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Different Parameters for Drying of Winter Melon (*Benincasa hispida)*

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Abstract

Winter melon (*Benincasa hispida)* was known as winter melon belongs to a family of *Cucurbitaceae*. It's a widely consumed crop in Vietnam and believed to impart special benefits to human health. In order to accelerate its valuable characteristics, we investigated an optimization of different parameters for processing of dried Benincasa hispida slices. We penetrated on the investigation of maturity of Benincasa hispida fruit, soaking time with $CaCl_2$, blanching time and temperature, sugar concentration and time o soaking, drying temperature to the dried *Benincasa hispida* slice quality. We also monitored product shelf-life during preservation. Our result showed that 10 mm in depth of Benincasa hispida slice, deep soaking in $CaCl_2$ 0.2% in 30 minutes; blanching at 95^{o}C in 30 seconds; drying at 40 ^{o}C to get 8% moisture content in the dried *Benincasa hispida* slice. Shelf-life of this product could be extended to 6 months without deterioration in PA bag.

Keywords: *Benincasa hispida, blanching, soaking, drying, shelf-life*

1. INTRODUCTION

Benincasa hispida, which is commonly called ash gourd, winter melon, winter gourd, wax gourd etc. belongs to the family Cucurbitaceae. It is a popular vegetable crop both for nutritional and medicinal purposes (Nimbal SK et al., 2011; Zaini Nam et al., 2011). The nutritional value of winter melon is what makes it so important for human health, as the high concentration of vitamin C and vitamin B2can have a wide variety of effects on the body. This is in addition to high levels of dietary fiber, zinc, iron, phosphorous, potassium and assorted other vitamins and minerals in smaller amounts. The plant was used medicinally in various complaints like gastrointestinal problems, respiratory diseases, heart diseases, diabetes mellitus and urinary diseases (Rajalakshmi C, 2018). Fruits were traditionally used as a laxative, diuretic, tonic, aphrodisiac, cardiotonic, urinary calculi, blood disease, insanity, epilepsy, schizophrenia and other psychologic disorders, jaundice, dyspepsia, fever, and menstrual disorders (Jayasree T et al., 2011). The major constituents of *Benincasa hispida* fruits are volatile oils , flavonoids, glycosides, sacchrides, proteins, carotenes, vitamins, minerals, ß-sitosterin and uronic acid (Wu CM et al., 1987; Yoshizumi S et al., 1998; Rana S and Suttee A, 2012; Chidan Kumar CS et al., 2012). *B. hispida* seeds are potential source of natural antioxidant compounds to replace synthetic antioxidants (Mandana, B. et al., 2012). Winter melon oil can be used as a diluent with other edible oils to enhance their essential fatty acid content i.e. linoleic acid and make its potential food uses for health benefits (Rayees, B. et al., 2013). People use the melons in stir fry or usually combined with pork or pork/beef bones to make winter melon soup, often served in the scooped out melon, carved by scraping off the waxy coating. It has also been used as the base filling in moon cakes for the Moon Festival (Marr *et al*., 2007). It can be used as a pastry. It is also an ingredient in some savory soups (sabaw) and stir-fries (guisado) (Zaini *et al.,* 2011). The matured ash gourd fruit and seeds are used to prepare a dehydrated product. *Benincasa hispida* fruit is cut into pieces then boiled with water or coconut and salt and usually eaten as breakfast or dinner.

The commercial utilization of this fruit is hindered by the lack of adequate processing techniques. The objectives of our research were to optimize various parameters for processing of dried *Benincasa hispida* slices. We focused on the investigation of $CaCl_2$ concentration in soaking, blanching time and temperature, drying temperature to the dried *Benincasa hispida* slice quality. We also monitored product shelf-life during preservation.

2. MATERIAL & METHOD

2.1 Material

Figure 1. *Benincasa hispida*

We cultivated *Benincasa hispida* from Soc Trang province, Vietnam. *Benincasa hispida* should be cultivated following Vietnamese Good Agriculture Practices (VietGAP) to ensure food safety. After harvesting, they must be stored and conveyed to laboratory within 4 hours for experiments. Besides *Benincasa hispida* fruit, we also used other materials such $CaCl_2$. Lab utensils and equipments included pH meter, weight balance, thermometer, refractometer, cooker, drying oven.

2.2 Research method

2.2.1 Effectiness of primary treatment time with $CaCl_2$

The sliced Benincasa hispida pulp (sliced in 10mm) must be deep soaked in different $CaCl_2$ concentration (0.05%, 0.1%, 0.15%, 0.20%, 0.25%). Then the sliced Benincasa hispida would be dried at 55^{o}C to 8% of moisture content.

Optimal parameter was selected owing to the values of total flavonoid (mg QE/g), vitamin C (mg/100g) and sensory score of dried *Benincasa hispida*.

2.2.2 Effectiveness of blanching time and temperature

Four levels of blanching temperature (^oC) namely (i) 85^oC in 60 seconds (ii) 90^oC in 45 seconds (iii) 95^oC in 30 seconds (iv) 100^oC in 15 seconds were carried out. During blanching, all samples were treated with $CaCl_2$ 0.20%. The best blanching temperature and time was selected based on the values of total flavonoid (mg QE/g), Vitamin C (mg/100g), sensory score of dried *Benincasa hispida*.

2.2.3 Effectiness of drying temperature

Five different levels of drying temperature (35^oC, 40^oC, 45^oC, 50^oC, 55^oC) were carried out. Before drying, all samples were treated with $CaCl_2$ 0.20% and blanched at 95^oC in 30 seconds. The best drying temperature was selected based on the values of total flavonoid (mg QE/g), Vitamin C (mg/100g), sensory score of dried *Benincasa hispida*.

2.2.4 Observation the shelf-life of finished products

The dried *Benincasa hispida* slice must be monitored the changes of a_w, color (avalue) and moisture (%) in finished product by time (0, 2, 4, 6 months) in PA bag to evaluate the product shelf-life.

2.3 Physico-chemical and statistical analysis

Total flavonoids (mg QE/g) content was determined by colorimetric method (Kim, D. O. et al., 2003). Ascorbic acid content **(**mg/100g**)** was measured by 2,6-dichlorophenolindophenol titration. Sensory score was based on 9-point hedonic scale. Water actitity (a_w) was measured was measured by a water activity meter. Color (a_{value}) was measured by colorimeter. Moisture content (%) was determined by comparing the weights of the sample with the electronic balance.

2.4 Statistical analysis

Data were statistically summarized by Statgraphics.

3. RESULT & DISCUSSION

3.1 Effectiveness of primary treatment time with $CaCl_2$ to sensory characteristics of dried *Benincasa hispida* slices

$CaCl_2$ treatments strongly affected to sensory characteristics of *Benincasa hispida* fruit, especially color and firmness. By 30 minutes of treatment with $CaCl_2$ 0.2%, we would get the optimal sensory score of *Benincasa hispida* (see table 1) so we decided to choose this value for next experiments.

Table 1. Effectiveness of treatment time with $CaCl_2$ in different concentration to total flavonoid (mg QE/g), vitamin C (mg/100g) and sensory score of the dried *Benincasa hispida*

$CaCl_2$ concentration (%)	Total flavonoid (mg QE/g)	Vitamin C (mg/100g)	Sensory score
0.05	2.78±0.02^b	9.45±0.01^b	5.22±0.03^c
0.10	2.94±0.02^{ab}	9.57±0.02^{ab}	6.13±0.00^{bc}
0.15	3.01±0.03^{ab}	9.63±0.01^{ab}	7.04±0.02^b
0.20	**3.11±0.01^a**	**9.71±0.01^a**	**8.15±0.02^a**
0.25	3.13±0.02^a	9.73±0.00^a	7.16±0.01^{ab}

Note: the values were expressed as the mean of three repetitions; the same characters (denoted above), the difference between them was not significant (α = 5%).

Table 2. Effect of blanching and time to total flavonoid (mg QE/g), vitamin C (mg/100g) and sensory score of the dried *Benincasa hispida*

Blanching	Total flavonoid (mg QE/g)	Vitamin C (mg/100g)	Sensory score
100^{o}C, 15 seconds	3.11±0.01^{ab}	9.71±0.01^{ab}	8.15±0.02^{ab}
95^{o}C, 30 seconds	3.19±0.00^a	9.85±0.02^a	8.47±0.01^a
90^{o}C, 45 seconds	3.01±0.01^b	9.63±0.00^{ab}	8.01±0.00^b
85^{o}C, 60 seconds	2.88±0.03^c	9.57±0.03^b	7.40±0.01^c

Note: the values were expressed as the mean of three repetitions; the same characters (denoted above), the difference between them was not significant (α = 5%).

Table 3. Effectiveness of drying temperature to total flavonoid (mg QE/g), vitamin C (mg/100g) and sensory score of the dried *Benincasa hispida*

Drying temperature (^{o}C)	Total flavonoid (mg QE/g)	Vitamin C (mg/100g)	Sensory score
35	3.40±0.02^a	10.03±0.01^a	8.67±0.03^a
40	**3.38±0.00^a**	**10.03±0.02^a**	**8.65±0.00^a**
45	3.27±0.02^{ab}	9.99±0.03^{ab}	8.58±0.01^{ab}
50	3.23±0.03^{ab}	9.93±0.01^{ab}	8.52±0.02^{ab}
55	3.19±0.00^b	9.85±0.02^b	8.47±0.01^b

Note: the values were expressed as the mean of three repetitions; the same characters (denoted above), the difference between them was not significant (α = 5%).

Table 4. Physico-chemical and sensory characteristics of dried *Benincasa hispida* slice by preservation time

Preservation time (months)	Water activity (a_w)	Color (a value)	Moisture (%)
0	0.39±0.01^a	72.31±0.002^a	8.00±0.01^a
2	0.39±0.02^a	72.24±0.01^{ab}	8.00±0.00^a
4	0.39±0.02^a	72.20±0.03^{ab}	8.00±0.03^a
6	0.40±0.00^a	72.17±0.00^b	8.01±0.02^a

Note: the values were expressed as the mean of three repetitions; the same characters (denoted above), the difference between them was not significant (α = 5%).

3.2 Effectiveness of blanching time and temperature

Four levels of blanching temperature (^oC) namely (i) 85^oC in 60 seconds (ii) 90^oC in 45 seconds (iii) 95^oC in 30 seconds (iv) 100^oC in 15 seconds were carried out. During blanching, all samples were treated with $CaCl_2$ 0.20%. From table 2, the optimal blanching time and temperature should be 95^oC in 30 seconds.

3.3 Effectiveness of drying temperature

Drying is one of the oldest and easiest methods of food preservation known to man and ranges from open sun drying to industrial drying. It is a process that involves the removal of water from food products in order to avoid or to slow down food spoilage by microorganism and deteriorative enzymes. The sliced *Benincasa hispida* would be dried at different temperature (35^oC, 40^oC, 45^oC, 50^oC, 55^oC) to get down to 8% moisture content. The higher temperatre applied the shorter drying time noticed. In table 3, we clearly saw that drying at 40^oC was appropriated to get a good product appearance.

3.4 Shelf-life of finished product

Drying is used to remove water from foods so as to prevent or inhibit micro-organisms, preserve the food, reduce the weight and bulk of the food hence, facilitating for storage (Danso-Boating, 2013). The quality of dried foods is greatly influenced by the drying operation and is judged by the amount of physical, chemical and biochemical changes occurring during the drying process (Jokic *et al.,* 2009). We monitored the changes of a_w, color and moisture in finished product by time (0, 2, 4, 6 months) to evaluate the product shelf-life. After 6 months, we didn't see any change of water activity, color and moisture. However, we noticed a little bit of color change at the 6th month so we strongly believed our products could be intact within 6 months of preservation.

4. CONCLUSION

Winter melon (*Benincasa hispida*) is one of the most highly prized vegetables in certain parts of the world due to its nutritional value and impressive health benefits, which include its ability to reduce chronic disease, improve digestion, strengthen the immune system, protect the heart, boost vision, and increase energy levels, among others. Winter melon is a vegetable crop with high functional properties. We have successfully optimized some technical drying parameters for dried *Benincasa hispida* slices. By applying different treatment processes, we could preserve this product with high a product shelf-life.

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