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Different Processing Parameters for Drying of Sliced Dragon Pulp

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Abstract: Dragon fruit is a cactus fruits that originated from Central and Northern South America. Dragon fruit (*Hylocereus polyrhizus*) is widely cultivated in Malaysia, Thailand, Vietnam, Australia, Taiwan and some other parts of the world. Dragon fruit is primarily grown for the fresh market. The fruit also has good potential to be processed into many products, thus adding value. In order to diversify its value added products, we examined different processing parameters for drying of sliced dragon pulp. Our results showed that the dragon fruit at semi-ripen stage ideal for processing. Optimal parameters in production were as follows: pulp thickness in 5 mm, drying at 55°C with air circulation at 2.5 m/sec, dragon pulp soaked in additive solution of $NaHSO_3$ 0.2% +$CaCl_2$ 0.5%+Citric acid 0.3%. Our product quality could be maintained in 6 months. Our primary study will improve the added value of dragon fruit for Vietnamese farmers in exporting this fruit into the international market.

Key words: Dragon fruit, drying, thickness, circulation, pulp, additive

INTRODUCTION

Hylocereus species grow well under the tropical climates. Binh Thuan Province in the South-Central Region is the main and origin dragon fruit production area of Vietnam. Fruits will be ready for harvesting 30-35 days after successful pollination of flowering. Dragon fruit is modest in calories. It holds many health-benefting antioxidants, minerals, vitamins and fiber. These fibers can improve the digestive system which in turn will reduce the accumulation of dietary cholesterol in your system. The red pigments in the red flesh dragon fruit is rich in lycopene, flavanoid antioxidants and phytoalbumins which can help prevent the formation of cancerous cells. Hot air treatment is normally used for disinfestation of fresh fruit (Hoa *et al*., 2006). Extensive researches have been conducted to optimize the processing of wine (Nguyen, 2014), betacyanin (Naderi *et al*., 2012), jelly (Islam *et al*., 2012), yoghurt (Jayasinghe *et al*., 2015), juice (Suguna *et al*., 2011), pectin (Izalin *et al*., 2016; Rubaiyi *et al*., 2016) from dragon fruit. Dragon fruit can be considered as the natural food colorants not only healthy for human body but also is friendly for society and environment (Moshfeghi *et al*., 2013). In order to diversify its value added products, we examined different processing parameters for drying of sliced dragon pulp.

MATERIALS AND METHODS

We collected dragon fruits from Binh Thuan Provine, Vietnam. Our utensils were used for the examination including slice machine, basin, tray, PE bag, drying oven, air circulation tester, thermometer. Citric acid, calcium chlorua, sodium bisulfit were chemical additives for soaking the dragon pulp.

Determination of the ripen stage for harvesting: The ripen stage of dragon fruits are normallyy based on time from flower blooming. We studied three groups:

- M1: after 25 days from flower blooming
- M2: after 30 days from flower blooming
- M3: after 35 days from flower blooming

In each group, sliced dragon pulp sample was introduced into drying to determine which one was appropriated for harvesting.

Determination of thickness of the sliced dragon piece for drying: Our experiments based on the same dragon type, the same ripen stage and the same size. We studied three groups:

- M4: sliced thickness of dragon pulp in 3 mm for drying
- M5: sliced thickness of dragon pulp in 5 mm for drying
- M6: sliced thickness of dragon pulp in 7 mm for drying

Determination of drying temperature for the sliced dragon piece for drying: Our experiments based on the same dragon type, the same ripen stage and the same size. We studied four groups:

- C1: control (none drying)
- M7: drying the slice dragon pulp in 50°C
- M8: drying the slice dragon pulp in 55°C
- M9: drying the slice dragon pulp in 60°C

Determination of air circulation speed for drying: Our experiments based on the same dragon type, the same ripen stage, the same size, the same sliced thikness, the same drying temperature. We studied three groups:

- M10: drying the sliced dragon pulp in air circulation of 2.0 m/sec
- M11: drying the sliced dragon pulp in air circulation of 2.5 m/sec
- M12: drying the sliced dragon pulp in air circulation of 3.0 m/sec

Determination of additive soaking for dragon pulp before drying: Our experiments based on the same dragon type, the same ripen stage, the same size, the same sliced thikness, the same drying temperature and air circulation speed. We studied five groups:

- C2: control (none additive soaking).
- M13: Dragon pulp soaked in $NaHSO_3$ 0.1%, citric acid 0.3%, $CaCl_2$ 0.5%
- M14: dragon pulp soaked in $NaHSO_3$ 0.1%, citric acid 0.3%, $CaCl_2$ 0.7%
- M15: dragon pulp soaked in $NaHSO_3$ 0.2%, citric acid 0.3%, $CaCl_2$ 0.5%
- M16: dragon pulp soaked in $NaHSO_3$ 0.2%, citric acid 0.3% $CaCl_2$ 0.7%

Sampling method: We collected 500 g in each sample from 3-5 fruits randomly.

Analysis of physico-chemical characteristics: We verified different physico-chemical characteristics as follows: soluble dry matter by the refractometer, texture by penetrator, moisture by drying to unchanged weight, total acidity by titration.

Sensory analysis: Sensory acceptance was evaluated by consumer satisfaction in score range from 1-9 (Hedomic) for the product color and taste.

Statistical analysis: Data were statistically summarized by Statgraphics.

RESULTS AND DISCUSSION

Determination of the ripen stage for harvesting: From Table 1-4, we noticed that the dragon fruit in M2 (30 days after flower blooming) was suitable for further drying.

Determination of thickness of the sliced dragon piece for drying: Thickness of the sliced dragon piece must be appropriated for drying. Our results were depicted in Table 5 and 6. We clearly noticed that the sample treated in M5 (5 mm) having the best color and aroma. So, we selected this value for further studies.

Determination of drying temperature for the sliced dragon piece for drying: From above result, we found that drying at 50°C having the best result owing to the Maillard reaction occuring at the lowest level as well as the total acidity decreasing at the lowest amount and the soluble dry matter maintaining with the highest content. However, drying at 50°C showed the much more water moisture content comparing to sample treated at 55°C. In order to compare which one was suitable, we performed one more sensory evaluation by color and aroma. From Table 7, we defined the sample M8 (drying at 55°C) giving the best product appearance, so, we chosed this value for further studies.

Determination of air circulation speed for drying: Air circulation speed in drying was an important parameter to the product appearance as well as the vapor evaporation. From Table 8, we realized the sliced dragon piece drying at the air circulation in 2.5 m/sec was ideal for product quality and economic.

Determination of additive soaking for dragon pulp before drying: Additive soaking before drying was very important to maintain color and shelf life of finished product. We examined the sliced dragon piece by soaking in different solutions:

Table 1: Primary evaluation on the dragon fruit for harvesting

	Sensory				Physic				
						Color of peel		Color of pulp	
Samples	Color of peel (%)	Color of pulp	Flavor	Taste	Firmness (mm)	L	b	L	b
M1	10-20 pink	Slight red	Not fragrant	Acidic	3.20	27.0	6.55	68.78	18.11
M2	50-60 pink	Red	Fragrant	Slight sweet	2.87	29.64	9.13	63.22	18.24
M3	100 pink	Deep red	Alcoholic fragrant	Sweet	2.13	36.32	12.38	55.01	18.65

Table 2: Chemical content in the raw material of dragon pulp

	Formula		
Criteria	Sample M1	Sample M2	Sample M3
Soluble dry matter (^{0}Bx)	12.15	13.70	14.11
Total sugar (%)	10.69	13.14	13.69
Total acidity (%)	0.71	0.68	0.64
Moisture (%)	83.94	84.62	85.68

Table 3: Chemical content in the dried sample of dragon pulp (by dry content)

	Formula		
Criteria	Sample M1	Sample M2	Sample M3
Soluble dry matter (^{0}Bx)	82.22	86.15	91.03
Total sugar (%)	80.12	84.47	88.38
Total acidity (%)	1.96	1.84	1.75
Moisture (%)	8.07	6.66	6.68

Table 4: Sensory acceptance of the dried dragon pulp

Sample/Criteria	M1	M2	M3
Color	6.84^b	8.54^a	5.63^c
Aroma	7.62^a	7.58^a	8.01^a

$^{a-c}$Significant values

Table 5: Sensory evaluation of the sliced dragon piece in different thichness

Sample/criteria	M4	M5	M6
Color	6.18^b	7.67^a	5.45^b
Aroma	6.65^b	8.17^a	7.08^b

^{a,b}Significant values

Table 6: Chemical content in the sliced dried dragon piece in different temperatures

	Formula			
Criteria	DC1	M7	M8	M9
Soluble dry matter (^{0}Bx)	89.76	89.11	86.35	83.45
Total sugar (%)	86.27	86.05	84.29	81.78
Total acidity (%)	4.29	1.82	1.69	1.19
Moisture (%)	84.55	8.17	6.59	7.84

Table 7: Sensory evaluation of the sliced dragon piece in different drying temperature

	Formula		
Criteria	M7	M8	M9
Color	6.32^b	8.06^a	5.82^b
Aroma	7.69^a	7.82^a	7.61^a

^{a,b}Significant values

Table 8: Sensory evaluation of the sliced dragon piece in different drying air circulation speeds

	Formula		
Criteria	M10	M11	M12
Color	7.79^a	8.02^a	6.38^b
Aroma	7.68^a	7.82^a	7.53^a

^{a,b}Significant values

Table 9: Chemical content in the sliced dried dragon piece in different soaking solutions

	Formula				
Criteria	C2	M13	M14	M15	M16
Soluble dry matter (^{0}Bx)	86.39	73.11	77.32	69.44	72.17
Total sugar (%)	84.25	70.69	74.71	63.12	68.84
Total acidity (%)	1.81	1.82	2.32	2.31	2.35
Moisture (%)	6.58	11.82	11.49	9.38	11.37

Table 10: Color of the finished product after 3 months of preservation

Values	M13	M14	M15	M16
L	67.53	64.57	70.27	70.53
b	27.622	26.209	30.208	27.856

Table 11: Sensory evaluation of the sliced dragon piece in different soaking solutions after 6 months of preservation

	Formula				
Criteria	C2	M13	M14	M15	M16
Color	3.32^c	5.75^b	6.30^b	8.20^a	5.75^b
Aroma	3.09^c	5.52^b	6.08^b	7.43^a	5.73^b

$^{a-c}$Significants values

- Sodium bisulfie ($NaHSO_3$) 0.1, 0.2%
- Citric acid 0.3%
- Calcium clorua ($CaCl_2$) 0.5, 0.7%

The dragon pulp was primarily sliced in 4 mm thickness and soaked in these solutions in 20 min. After that, all these samples were dripped and dried at 55°C during 12 h. Then we analyzed the chemical contents Table 9. $NaHSO_3$ linked with the cacbonyl group of sugar to depress the Maillard reaction. Citric acid decreased PH value and slowed down the brown apprearance.

From Table 10, we noticed the sample M15 having the best apperance. From Table 11, the treated sample M15 gave us the best sensory value, so, we selected this soaking regime in application.

CONCLUSION

We successfully studied different parameters affecting to the drying of the dragon pulp. Owing the time limit, we recommend further researches focusing on microbial analysis, way of packing, raw material blanching, so that, the best product quality could be obtained.

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