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Production of dried ivy gourd sheet as a health snack

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ABSTRACT

Ivy gourd (*Coccinia grandis*) has recently been recognized as a rich source of β-carotene. To add value to the fresh leaves a process to produce dried ivy gourd sheet as a health snack was the aim of this study. The effects of pretreatment, i.e., blanching in NaCl solution (0–3% w/v), and drying methods, i.e., hot air drying and vacuum drying at 60–80 °C, on the drying characteristics and quality, viz. colour, texture and β-carotene content of dried ivy gourd sheet were investigated. The results showed that dried sheet pretreated by brine blanching and vacuum drying resulted in better retention of colour and β-carotene as well as texture of the dried sheet as compared to the dried untreated and dried water blanched samples. Higher drying temperature also resulted in higher β-carotene retention due to shorter drying time.

Keywords: β-Carotene; Blanching; Hot air drying; Pretreatment; Sodium chloride; Vacuum drying

1. Introduction

Ivy gourd (*Coccinia grandis*) is a tropical plant in the pumpkin family and is grown widely in Thailand (Sinchaipanit et al., 2000; Sungpuag et al., 1999). The plant is inexpensive and widely available all year round, especially during rainy season (Sinchaipanit et al., 2000). Ivy gourd has been recognized as a rich source of β-carotene, a major vitamin A precursor (Sinchaipanit et al., 2000; Sungpuag et al., 1999). It is also considered as a good source of iron, vitamin C, protein and fiber (Suresh-Babu and Rajan, 2001).

To extend the shelf life and add value to fresh vegetables, new products may be developed through a drying process. There is a wide range of dried vegetable products such as dried whole vegetable leaves (Negi and Roy, 2000; Sinchaipanit et al., 2000) and sliced vegetable leaves (Sinchaipanit et al., 2000; Maharaj and Sankat, 1996). Dried vegetable sheet or vegetable leather has also been suggested as an alternative. The process of producing this latter type of products starts from grinding vegetable leaves to fine pieces; a thin sheet is then formed prior to drying. Many types of vegetables can be made into this type of products. For example, Dumrongratkul et al. (2005) produced vegetable leather using varying ratios of Chinese kale and ivy gourd leaves. Various texture modifying agents, e.g., agar, carrageenan and glycerin, at the concentrations of 0.5–1% w/w were added to improve the texture of the dried product. It was reported that the ratio between Chinese kale and ivy gourd leaves of 75:25 should be used to obtain the leather with the highest consumer acceptance. No significant differences were observed between the samples with and without texture modifying agents, however.

Since losses of nutritional quality normally occur during hot air drying, vacuum drying has been suggested as an alternative for drying heat-sensitive food materials. Compared with conventional hot air drying, vacuum drying provides higher drying rate, lower drying temperature and oxygen deficient environment (Wu et al., 2007). Therefore, colour, texture and bioactive compounds are better retained (Alibas, 2009).

The quality of dried food products may also be improved by the use of various pretreatment methods. Blanching is one of the most common pretreatment methods, which can help preserve or improve the quality of food products in such terms as colour retention and texture modification. Blanching in hot water or in various chemical solutions, e.g., sodium chloride (Dutta et al., 2006; Severini et al., 2003; Negi and Roy, 2000), calcium chloride (Severini et al., 2003), magnesium carbonate (Maharaj and Sankat, 1996), has indeed been used widely for fruits and vegetables. Sodium chloride is of special interest as it is an oxidizing agent, hence its ability to inhibit browning reaction.

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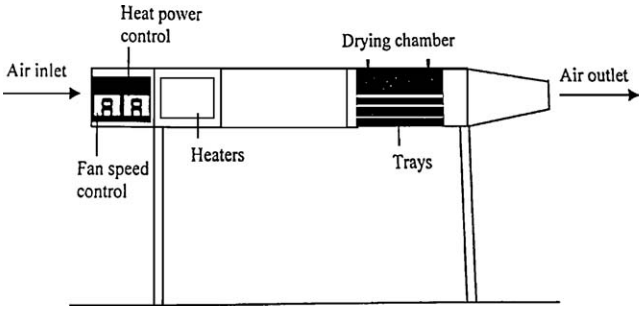

Fig. 1 – A schematic diagram of hot air dryer and associated units.

Table 1 – Moisture content of ivy gourd leaves after pretreatment.

Pretreatment method	Moisture content (kg/kg d.b.)
Control (fresh leaves)	10.53 ± 0.12^{b}
Blanching in hot water	14.57 ± 0.13^{a}
Blanching in 1% NaCl	11.08 ± 0.21^{b}
Blanching in 2% NaCl	11.71 ± 0.66^{b}
Blanching in 3% NaCl	9.67 ± 0.71^{c}

Different letters indicate that the values are significantly different ($p < 0.05$).

The production of dried ivy gourd sheet as a health snack was developed in this study. The effects of pretreatment, i.e., blanching in NaCl solution (0–3% w/v); and drying methods, i.e., hot air drying and vacuum drying at 60–80 °C on the drying kinetics and quality of dried ivy gourd sheet were evaluated. The quality of the dried product was determined in terms of the colour, texture as well as β-carotene content.

2. Materials and methods

2.1. *Sample preparation*

Fresh ivy gourd was obtained from a local market; only the leaves were used for the experiments. After washing with tap water 100 g of fresh leaves were blanched either in 2 L of hot water or NaCl solution (1–3% w/v) at 100 ± 2 °C for 1 min. The blanching time was predetermined in preliminary experiments as the time that could inactivate both polyphenoloxidase (PPO) and peroxidase (POD) in the leaves. The blanched leaves were then immediately cooled in cold water (4 °C) for 5 min; excess water was removed by placing the blanched leaves on a screen for 5 min. The leaves were then mixed with distilled water at a ratio of 1:1 before being blended in a blender (Waring model 32BL80, Torrington, CT) at high speed (18,000 rpm) for 1 min. After that 50 g of the slurry was poured onto a drying tray (15 cm × 10.5 cm) layered with a Teflon sheet. The initial sheet thickness was set at around 3 mm to obtain the sheet thickness of approximately 0.2 ± 0.1 mm after drying. The final thickness of dried sheet was selected based on a typical thickness of a dried nori thin sheet (Ogawa et al., 1991). Two trays were prepared for each experiment.

2.2. *Drying experiments*

Hot air dryer experiments were conducted in a typical hot air tray dryer schematically shown in Fig. 1. The dryer consists of a stainless steel drying chamber, which is connected to an electric heater which was controlled by a PID temperature controller. A small sample was collected at every 30 min interval for moisture content determination using a gravimetric method at 105 °C (AOAC, 2000). The water activity was also determined using a water activity meter (Novasina Model TH2/RTD33, Zurich, Switzerland). Drying experiments were conducted at 60, 70 and 80 °C.

Fig. 2 shows the vacuum drying system used in this study. The dryer consists of a stainless steel drying chamber with inner dimensions of 45 cm × 45 cm × 45 cm and a liquid ring vacuum pump (Nash, model ET32030, Trumbull, CT), which was used to maintain the vacuum in the drying chamber (fixed at 7 kPa in this study). An electric heater, rated at 1.5 kW, which was controlled by a PID controller (Omron, model E5CN, Tokyo, Japan) was installed in the drying chamber to control the temperature. Two variable-speed electric fans were used to disperse heat throughout the drying chamber. The sample holder was made of a stainless steel screen with dimensions of 16.5 cm × 16.5 cm. The change of the mass of the sample was detected continuously (at

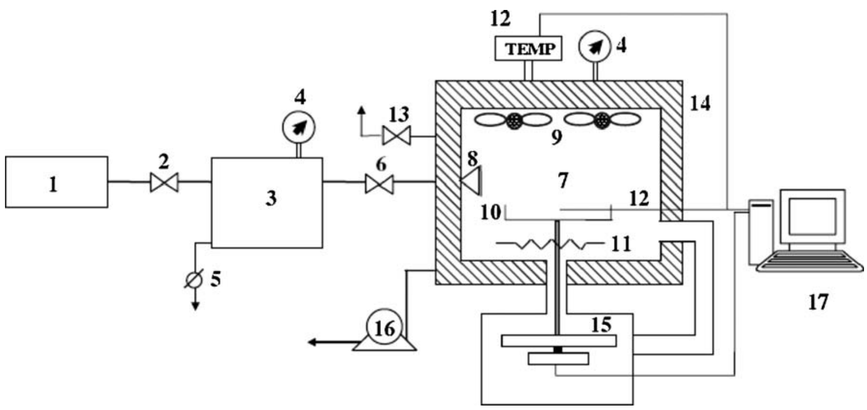

Fig. 2 – A schematic diagram of vacuum/low pressure superheated steam dryer and associated units. 1, boiler; 2, steam valve; 3, steam reservoir; 4, pressure gauge; 5, steam trap; 6, steam regulator; 7, drying chamber; 8, steam inlet and distributor; 9, electric fans; 10, sample holder; 11, electric heater; 12, on-line temperature sensor and logger; 13, vacuum safety valve; 14, insulator; 15, on-line weight indicator and logger; 16, vacuum pump; 17, PC with installed data acquisition card