Effect of infrared (IR) drying and electrical oven drying on antioxidant potential of brown seaweed

Dona Jaiju[1,2], Aniesrani Delfiya[1], Devananda Uchoi[1*], and Niladri Sekhar Chatterjee [1]

[1]ICAR-Central Institute of Fisheries Technology, Cochin-29

[2]Faculty of Marine Sciences, Cochin University of Science and Technology, Cochin-16

*uchoidev514@gmail.com

Seaweeds in dried and powdered form have gained popularity as an ingredient in nutraceutical and dietary supplements. Usually, fresh seaweeds have 75 to 85% water and drying of seaweeds is a common post-harvest method for their preservation (Neoh, Matanjun and Lee, 2016). Drying seaweeds prior to their processing also prevents microbial attack and serve the purpose of easy handling and storage. In India, one of the most popular drying methods is open-air sun drying. Though economical, open-air sun drying requires large area, and poses the risk of getting contaminated with dust, insects or animal droppings. Open-air sun drying can result in uneven drying and a significant loss in quality (Santoshkumar, Yoha and Moses, 2023). Thus, drying in a hygienic and controlled environment is more favored. Oven drying can overcome most of the limitations of open-air drying. Retention of phytochemicals and other bioactive compounds was reported in brown seaweeds dried in an oven dryer (Uribe et al., 2020). But the process is less energy efficient as longer drying time is required. Modern drying processes, such as vacuum drying, freeze drying, microwave-assisted drying, and infrared drying, are replacing traditional drying methods because they are much more efficient and takes lesser time. Though each method has its own advantages, it is crucial to select the right drying conditions and process for superior results. However, little is known about how various drying methods impact the phytochemical and nutrient content of seaweeds.

Turbinaria conoides (J. Agardh) Kuzing, a brown seaweed, was collected from the Gulf of Mannar in Mandapam region of Tamil Nadu. It was dried separately using an infrared dryer (IR) at 50°C and a conventional electrical oven dryer at 50°C for 3 hours and 28 hours, respectively and pulverized. Samples were extracted with ethanol and electrical oven-dried samples showed a higher percentage of extract. Crude protein content of IR dried sample was 9% while that of electrical dried sample was 12%. Water activity for both samples was below 0.6, which is lower than the required level for microbial growth (Jayasinghe, Pahalawattaarachchi and Ranaweera, 2016). DPPH radical scavenging activity, ABTS activity, and total antioxidant assay were used to assess the antioxidant activity of ethanolic extract for IR and electrical oven-dried seaweed powder and results are given in Table 1. In addition, the total phenolic and flavonoid levels were determined. Phenolic content of IR dried sample ranged from 12.4 to 15 mg Gallic acid equivalent/g and for electrical oven dried sample it ranged from 17.2 to 21 mg Gallic acid equivalent/g, respectively. In addition, flavonoid content in IR dried sample ranged from 38 to 40 mg Quercetin equivalent/g and in electrical oven dried sample, it ranged from 40.6 to 42 mg Quercetin equivalent/g, respectively. Significant difference in phenolic content was observed between the two drying methods ($p<0.05$) though not much difference was found in flavonoid content.

IR dryer significantly reduces the drying time which compensates its higher costs. In addition, IR dryer offers more precise temperature control and thus improves the quality of final product. For bulk preparation of hygienic dried seaweeds, IR dryer showed more potential than a conventional electrical oven dryer without compromising the antioxidant potential of seaweed.

Table 1. Results of antioxidant assays for the two drying methods

	mg Trolox Equivalent / g of extract		
	DPPH Assay	**ABTS Assay**	**Total antioxidant Assay**
IR dried sample	2.26 ± 0.95	17.86 ± 0.24	30.78 ± 0.25
Electrical oven dried sample	2.53 ± 0.70	13.74 ± 0.33	30.38 ± 0.62

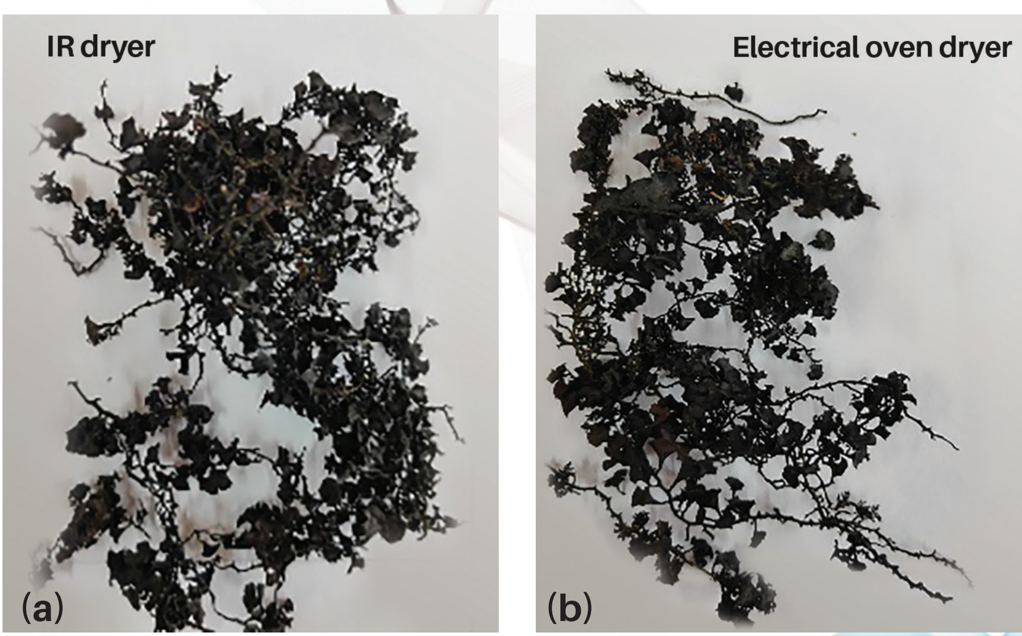

Fig. 1. Turbinaria conoides dried using (a) IR dryer (b) Electrical oven dryer.

References

Jayasinghe, P.S., Pahalawattaarachchi, V., and Ranaweera, K.K.D.S. (2016). Formulation of Nutritionally Superior and Low Cost Seaweed Based Soup Mix Powder. Journal of Food Processing and Technology, 07, 04. https://doi.org/10.4172/2157-7110.1000571

Neoh, Y.Y., Matanjun, P., and Lee, J.S. (2016). Comparative study of drying methods on chemical constituents of Malaysian red seaweed. Drying Technology, 34(14), 1745–1751. https://doi.org/10.1080/07373937.2016.1212207.

Santhoshkumar, P., Yoha, K.S., and Moses, J. A. (2023). Drying of seaweed: Approaches, challenges and research needs. Trends in Food Science and Technology, (138), 153–163. https://doi.org/10.1016/j.tifs.2023.06.008.

Uribe, E., Pardo-Orellana, C.M., Vega-Gálvez, A., Ah-Hen, K.S., Pastén, A., García, V., and Aubourg, S.P. (2020). Effect of drying methods on bioactive compounds, nutritional, antioxidant, and antidiabetic potential of brown alga Durvillaea antarctica. Drying Technology, 38(14), 1915–1928. https://doi.org/10.1080/07373937.2019.1679830.