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Low-pressure microwave heating system for drying of swiftlet bird's nest

M. Nisoa^{1,a} and P. Kerdthongmee²

¹Faculty of Science, Walailak University, Nakhon-si-thammarat, Thailand; ²Center for scientific and technological equipment, Walailak University, Nakhon-si-thammarat, Thailand

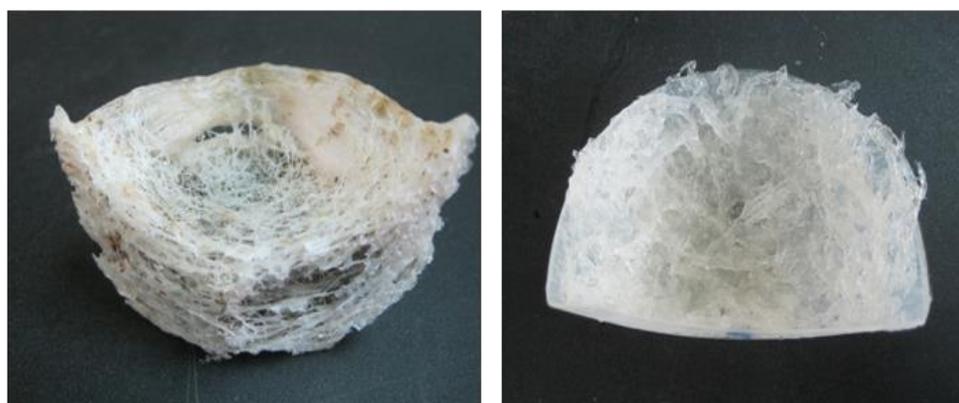
Abstract

The swiftlet bird's nest is famous for high-valuable functional food, which is popular among Asian countries. Southern provinces of Thailand, especially Nakhon-si-thammarat, have produced the bird's nest commercially both for local need and for export. For conventional drying, cold and dry air is used to dry the nest. The drying time is very long, about 22 hours. Low-temperature is critically important to preserve the high-quality of the nest, especially its colour. We have developed the low pressure microwave system to dry the nest more effective, shorten the time to be less than 2 hours. The system consist of vacuum chamber, microwave power unit, condensing chamber for trapping moisture and oil vapour. Adjustable microwave power by using phase control has been developed. Microwave power is generated by magnetron by mean of energy conversion from electricity. The microwave is transmitted through Waveguide to the multi-mode cavity to dry the nest. We have successfully dried the nest by low temperature and short period of time to preserve its colour and protein. The low pressure microwave system is suitable for drying the bird's nest, which can be scaled up for industrial prototype.

Keywords: swiftlet's nest, microwave vacuum drying, phase control microwave power

INTRODUCTION

Figure 1(a) shows the Swiftlet bird's nest, known as healthy functional food in Asia. It is good for skin care, curing respiratory malfunction. It is impressed as Caviar of the East (Zainab et al., 2013).



(a)

(b)

Figure 1. (a) Natural swiftlet bird's nest and (b) Clean and white swiftlet bird's nest

^a E-mail: mnisoa@gmail.com

Typically people consume the nest for their good health and living well. The nutrition contents of the swiftlet bird's nest are fat, carbohydrate and protein of 0.14-1.28%, 25-27% and 62-63%, respectively (Glai-more Magazine, 1988; Zainab et al., 2013; Mei et al., 2014; Babji et al., 2015). The protein of the nest is special, known as glycoprotein. Its precursor substance, which has higher nutrition than normal protein, can boost immunity and stimulate the growth the skin cell. It also has inhibition effect to inhibit the contamination of bacteria, fungi and virus. To process the bird's nest for food product, first raw nest is put in clean water to eliminate the dirt, such as dust, feather. The clean one is shown in Figure1 (b). Then the nest is dried for preservation. Since the bird's nest is very sensitive to temperature, its quality will be deteriorated if the temperature is higher than room temperature (Gan et al., 2015). For conventional drying, cold and dry air is used to dry the nest. The drying time is very long, about 22 hours, which is not practical for industrial production. Freeze drying is the most appropriated method to dry bird's nest (Gan et al., 2015). Drying at temperature below zero can keep original value of the nest. Freeze drying system requires sophisticated vacuum pump and condensing unit which are very expensive. Microwave vacuum(MV) takes advantage of microwave heating and moderate pressure to dry materials at room temperature as shown in Figure2. The qualities of drying products are good enough for herbs and foods, whereas its cost is much cheaper than freezing dry. We have developed low pressure and low temperature microwave drying system to reduce the drying time and preserve the good quality of the nest. Low-temperature is critically important to preserve the high-quality of the nest, especially its colour.

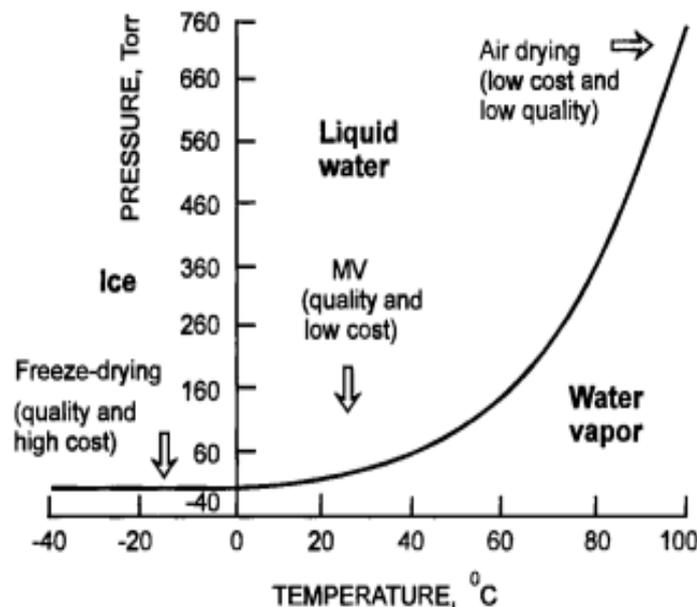


Figure 2. Pressure-temperature curve showing conditions for freeze-drying, Microwave vacuum (MV) and air drying (Kudra and Mujumdar, 2002).

MATERIALS AND METHODS

Experimental setup

We have developed the low pressure microwave system to dry the nest more effective, shorten the time to be less than 2 hours. The system consist of vacuum chamber, microwave power unit, condensing chamber for trapping moisture and oil vapour. Adjustable microwave power by using phase control has been developed. Microwave power is generated by magnetron by mean of energy conversion from electricity. The microwave is transmitted

through Waveguide to the multi-mode cavity to dry the nest. The picture and diagram of the system are shown in Figure 3 and Figure 4, respectively.

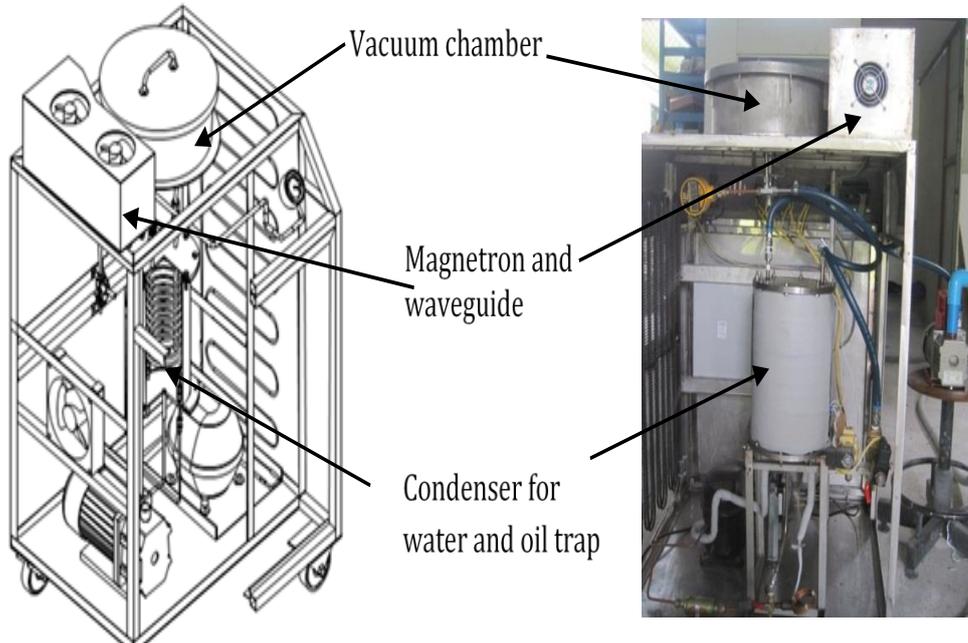


Figure 3. Low-pressure microwave drying system.

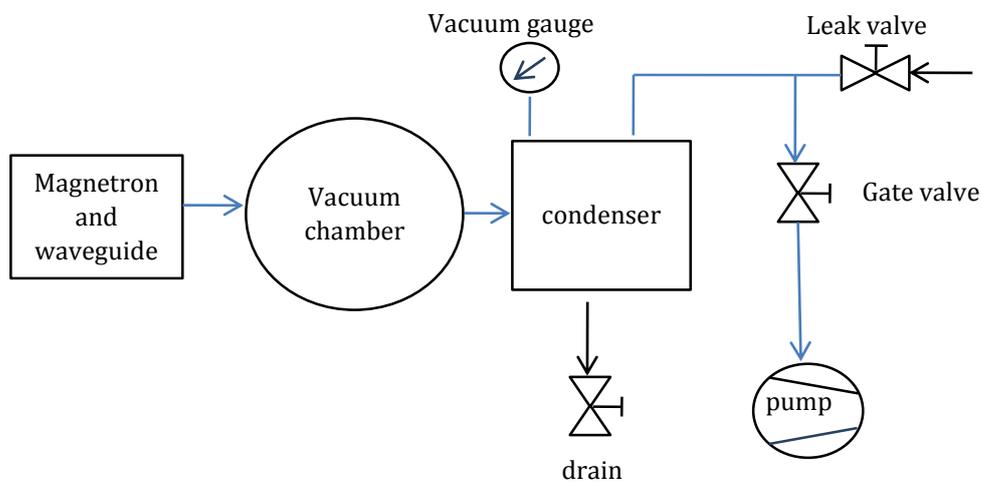


Figure 4. Schematic diagram of Low-pressure microwave drying system.

RESULTS AND DISCUSSION

The drying time of the bird's nest in Figure 5 shows that the nest can be dried to have moisture content less than 1% within three hours. Depending on microwave powers, drying time is varied, more high power have shorter drying time. At 150 watts, drying time is about 2 hours. Since the nest is dried at low temperature in a short time, its colour is still white as the original one. Figure 6 shows the comparison between the original bird's nest and the dried bird's nest by low pressure microwave drying system.

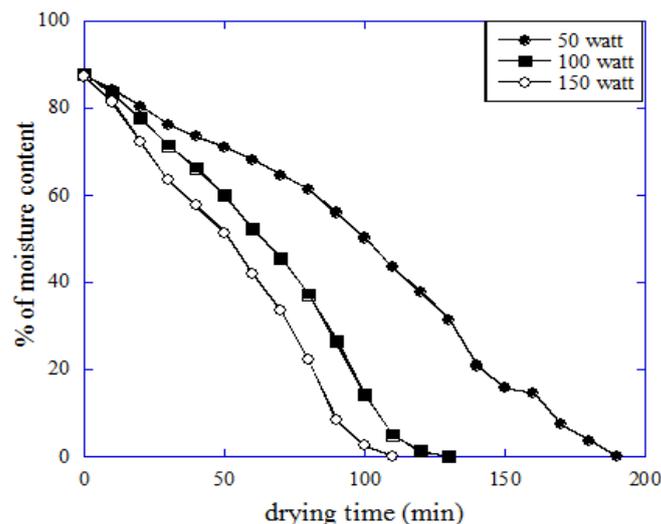


Figure 5. Dependence of percentage of moisture content on drying time.



Figure 6. Comparison of color of bird's nest

Table 1. Comparison of percentage of protein for different kinds of bird's nest.

Swiftlet bird's nest	% of protein
Original wet bird's nest	74.0
Dried by 50 watts of microwave	79.1
Dried by 100 watts of microwave	78.9
Dried by 150 watts of microwave	78.9
Dried bird's nest from local store	1.4
Dried by wind convection in air conditioned room	62.9
Export grade of dried bird's nest	61.7

Table 1 shows the percentages of the protein of the bird's nests. It is seen that drying bird's nests by low pressure microwave system can preserve higher content of protein than conventional drying method. Low temperature and shorter time by microwave plays the key role for higher content of protein.

CONCLUSIONS

The following conclusions can be drawn from the study:

- We have shown that low pressure microwave drying system is suitable to dry the swiftlet bird's nest.
- The good qualities of the bird's nest, such as colour and protein content, can be preserved.
- The drying time is shorten to be only about 2 hours. The protein content is high as the original one.

- The drying system can be developed to increase drying capacity for industrial prototype.

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