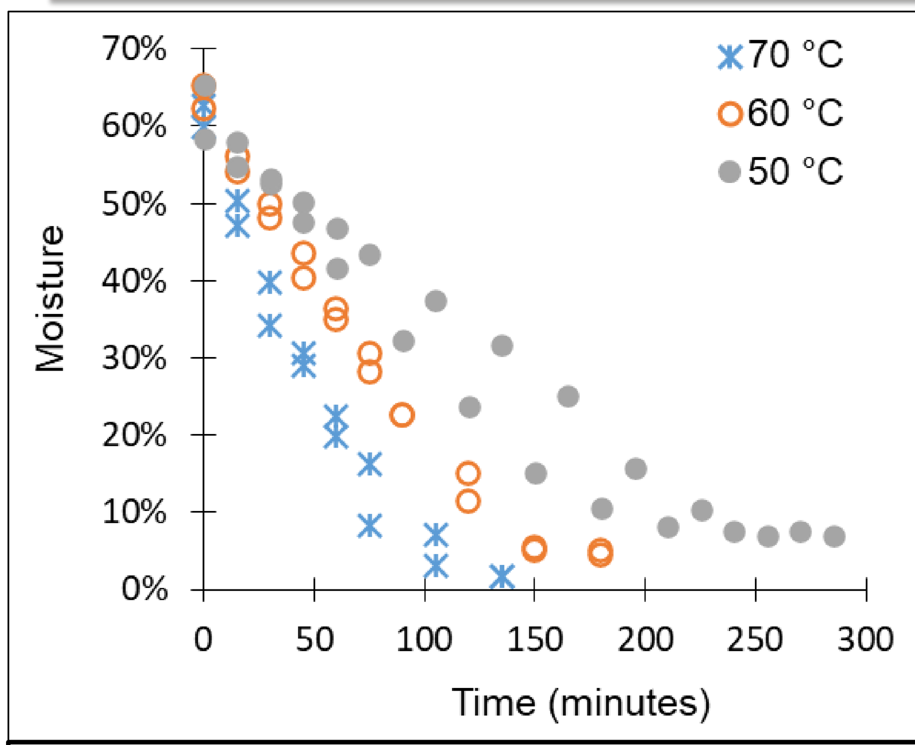


Fig 1. Moisture kinetics during drying process.

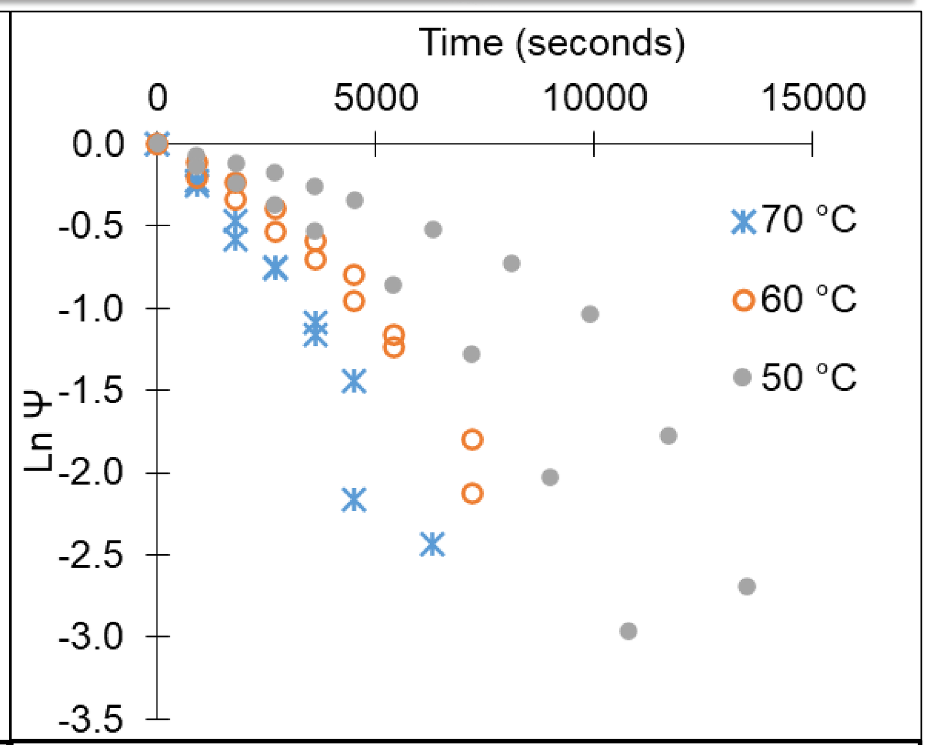


Fig 2. Logarithm of moisture ratio vs time.

As expected, higher temperatures decreased the drying times from 270 to 135 minutes (Fig 1).From the linear zone of the experimental ln Ψ vs t (Fig. 2) the average water diffusivities at the three temperatures were estimated with a 95% confidence interval (Table 1). The average water diffusivities ranged from 3.03 to 1.10 x 10^{-11} m^2s^{-1}, these results are similar to those reported in the literature. [3,4]. From Figure 3 activation energy for diffusion was determined in 32.23 kJ $mol^{-1}K^{-1}$.

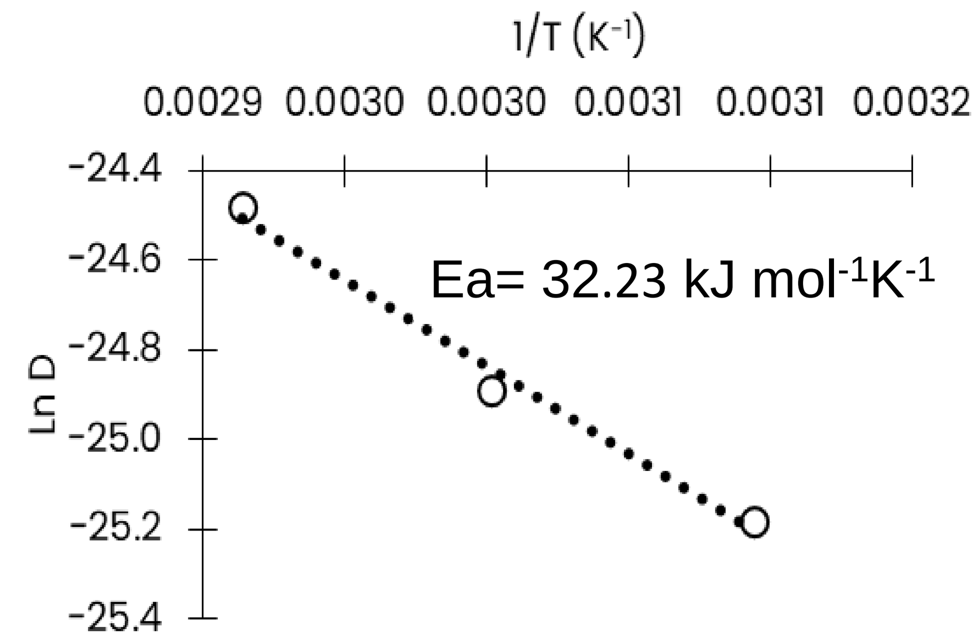


Fig 3. Logarithm of water diffusivities vs inverse of temperature.

Table 1. Average water diffusivities.

T [°C]	Confidence interval of $D \times 10^{11}$ [m^2s^{-1}] Lower limit	Estimated	Upper limit
70	2.65	2.84	3.03
60	1.52	1.55	1.59
50	1.10	1.16	1.21

Table 2. Total flavonoids content in fresh and dried leaves of pirul.

T [°C]	Total Flavonoids [mg QE/g dry leaves]
50	36.21 ± 0.23
60	36.48 ± 0.20
70	34.94 ± 0.26
Fresh leaves	35.80 ± 0.24

The flavonoids are phytochemicals with beneficial uses. Total flavonoids were determinate in fresh and dried leaves. As observed in Table 2, the temperatures evaluated does not have effect on total flavonoids.

CONCLUSION

Average water diffusivities and activation energy were estimated during pirul leaves drying process. Therefore, the flavonoids content remained constant during the process. These results indicate that optimum drying conditions are directly dependent on energy consumption and the average water diffusivities estimated are the most relevant properties required to predict pirul leaves drying dynamic.

FUTURE WORK / REFERENCES

The following stages consist of establishing the optimal storage conditions for the dried leaves. Subsequently, the antimicrobial evaluation of the extract and optimization of the extraction process.

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