

Refractance Window Drying- A Novel Drying Technique Of Food Processing

Baghya Nisha Radhakrishnan¹, Rita Narayanan^{2*}

¹Ph.D. Scholar, ² Faculty, Department of Food Processing Technology, College of Food and Dairy Technology, Chennai 600 052, Tamil Nadu Veterinary and Animal Sciences University, Chennai – 600 007

ritanarayanan@yahoo.com

ARTICLE ID: 083

Keeping quality of fresh produces is difficult to maintain throughout the distribution chain. In the early days, drying was considered as an important unit operation for extending the shelf life of harvested produces. Drying of produces aids in increasing the shelf life and product quality. Therefore, for many biological resources include fruits, vegetables, herbs, and aquatic sources drying technique had become the frequent method of food preservation. Thereafter, drying technique had continuously gaining significant interest among researchers and processors. It is a process that involves the application of heat to remove moisture from fresh products which results in the transfer of moisture within the material to its surface and then water removal from the material to the atmosphere. The various benefits of drying attracted producers include reduction of weight, which greatly decreases the cost of packaging, handling, storage and transport.

Conversely, drying of fruits and vegetables is a complex operation that demands more energy and time. Preserving the quality attributes of food products had always been a challenge in drying of heat sensitive products. Traditional drying adversely affects the taste, colour, nutritional qualities and preservation of bioactive compounds due to constant exposure of the product. Hence efforts were taken towards development of improved and innovative drying methods for preservation include Refractance, high-vacuum, fluidization, microwaves, and Radio frequency drying technique. Drying of puree and juice products was achieved by drum, spray, and freeze drying, each with certain limitations. Hence, innovative drying techniques has gained a huge importance in food industries in delivering superior quality products to consumers.

Refractance window (RW) is a new film drying method it helps to deliver the better quality product with excellent retention of colour, flavour, vitamins and phytochemicals.

Studies conveyed that refractance window drying utilises less energy for operation therefore it has the ability to improve the efficiency and efficacy of drying. RW drying can dry a similar amount of freeze dried product at one-third of the cost of a freeze-dryer (FD). This technology can be applied to both evaporations for concentration and drying of liquid and semi-liquid food products (slurries) into powders, flakes or dried sheets.

Principle and Working of RWD

RW uses circulating water usually at 95–97°C and at atmospheric pressure which transfers thermal energy to food products to be dried. Heat transfer occurs from circulating hot water to the wet product via a plastic interface (Mylar flim) that is relatively transparent to infrared radiation and product temperature is generally below 70°C.

Liquid or semi viscous products such as juices and purees are allowed to spread on the transparent plastic mylar sheet. Mylar flim is made very thin, thereby the temperature of the hot water is absorbed to the product very easily. When the conveyor moves product heat transfer from the bottom occurs by the hot water circulating on shallow troughs. Product will not be in direct contact with the heat transfer medium during drying, therefore no cross-contamination occurs. The circulating hot water is recycled and reused, thereby the thermal efficiency of the system is improved.

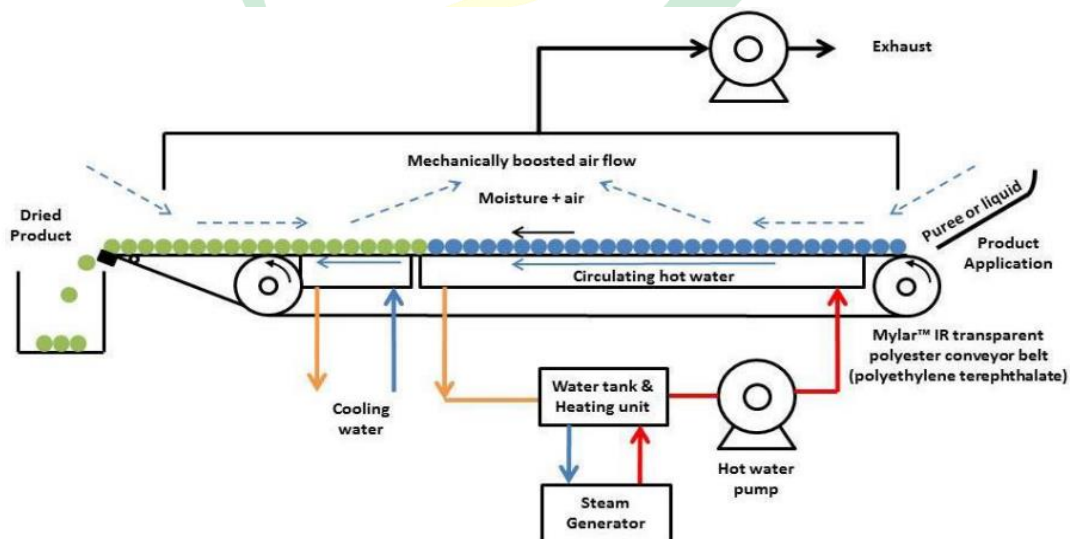


Fig. 1 Schematic Diagram of Refractance Window Drying Mode of heat transfer

During RW drying, the three modes of heat transfer occurs, namely conduction (q_{cond}), convection (q_{conv}), and radiation (q_{rad}). The process by which heat is transferred from circulating hot water to the product is convection. The process of heating water by steam within an insulated tank and circulated in shallow troughs to transfer thermal energy to the plastic conveyor Mylar film is conduction. Thermal energy from the hot water is transmitted through the plastic conveyor by conduction and radiation. The infrared transmissivity of mylar film is depends on their thickness.

Table 1. Applications of refractance window drying in food industry

FOOD PRODUCTS	FINDINGS	REFERENCES
Strawberry	Retained higher amount of ascorbic acid same as that of freeze drying	Abonyi <i>et al.</i> , 2002
Carrots	Retention of carotene was almost comparable to freeze drying.	B.I. Abonyi <i>et al.</i> ,2002
Asparagus	High retention of antioxidant activity by retrieving maximum amount of ascorbic acid.	C.I. Nindo <i>et al.</i> , 2007
Aloe vera	Same quality as the freeze dried	C.I. Nindo et al., 2007
Paprika	Carotene losses was higher compared to freeze drying.	Topuz <i>et al.</i> ,2009
Tomato powder	Higher retention of flavonoids particularly lycopene.	M.M. Abul-Fadl and T.H. Ghanem, 2011
Purple potatoes	Maximum retention of bioactive compounds	Nayak <i>et al.</i> , 2011
Pomegranate	Retention of anthocyanin content than spray and freeze drying.	V. Baeghbalia <i>et al.</i> 2015
Haskap berry	Retention of 98% of anthocyanin.	G. B. Celli <i>et al.</i> , 2015
Kiwi fruit	Better texture in the final product and surface hardening were reduced in	Azizi <i>et al.</i> , 2017

	RW drying.	
Mango	Better retention of colour in the final product.	Bhagebali <i>et al.</i> , 2018

Other applications of RW were also found on drying of avocado mix powder, algae, egg mix, herbal extracts, probiotics and nutrition supplement products.

Advantages

- Retention of bioactive components.
- Retains complex, subtle flavours and aromas. as well as colours and nutrients
- No vacuum and processing under low temperature.
- Energy efficient.

Disadvantages

- Scaling up of RW drying process.
- Dehydration of large quantity of product requires large surface area for drying and heat exchange.

Conclusion

Refractance window drying is a powerful tool for drying of plant based liquid foods/purees. RW drying is an energy efficient method and a gentle dehydration process which gives excellent retention of nutrients, flavor and color in the food material.