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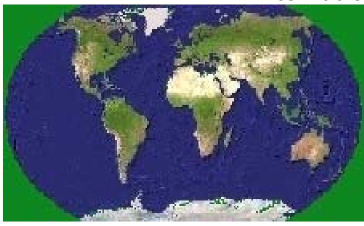

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Factors influencing to nipa *Nypa fruticans* endosperm in canned food production

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Abstract

Nypa fruticans (nypa palm) is found in the upstream estuarine zone forming extensive stands along brackish to tidal freshwater creeks and rivers. It is fast growing especially in fresh water. Total phenolics, flavonoid content, and antioxidant capacities present in endosperm of Nypa fruticans. We examine several factors possibly affecting to nipa *Nypa fruticans* endosperm in canned processing. Nipa is selected carefully before getting endosperm. To avoid the browning reaction, its endosperm should be rinsed thoroughly and blanched in $CaCl_2$ at different concentrations and times. Then it's arranged into can and poured by mixtures with different ratios (sugar-acid-pulp: water). Product is then pasteurized at different temperatures and times. Our results show that blanching nipa endosperm by $CaCl_2$ solution 0.3% in 1 minute can prevent the browning reaction as well as keep its firm structure. Mixing nipa endosperm with a compound including 18% soluble dry matter; 0.08% acid citric; ratio of pulp: water, 40%: 60% gives the best product sensory value. Pasteurization performed at 100 ^{0}C within 4 minutes will not affect to sensory value and product shelf-life.

Keywords: Nypa fruticans, endosperm, blanching, mixing, pasteurization, canned food.

1. Introduction

Nipa (*Nypa fruticans*) is a monoecious palm with special characteristics. Contrast to usual palms like coconut (*Cocos nucifera*) and oil palm (*Elaeis guineensis*), it thrives in river estuaries and brackish water environment in which salt and fresh water mingle. Nipa differs from most palms in the lack of an upright stem, trunkless and develops its inflorescence at a height of about 1m (Tamunaidu *et al.*, 2011) [7]. Nipa palms abundantly grow in Southeast Asia, especially in Mekong Delta - Vietnam.

The widespread occurrence of nipa palms made rural communities to grow these palms in agriculture fields for limited use. Sap (obtained from the inflorescence stalk) is used as a drink by the indigenous peoples, while young fruits are eaten (Tang *et al.*, 2010) [8]. The sap is a good source of sugar and used for making sweets, vinegar, beverage, and alcohol production (Hamilton & Murphy, 1988) [2]. The fruit is also rich in carbohydrates, fibers, minerals, and vitamin A (Osarbo *et al*., 2011) [4]. Traditionally, leaves, stems, and roots of *Nypa fruticans* are used to treat asthma, leprosy, tuberculosis, sore throat, liver disease, snake bite, as a pain reliever, and can also be used as sedative and carminative (Rahmatullah *et al.*, 2010; Bandaranayake *et al.*, 1998) [5, 1]. Recently, stem and leaf methanol extracts of *Nypa fruticans* have been shown to have antidiabetic and analgesic effect (Reza *et al.*, 2011) [6].

Actually, endosperm extract of unripe fruits (EEU) exhibited the highest phenolics (135.6 ± 4.5 mg GAE/g), flavonoid content (68.6 ± 3.1 RE/g), and antioxidant capacity. Free radical scavenging capacity of EEU as assessed by 2--azino-bis (3-ethylbenz-thiazoline-6-sulfonic acid (ABTS) and 1,1-diphenyl-2-picryl hydrazyl (DPPH) radicals showed inhibitory activity of 78 ± 1.2% and 85 ± 2.6%, respectively. Beta carotene bleaching coefficient of EEU was higher (2550±123), when compared to endosperm extract of ripe fruits (1792±172) (Nagendra Prasad *et al.*, 2013) [3].

Purpose of our research is to determine the appropriate ripen maturity; blanching time and $CaCl_2$ concentration; ratio of mixing solution; pasteurization temperature and time which can affect to product quality and shelf-life of canned food quality.

2. Material & Method

2.1 Material

Whole bunch of unripe and ripe fruits of *Nypa fruticans* at three and six month's maturity, respectively, were collected in Tra Vinh, Soc Trang, and Bac Lieu province, Vietnam. The fruits were immediately transported to the laboratory. Upon arrival, the fruits were washed under running tap water and air dried. The individual fruits were separated from the bunch and physical parameters of the fruits were measured. Later, the fruits were manually separated to obtain the edible endosperm. The endosperm was kept in an refrigerator maintained at 4°C.

Fig 1: Endosperm of nipa *Nypa fruticans*

2.2 Research method

2.2.1 Experiment #1: Effect of nipa ripen maturity to product quality

Nipa fruits are chopped to collect endosperm. They are then washed, size-formed and blanched in $CaCl_2$. They are arranged into can, mixed with solution, sealed and pasteurized. Experiment is randomly designed with 1 factor, Factor A: ripen maturity as follows A_1: Soft; A_2: Medium; A_3: Hard. Total numbers of testing are 3. Testing analysis includes firmness and sensory evaluation.

2.2.2 Experiment #2: Effect of $CaCl_2$ concentration and blanching time to product structure

Nipa endosperm at ripen maturity as defined in experiment #1 will be blanched in $CaCl_2$ with various concentrations and times. They are arranged into can, mixed with solution, sealed and pasteurized. Experiment is randomly designed with 2 factors. Factor B: $CaCl_2$ concentration with B_1: 0.1%; B_2: 0.3%; B_3:0.5%. Factor C: blanching time: C_1: 1 minutes; C_2: 2 minutes; C_3: 3 minutes. Total numbers of testing are 9. Testing analysis includes firmness and sensory evaluation.

Table 1: Effect of blanching time and $CaCl_2$ to product structure

	$CaCl_2$ concentration, %		
Blanching time, minutes	**B_1**	**B_2**	**B_3**
C1	C1B1	C1B2	C1B3
C_2	C_2B_1	C_2B_2	C_2B_3
C_3	C_3B_1	C_3B_2	C_3B_3

2.2.3 Experiment #3: Effect of mixing ratio to product sensory value

Nipa endosperm at ripen maturity as defined in experiment #1 will be blanched in $CaCl_2$ concentration and time as defined in experiment #2. They are arranged into can, mixed with different ratios of solution (sugar, citric acid, pulp: water). Finaly they are sealed and pasteurized. Experiment is randomly designed with 3 factors: Factor D: sugar concentration (%): D_1: 16%; D_2: 18%; D_3: 20%. Factor E: citric acid (%): E_1: 0.04%; E_2: 0.08%; E_3: 0.12%. Factor H: ratio of pulp: water: H_1: 40:60; H_2: 50:50

Total numbers of testing are 2*3*3=18. Testing analysis includes product firmness and pH.

Table 2: Effect of different mixing ratios

Ratio of pulp: water	**Citric acid (%)**	**Sugar concentration (%)**		
		D_1	**D_2**	**D_3**
H_1	E_1	$E_1D_1H_1$	$E_1D_2H_1$	$E_1D_3H_1$
	E_2	$E_2D_1H_1$	$E_2D_2H_1$	$E_2D_3H_1$
	E_3	E3D1H1	E3D2H1	E3D3H1
H_2	E_1	$E_1D_1H_2$	$E_1D_2H_2$	$E_1D_3H_2$
	E_2	$E_2D_1H_2$	$E_2D_2H_2$	$E_2D_3H_2$
	E_3	$E_3D_1H_2$	$E_3D_2H_2$	$E_3D_3H_2$

2.2.4 Experiment #4: Effect of pasteurization temperature and time to product quality and shelf-life

Nipa endosperm at ripen maturity as defined in experiment #1 will be blanched in $CaCl_2$ concentration and time as defined in experiment #2. They are arranged into can, mixed with ratio of solution as defined in experiment #3. Finaly they are sealed and pasteurized at different temperatures and times. Experiment is randomly designed with 2 factors. Factor F: pasteurization temperature: F_1: 90 ºC; F_2: 95 ºC; F_3: 100 ºC. Factor G: Keeping pasteurization time: G_1: 2 minutes; G_2: 4 minutes; G_3: 6 minutes. Total numbers of testing are 3*3=9. Testing analysis includes product color, aroma, and firmness. Monitor the sugar content, acidity, pH of product to determine product shelf-life, F-value.

Table 3: Effect of pasteurization

Temperature (°C)	Keeping time (minutes)		
	G_1	G_2	G_3
F_1	F_1G_1	F_1G_2	F_1G_3
F_2	F_2G_1	F_2G_2	F_2G_3
F_3	F_3G_1	F_3G_2	F_3G_3

2.3 Analytical method

Table 4: Analytical method

No	Criteria	Method
1	pH	pH meter
2	Acidity	Titration
3	Total sugar	Bertrand
4	Soluble dry matter	Refractometer
5	Firmness	Rheotex
6	Moistute	Dry to basic weight

Table 5: Sensory evaluation

No	Preference	Score
1	Like utmost	9
2	Very like	8
3	High like	7
4	So so like	6
5	Normal	5
6	Boring	4
7	Very boring	3
8	So so boring	2
9	Little boring	1

2.4 Statistical analysis

All data are processed by ANOVA (Startgraphics) to check the significant difference via LSD.

3. Result & Discussion

3.1 Effect of nipa ripen maturity to product sensory value

Table 6: Composition in nipa raw material

Ripen maturity	Soluble dry matter (%)	Total sugar (%)	Acidity (%)	Moisture (%)	Firmness (g/6.15mm2)
Soft (unripe)	3.6	7.9	0.017	94.00	180 – 263
Medium (ripe)	3.0	5.5	0.015	91.85	291 – 347
Hard (overripe)	2.6	4.3	0.009	85.00	549 – 668

Table 7: Effect of ripen maturity to product sensory value

Ripen maturity	Sensory score
Soft (unripe)	6.1a
Medium (ripe)	7.9b
Hard (overripe)	6.1a
	F=11.73; P=0.0004

From table 7, nipa at medium ripen maturity gives the highest sensory score so we choose this maturity to process canned food.

3.2 Effect of $CaCl_2$ concentration and blanching time to product firmness

Table 8: Effect of $CaCl_2$ concentration and blanching time to product firmness

Blanching time (minutes)	$CaCl_2$ concentration (%)	Firmness ($g/6.15mm^2$)	
1	0.1	203	– 206
	0.3	292	– 318
	0.5	332	– 343
2	0.1	236	– 251
	0.3	312	– 331
	0.5	349	– 413
3	0.1	243	- 278
	0.3	337	- 340
	0.5	352	- 431

From table 8, sample treated by $CaCl_2$ 0.5% - 2 minutes and 0.5% - 3 minutes has high firmness. Sample treated by $CaCl_2$ 0.1% at different interval 1 minute, 2 minutes, 3 minutes has soft firmness. Sample treated by $CaCl_2$ 0.3% at 1 minutes, 2 minutes, 3 minutes and 0.5% - 1 minutes has similar firmness but the sample treated by 0.3% - 1 minute is more economic so we choose 0.3% - 1 minute.

Table 9: Effect of $CaCl_2$ concentration and blanching time to sensory score

Blanching time (minutes)	$CaCl_2$ concentration (%)	Sensory score
1	0.1	6.0^a
	0.3	7.9^b
	0.5	5.6^a
2	0.1	6.3^a
	0.3	6.0^a
	0.5	5.8^a
3	0.1	5.6^a
	0.3	5.6^a
	0.5	6.0^a
	F = 4.54; P = 0.0002	

From table 9, the sensory score of sample treated with 0.3% $CaCl_2$ – 1 minute has the highest average score and statistically significant difference with other samples. So we choose treatment 0.3% $CaCl_2$ – 1 minute for further experiments.

3.3 Effect of the mixing ratio to product quality

Table 10: Effect of the mixing ratio to product quality

Pulp: water	Sugar concentration (%)	Acidity (%)	pH	Sensory score
40:60	16	0.04	4.3	5.9^a
	16	0.08	3.9	5.9^a
	16	0.12	3.6	5.9^a
	18	0.04	4.3	5.8^a
	18	0.08	4.0	7.9^b
	18	0.12	3.6	5.6^a
	20	0.04	4.3	6.1^a
	20	0.08	3.9	5.8^a
	20	0.12	3.5	5.8^a
50:50	16	0.04	4.4	6.4^a
	16	0.08	4.0	5.7^a
	16	0.12	3.5	5.7^a
	18	0.04	4.4	5.8^a
	18	0.08	4.0	5.8^a
	18	0.12	3.7	5.6^a
	20	0.04	4.4	6.0^a
	20	0.08	4.0	5.9^a
	20	0.12	3.4	5.8^a
	F = 4.82; P = 0.0000			

From table 10, sample with ratio pulp:water 50:50 has the sensory score is lower than sample with ratio pulp:water 40:60 owing to high viscosity of high pulp ratio. Sugar concentration doesn't affect to pH of sample, only affect to sensory. At 18% sugar, product has the best feeling. Acidity 0.08% is suitable. So we choose mixing compound with 40% pulp, 18% sugar, acidity 0.08% for further experiments.

3.4 Effect of pasteurization to product quality and shelf-life

Table 11: F-value of pasteurization, minutes

Pasteurization temperature (^oC)	Keeping time (minutes)		
	2	**4**	**6**
90	0.4	0.5	0.6
95	0.8	1.2	1.6
100	2.8	3.9	4.9

At F_o = 3 minutes, we get the safe product, so we can choose the pasteurization 100^{o}C in 4 minutes or 6 minutes.

Table 12: Effect of temperature and time of pasteurization to product structure

Pasteurization		Product firmness (g/ 6.15mm^2)
Temperature (^{0}C)	Time (minutes)	
90	2	419 – 423
	4	396 – 412
	6	294 – 316
95	2	399 – 415
	4	380 – 391
	6	286 – 310
100	2	381 – 394
	4	295 – 329
	6	256 – 275

The higher temperature and longer time of pasteurization, product structure will be decreased also and vice versa.

Table 13: Effect of temperature and time of pasteurization to product sensory value

Pasteurization		Sensory score		
Temperature (^{0}C)	Time (minutes)	Color	Aroma	Structure
90	2	5.3^a	5.8^a	6.3^{ab}
	4	5.3^a	5.1^a	5.9^{ab}
	6	5.6^a	5.1^a	6.0^{ab}
95	2	5.5^a	5.4^a	6.0^{ab}
	4	6.3^a	5.1^a	5.4^{ab}
	6	5.6^a	4.8^a	5.8^{ab}
100	2	5.3^a	5.8^a	6.4^{bc}
	4	8.0^b	7.3^b	7.4^c
	6	6.0^a	4.8^a	5.3^a
F_{color} = 2.44		P = 0.0229		
F_{aroma} = 3.31		P = 0.0033		
$F_{structure}$ = 2.55		P = 0.0178		

Pasteurization at 100^{o}C in 4 minutes, product has the highest sensory score and statistically significant difference with other samples so we choose the pasteurization at 100^{o}C in 4 minutes for further experiments.

Table 14: Sugar fluctuation during preservation, %

Pasteurization		Preservation time, week				
Temperature (^{0}C)	Time (minutes)	0	1	2	3	4
90	2	24.0	18.8	18.1	18.1	18.1
	4	23.5	18.5	18.0	18.0	18.0
	6	23.3	18.6	18.0	18.0	18.0
95	2	23.8	18.5	18.2	18.2	18.2
	4	23.5	18.4	17.6	17.6	17.6
	6	23.2	18.2	18.0	18.0	18.0
100	2	23.8	18.4	18.0	18.0	18.0
	4	23.2	18.3	18.0	18.0	18.0
	6	23.0	18.1	18.1	18.1	18.1

From table 14, product still remains quality without damange or microorganism. However to choose the appropriate pasteurization, we must depend on F-value.

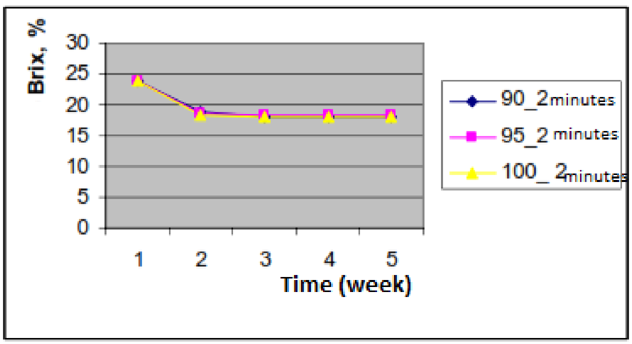

Fig 2: Change of Brix in preserved product by pasteurization at 90 ^{o}C, 95 ^{o}C, 100 ^{o}C in 2 minutes

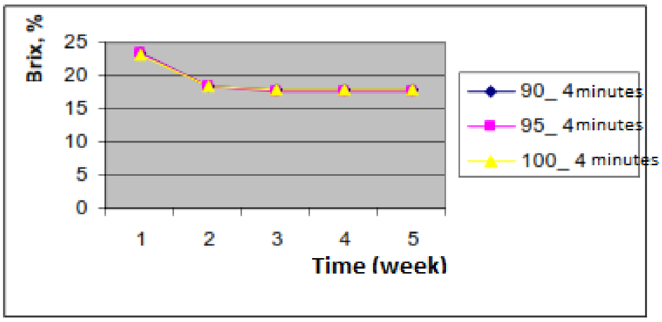

Fig 3: Change of Brix in preserved product by pasteurization at 90 °C, 95 °C, 100 °C in 4 minutes

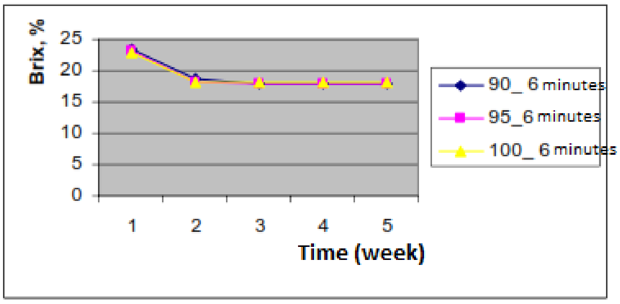

Fig 4: Change of Brix in preserved product by pasteurization at 90 °C, 95 °C, 100 °C in 6 minutes

From figure 2, 3, 4 we see the pasteurization at 100 °C in 4 minutes has the highest sensory score and statistically significant difference with other regime. So we choose pasteurization at 100 °C in 4 minutes for nipa canned food.

4. Conclusion

We have successfully investigated some technical factors capable of influencing to nipa canned food during processing. By this, we can maximizely preserve the nutritional composition in nipa endosperm. Creating the value-added nipa canned food is very vital to help lifting living condition for people in rural area in Mekong river delta, Vietnam.

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