A study on the effect of microwave drying of herbs for determination of antioxidant activity

Cite as: AIP Conference Proceedings **2387**, 020004 (2021); https://doi.org/10.1063/5.0068563
Published Online: 01 November 2021

J. Shafana, S. Kandasamy, Meghana Shaji, et al.

A Study on the Effect of Microwave Drying of Herbs for Determination of Antioxidant Activity

J.Shafana[a)], S.Kandasamy, Meghana Shaji, K.Kavivarshini

Department of Food Technology, Kongu Engineering College, Erode -638060, Tamil Nadu, India.

[a)] Corresponding author: *shafanajahir@gmail.com*

Abstract. Drying is one the oldest method used in preservation of foods. Preservation is achieved by removal of moisture through conduction, convection and/or radiation to obtain a product with better quality and extended shelf life. For this purpose, microwave drying is considered to be one of the fastest methods of moisture removal from the product. This work has focused on the effect of microwave drying of herbs and also the retention and degradation of essential nutrients. The comparison between the herbs is done in terms of determination of antioxidant activity. The better drying conditions for *Phyllanthus niruri* and *Boerhaavia diffusa* was at 0.2 kW with superior quality of the end product whereas *Annona muricata* was at 0.6 kW. On investigating the antioxidant activity, the samples of *Phyllanthus niruri* and *Boerhaavia diffusa* dried at 0.2 kW exhibited highest antioxidant activity. The sample *Annona muricata* dried at 0.4 kW exhibited highest antioxidant activity. To be applied in large scale applications, the process needs further research and improvements to achieve a product with better sensorial and nutritional attributes.

Keywords: Preservation, microwave drying, quality, antioxidant activity, medicinal herbs.

INTRODUCTION

Drying of samples using microwaves is an alternative method with wide range of applications in the field of food processing during recent decades[1, 2]. Drying, sterilization, thawing, pasteurization, baking and tempering of food materials are some of the applications of microwaves in food industries[1]. For determination of moisture content in the food industries, microwave drying has turned to be the most common practice as it can produce the results in shorter duration of time which is usually few minutes[3]. This method has gained importance as it has reduction in processing time, high drying rates, uniform drying, safe handling, low maintenance and easy to operate[1]. The limitations of the method are high initial cost, partial loss of aroma, negative sensory changes and specific sample size and shape may be required for effective drying. Process parameters such as sample mass, microwave power level and exposure time must be determined while selecting this method of drying[3].

Microwaves are electromagnetic radiation with frequency 300 MHz to 300 GHz and wavelength of 1m to 1 mm. It is a mechanism in which the electromagnetic radiation propagates through space with the help of electric field and magnetic field which are varied in respect to time. The heat generation by microwaves is caused by the interaction between the electromagnetic radiation (microwaves) and the medium in which a part of energy is dissipated in the form of heat[4]. Microwaves are widely used as the source of heat as they can rapidly heat materials. It is also more uniform and energy efficient. This method can cause changes in flavour and nutritional quality of the food to a lesser extent. The reduction in drying rate and increase in the quality of the product is achieved in microwave drying as the applied heat penetrates directly into the food. The reduction in the drying time is achieved by dielectric heating with microwaves[5].

Phyllanthus niruri is a perennial herb which belongs to Euphorbiaceae family. *Phyllanthus niruri* is used in traditional medicine for treating jaundice, diarrhoea, dyspepsia, genitourinary infections, renal stones etc[6]. It

Proceedings of the 4th National Conference on Current and Emerging Process Technologies e-CONCEPT-2021
AIP Conf. Proc. 2387, 020004-1–020004-6; https://doi.org/10.1063/5.0068563
Published by AIP Publishing. 978-0-7354-4146-0/$30.00

consists of various phytoconstituents which are responsible for its pharmacological activity. The phytochemical studies on *Phyllanthus niruri* has revealed that the plant is rich in bio active constituents such as tannins, flavonoids, alkaloids, terpenes, coumarins, lignans, phenylpropanoids, anthocyanins, chlorogenic acids, saponins, glycosidic substitutes and terpenoids which are responsible for the pharmacological activity of *Phyllanthus niruri* [6, 7].

Boerhaavia diffusa is generally called as Punarnava, which is a green leafy vegetable belonging to *Nyctaginaceae* family [8], utilized by South Asian people because of its nutraceutical characteristics and this medicinal herb fully utilized for the traditional treatment for various diseases on account of its numerous immuno suppressant, antiviral, medicative activities viz., analgesic, anti-diabetic, hepatoprotective and antifibrinolytic activity, etc. The medicinal significance of herbs is chiefly due to their antioxidant properties and polyphenols. The phytochemical investigation on *Boerhaavia diffusa* has disclosed that the herb has wide range of bio active compounds such as phenols, glycosides, Alkaloids, tannins, flavonoids, Terpenoids , Saponins and Steroids[9].

Annona muricata L., belonging to the family of *Annonaceae* has gained great importance in the past decade for its therapeutic potential [10].This has abundance of bioactive constituents nearly about 212 compounds. Flavonoids, alkaloids, carbohydrates, saponins, cardiac glycosides, tannins, terpenoids, phytosterols and proteins are the phytochemicals present in *Annona muricata L*. Te major compounds are acetogenins, phenols and alkaloids [11].

MATERIALS AND METHODS

Materials

Fresh leaves of *Phyllanthus niruri, Boerhaavia diffusa, Annona muricata L.* were collected from the local markets of Wayanad and Erode. The samples were cleaned and sorted to remove dust, dirt and other foreign materials and taken for analysis. The reagents used for the process were ethanol and 2,2 diphenyl-1-picrylhydrazyl (DPPH).

Microwave Drying

The ability of materials to absorb microwave energy and convert it to heat is known as microwave drying. Dipole rotation and ionic polarization are the main two mechanisms governing microwave heating[1]. Energy dissipation is dependent on the characteristics of the medium and frequency of the wave[4]. When a sample absorbs microwave radiation, the water molecules in the sample which contain dipolar electric charges rotate as they tempt to align their dipoles with the rapidly changing electric field. Thereby heat is created by the friction which is transferred to the neighbouring molecules. The area with high liquid content in the sample is heated rapidly by the microwaves. The internal temperature of the sample will nearly reach to the boiling point of water. This results in the evaporation of free moisture from the sample. There is no overheating of the sample and it can also achieve rapid drying. The rate of moisture removal is more higher than any other convective drying methods[3].

The cleaned leaves of *Phyllanthus niruri, Boerhaavia diffusa, Annona muricata L.* were subjected to microwave drying at a power variation 0.2, 0.4 and 0.6 kW at an interval of 2 minutes.

Determination of Antioxidant Activity

The method of sample preparation is to weigh 0.1g of the sample is treated with 10ml of ethanol for 10 mins and filtered using Whatman No.1 filter paper. Take 1ml of sample extract in a test tube and make the volume to 2ml by using 95% of ethanol. Add 2ml of 10mM DPPH solution to the test tube. Mixing the content for about 10 mins and test tube was kept in dark place for 25-30 minutes. Read the absorbance at 517 nm by UV Visible Spectrometer.

Radical scavenging activity or inhibition (%) was calculated as follows:

$$\% \text{ Inhibition} = [(AB - AA) / AB] \times 100$$

Where, AB – Absorbance Control AA – Absorbance Sample

RESULTS AND DISCUSSION

Microwave Drying of *Phyllanthus niruri*

The microwave drying of *Phyllanthus niruri* was carried out at different power levels such as 0.2, 0.4, 0.6 kW which is used to determine the drying rates of *Phyllanthus niruri.* The exposure of microwave power greatly influenced the drying characteristics of *Phyllanthus niruri.* The exposure of *Phyllanthus niruri* at 0.6 kW resulted in reduced drying time but lead to darkened end product which implies that exposure to higher power level will deteriorate the quality of the sample. Drying of *Phyllanthus niruri* at 0.2 and 0.4 kW consumed more time than 0.6 kW but the quality of the product was superior.

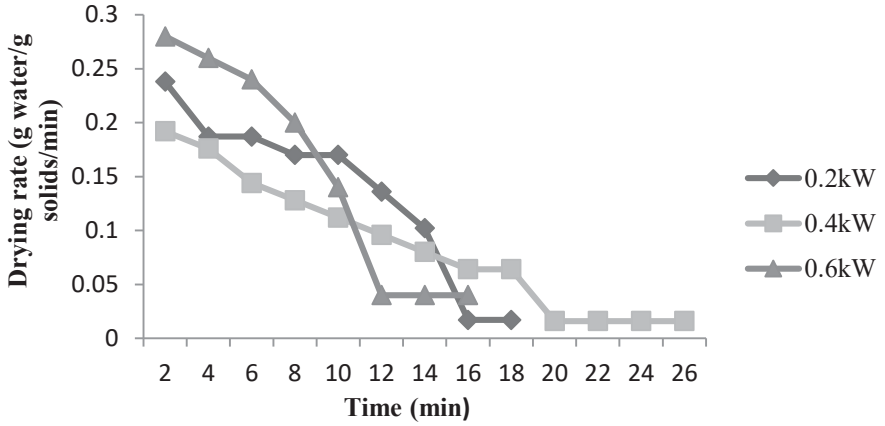

FIGURE 1. Time Vs Drying rate of *Phyllanthus niruri* at various power levels

Microwave Drying of *Boerhaavia diffusa*

The microwave drying of *Boerhaavia diffusa* was carried out at different power levels such as 0.2, 0.4, 0.6 kW which is used to determine the drying rates of *Boerhaavia diffusa.* The exposure of microwave power greatly influenced the drying characteristics of *Boerhaavia diffusa.* The drying time was directly proportional to the microwave power levels i.e the higher power consumes more time. The best drying conditions were observed at 0.2 kW. The drying of *Boerhaavia diffusa* at 0.2 kW resulted in superior quality end product than 0.4 and 0.6 kW.

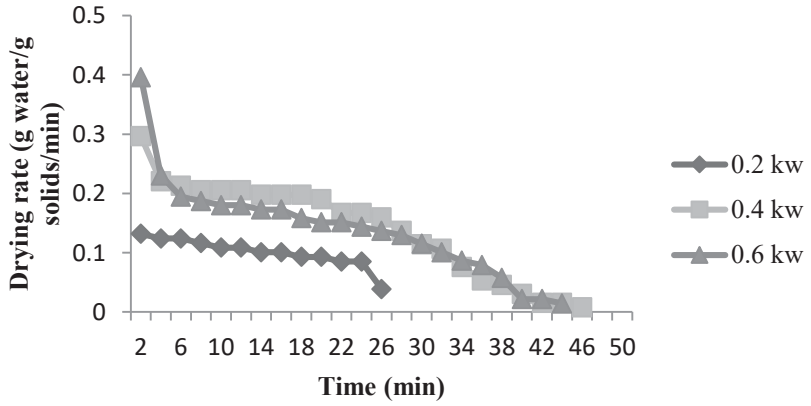

FIGURE 2. Time Vs Drying rate of *Boerhaavia diffusa* at various power levels

Microwave Drying of *Annona muricata*

The microwave drying of *Annona muricata* was carried out at different power levels such as 0.2, 0.4, 0.6 kW which is used to determine the drying rates of *Annona muricata.* The exposure of microwave power greatly influenced the drying characteristics of *Annona muricata.* The drying time was inversely proportional to the microwave power levels i.e the higher power consumes less time. The best drying conditions were observed at 0.6 kW. The drying of *Annona muricata* at 0.6 kW resulted in superior quality end product than 0.2 and 0.4 kW.

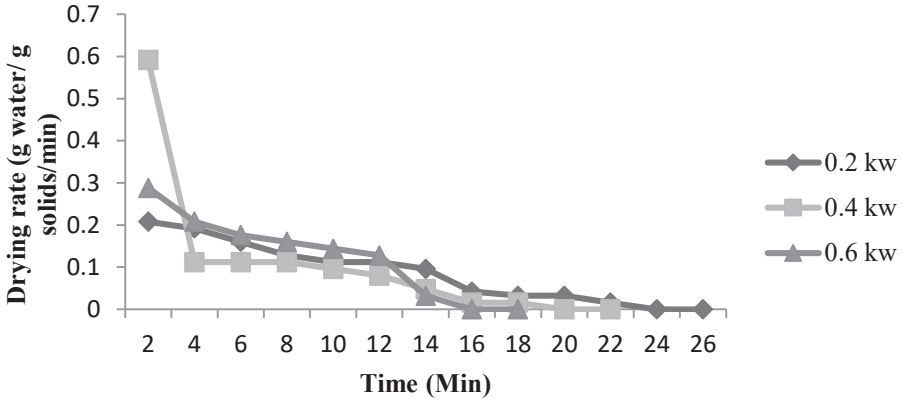

FIGURE 3. Time Vs Drying rate of *Annona muricata* at various power levels

Determination of Antioxidant Activity of *Phyllanthus niruri*

The samples dried at different microwave power levels such as 0.2, 0.4, 0.6 kW was investigated for its antioxidant activity using DPPH assay. The results revealed that the samples dried at 0.2 kW showed highest antioxidant activity. The increase in microwave power for drying of the samples lead to degradation of its antioxidant activity.

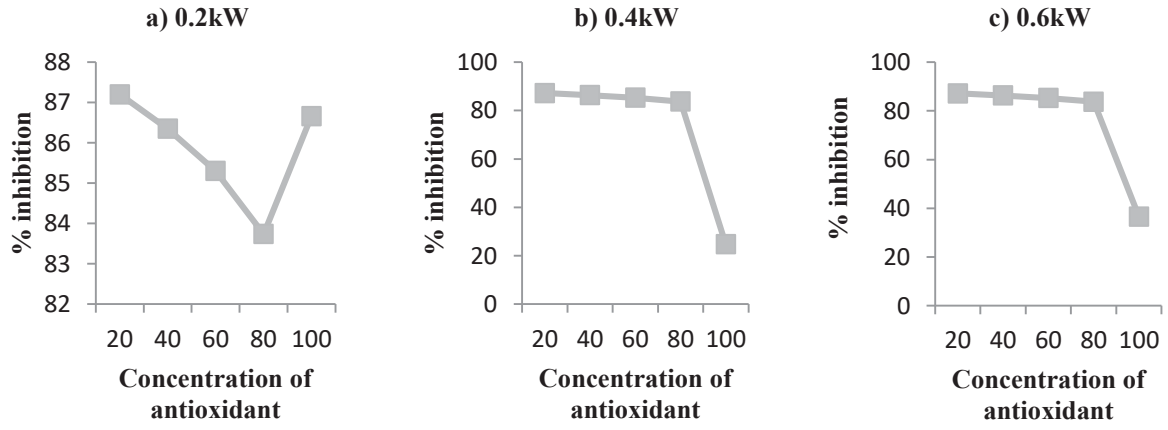

FIGURE 4. Antioxidant activity of *Phyllanthus niruri* at a) 0.2, b) 0.4 and c) 0.6 kW

Determination of Antioxidant Activity of *Boerhaavia diffusa*

The samples dried at different microwave power levels such as 0.2, 0.4, 0.6 kW was investigated for its antioxidant activity using DPPH assay. The results revealed that the samples dried at 0.2 kW showed highest antioxidant activity. The increase in the microwave powers for drying of the samples lead to the degradation of its antioxidant activity.

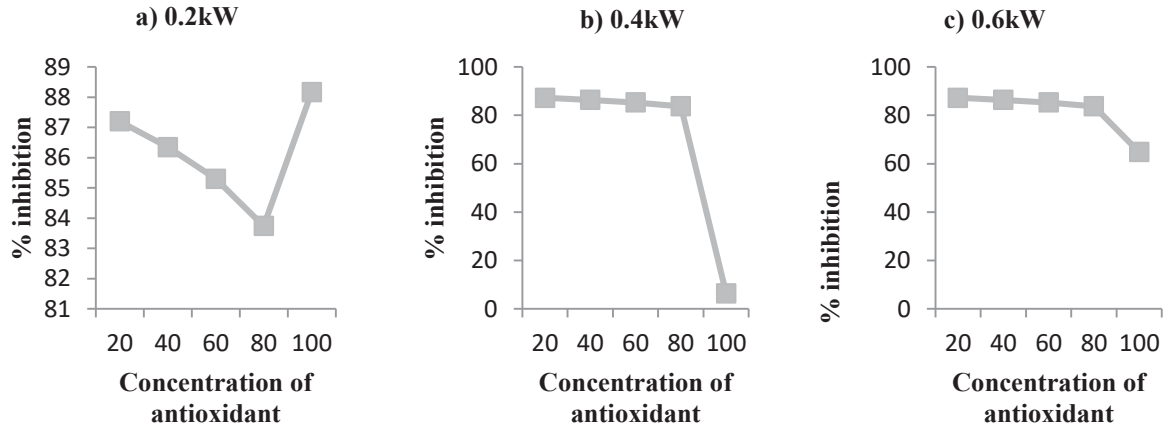

FIGURE 5. Antioxidant activity of *Boerhaavia diffusa* at a) 0.2, b) 0.4 and c) 0.6 kW

Determination of Antioxidant Activity of *Annona muricata*

The samples dried at different microwave power levels such as 0.2, 0.4, 0.6 kW was investigated for its antioxidant activity using DPPH assay. The results revealed that the samples dried at 0.4 kW showed highest antioxidant activity.

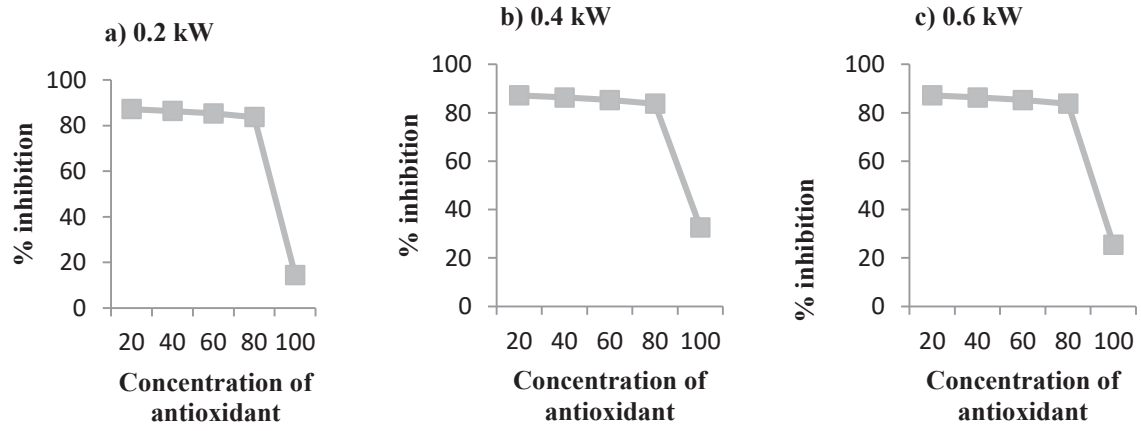

FIGURE 6. Antioxidant activity of *Annona muricata* at a) 0.2, b) 0.4 and c) 0.6 kW

Percentage Inhibition of Free Radical

Percentage inhibiton of free radical	*Phyllanthus niruri*			*Boerhaavia diffusa*			*Annona muricata*		
	0.2 kW	**0.4 kW**	**0.6 kW**	**0.2 kW**	**0.4 kW**	**0.6 kW**	**0.2 kW**	**0.4 kW**	**0.6 kW**
	85.89	73.46	75.84	86.16	69.80	81.48	71.40	75.05	73.62

CONCLUSION

The microwave drying of *Phyllanthus niruri, Boerhaavia diffusa, Annona muricata* was studied at various power levels of 0.2, 0.4 and 0.6 kW and its antioxidant activity was investigated. The samples *Phyllanthus niruri* and *Boerhaavia diffusa* exhibited better drying characteristics at 0.2 kW with superior quality of the end product whereas *Annona muricata* exhibited better drying characteristics at 0.6 kW. On investigating the antioxidant activity of

Phyllanthus niruri, Boerhaavia diffusa, Annona muricata, the samples of *Phyllanthus niruri* and *Boerhaavia diffusa* dried at 0.2 kW exhibited highest antioxidant activity. The sample *Annona muricata* dried at 0.4 kW exhibited highest antioxidant activity.

These underutilized herbs are true miracle of nature and they can be used in food products which can enhance the medicinal properties. These herbs can fight against diseases such as jaundice, renal stones, cancer, liver disorders and diabetes. Further research in phytoconstituents of the herbs is required for the better utilization.

REFERENCES

[1] Chandrasekaran, S., S. Ramanathan, and T. Basak, "Microwave food processing—A review", *Food Research International*, vol. 52, no.1, pp. 243-261, 2013.

[2] Krokida, M. and Z. Maroulis, "Quality changes during drying of food materials," *Drying technology in agriculture and food sciences*, vol. 4, no. 2, pp. 61-68, 2000.

[3] Bouraoui, M., P. Richard, and J. Fichtali, "A review of moisture content determination in foods using microwave oven drying," *Food research international*, vol. 26, no. 1, pp. 49-57, 1993.

[4] Feng, H., Y. Yin, and J. Tang, Microwave drying of food and agricultural materials: basics and heat and mass transfer modeling. Food Engineering Reviews, 2012. 4(2): p. 89-106.

[5] Deepika, S. and P. Sutar, "Microwave assisted hybrid drying in food and agricultural materials," *Drying Technologies for Foods: Fundamentals and Applications (Part I)*, pp. 121-154, 2015.

[6] Lee, N.Y., et al., "The pharmacological potential of Phyllanthus niruri," *Journal of pharmacy and pharmacology*, vol. 68, no. 8, pp. 953-969, 2016.

[7] Kaur, N., B. Kaur, and G. Sirhindi, "Phytochemistry and pharmacology of Phyllanthus niruri L.: a review," *Phytotherapy Research*, vol. 31, no. 7, pp. 980-1004, 2017.

[8] Prathapan, A., et al., "Antiperoxidative, free radical scavenging and metal chelating activities of boerhaavia diffusa l.," *Journal of Food Biochemistry*, vol. 35, no. 5, pp. 1548-1554, 2011.

[9] Banjare, L., A.K. Prasad, and M. Naik, "Boerhaavia diffusa from traditional use to scientific assessment-a review," *Int J Pharm Biol Arch*, vol. 3, no. 6, pp. 1346-1354, 2012.

[10] Coria-Téllez, A.V., et al., "Annona muricata: A comprehensive review on its traditional medicinal uses, phytochemicals, pharmacological activities, mechanisms of action and toxicity," *Arabian Journal of Chemistry*, vol. 11, no. 5, pp. 662-691, 2018.

[11] Vijayameena, C., et al., "Original Research Article Phytochemical screening and assessment of antibacterial activity for the bioactive compounds in Annona muricata," *Int. J. Curr. Microbiol. Appl. Sci*, vol. 2, pp. 1-8, 2013.