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Process and Quality of Canned Baby Corn Juice

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ABSTRACT

The study on the process of canned baby corn juice and drink was carried out. Pulper and the screw and hydraulic press were used in the juice extraction processes. Results of organoleptic test, indicated that Thai tasters prefered diluted drink more than juice or more concentrated ones. The color, taste, odor, turbidity and nutritive values of the juice were more intense than those of the drink. Such characters of the products from the pulper were more intense than those of the products from the screw and hydraulic press. The minimum process times of canned baby corn juice and drink at 115.6°C were found to be 25 and 20 mins. respectively.

INTRODUCTION

Vegetables are generally recognized as the vitamin and mineral rich foods. In the old time, vegetable juice was prepared either with or without acidification and consumed as drink or incorporated in other foods such as soup. The commercial production of vegetable juice in Thailand was believed to start within the World War II, and canned tomato juice took the large proportion of all the vegetable juice produced. Nowaday, other kinds of vegetable juice for instance the juice from leafy and stem vegetables including letuce, celery, spinach, cabbage, etc. and other fermented vegetable juice are produced commercially and some are sold at the health food stores. (Nelson and Tressler, 1980; Tressler and Joslyn, 1954).

The use of baby corn as a kind of vegetable just start recently after the production of canned baby corn was succeeded and got rapid increase in the market demand. However, the quality of canned baby corn itself depends greatly on the wholesomeness in the size of the baby corn in can (TISI 43 - 2516, 1973; Trongpanich, 1986). The broken pieces or pieces with irregular in shape and size are considered as substandard and the sale price is much lower down. Thus most canned baby corn factories set their standards on the size of the baby corn purchased. The out of the demanded sizes are rejected and used as feed. Bhumiratana, *et al.* (1987) reported that in the normal condition only 70 - 80% of the dehulled baby corn from the farmers can be used for canning and in the dry season less than 70% can be used for the same purpose. Due to the processing practice in canning, unavoidable broken pieces of more than 10% to 20% of the purchased baby corn can be expected (Patthamayothin *et al.*, 1986). With the problems of high percentages not only in the amount of rejected baby corns from which may discourage the farmers from continual growing of this crop and consequently result in the shortage of raw material for

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baby corn canning but also in the amount of broken pieces which affect the unreasonable high production cost of the good quality canned baby corn being produced, the solution should be set by adding up the value of both the rejected baby corn and the broken pieces.

Therefore, the objective of this study was to utilize the broken pieces and those rejected corns, especially those of the too - small in size, as a raw material for producing canned baby corn juice. The qualities, nutritive values, consumer preference, acceptability and the thermal process characters of the product were determined. The advantages of the project are believed to increase the value of the broken pieces and those formerly rejected from the factories and create a new high nutritious vegetable juice for mankinds.

MATERIALS AND METHODS

1. Preparation of baby corn juice

The baby corn juice was prepared from the fresh baby corn purchased from the local market. The process steps were shown in Figure 1.

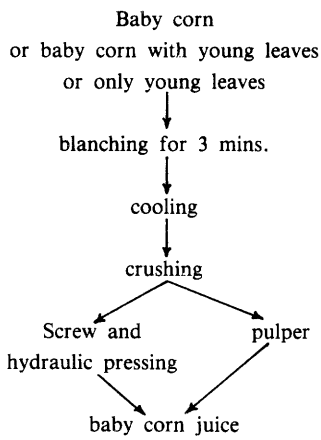

Figure 1. Steps in preparation of baby corn juice.

2. Formulation/dilution

For baby corn juice, the juice obtained was formulated by adding sugar and salt to make the product with the same degree of soluble solid as that of the fresh baby corn. Acidification of the juice with 0.05% citric acid was also made in order to examine the consumers' taste preference.

For baby corn drink, the juice was diluted into 75%, 50% and 25% concentrations. Then the drink was formulated by adding flavoring agents i.e. sugar and salt until the soluble solids were the same degree as that of the fresh baby corn.

Both juice and drink were hot filled in the no. 2 enamel cans and processed at 115.6°C for 25 and 20 mins. respectively.

3. Sensory evaluation

Juice samples used were chilled to about 5 - 10°C before serving.

3.1 Raw material preference test. The juice samples which were made from only baby corn, baby corn and the young leaves attached, and only young leaves were tested for preference. Twenty panelists scored the sample with 1 - 9 pointed hedonic scale, from which 1 point was the extreme dislike while 9 point was the extreme like. The quality including color, odor, taste, mouth feel and acceptability characters was evaluated.

3.2 Formulation preference test. Two baby corn juice samples, one of which was acidified with citric acid while another was not, were tasted for preference with 279 Thais.

3.3 Extraction and dilution tests.

3.3.1 No comparison between samples treatment. Two juice samples obtained from

two different extraction methods and six drink samples obtained from three different dilutions (25, 50 and 75%) made from the juice samples were sensory evaluated for quality such as color, odor, taste, mouthfeel and overall preference. The Balanced Incomplete Block Design of the first type (Uppraditskul, 1983) was used for the test. Eight glasses of samples, coded with different three random numbers, were randomly presented to each group of two tasters. The total of 14 tasters, who were familiar to the evaluation practice, made 7 replicates for the test. Tea spoons were also provided to stir the products. The tasters were asked to evaluate such the characteristics by using scores of the 9 - points hedonic scale (Peryam and Pilgrim, 1957) of which the score of 1 represented dislike very much and 9 represented like very much. A glass of water was provided for each taster to get rid of the aftertaste effect from each sample tasting.

3.3.2 With comparison between samples treatment. Six drink samples, obtained from two different extraction methods, each of which prepared into three different dilutions (25, 50 and 75%), were sensory evaluated with comparison for color, odor, taste and acceptability. Randomized Complete Block Design (RCB) (Uppraditskul, 1983) was used for the test. Six glasses of samples, coded with different three random numbers, were randomly presented to each taster. The total of 12 tasters, who were familiar to the evaluation practice, participated in the test. Tea spoons were also provided to stir the product. The tasters were asked to evaluate such the characteristics by using scores of the 7 points hedonic scale of which the scores of 1 represented dislike very mush, 4 represented can not tell whether like or dislike and 7 represented like very much. A glass of water was provided for each taster to get rid of the aftertaste effect from each sample tasting.

4. Thermal processing characters of the canned baby corn juice and drink

The initial temperatures of canned baby corn juice and drink during heating (T_{ih}) and cooling (T_{ic}) periods together with the rate of the heat penetration during heating (f_{ch}) and cooling (f_{cc}) and the integrated sterilizing values (IS values) were measured and evaluated.

A digital heat penetration measuring instrument (Ellab) was used for the heat penetration studies. The processed samples were microbial tested for safety by using the microbiological examination method for low - acid foods (Frazier and Westhoff, 1979; Speck, 1976 and Subcommittee on methods for the microbiological examination of foods, 1958.)

5. Determination of nutritive values

The juice and drink samples were analysed for protein, carbohydrate, fat, crude fiber, moisture, ash, vitamin and mineral contents by using AOAC, 1984 methods.

To indicate the turbidity of samples, the percentages of absorpbance of the juices and the drinks were measured by using spectrophotometer at the wavelength of 630 mm. The samples were filtered before measuring.

RESULTS AND DISCUSSION

Raw material preference test

The percentages of baby corn and young leaves in the purchased fresh samples from the local market and the percentages of the juices extracted by using screw and hydraulic press, the original soluble solids (°B) of the raw juices and the proximate analysed values of the raw juice samples were

shown in Table 1. The baby corn itself had more than 50% of the total weight of fresh purchased samples and contained higher percentages than the young leaves in the original total soluble solids (^{o}B), soluble protein and ash. The ^{o}B of both the baby corn and the young leaves were quite high and the sweet taste could be detected very easily. The fiber content was naturally higher in the young leaves than in the corn and the data obtained confirmed this fact.

The juice from young leaves had the dark green color, greeny odor and contained bitter taste, thus the product was rejected by all tasters. Therefore, only baby corn juice and the juice obtained from the mixture of baby corn and young leaves were tested for preference. The result shown in Table 2, indicated that, the average scores of all characters of the juice from only baby corn were higher than the average scores of the juice from baby corn and young leaves. The frequency of the giving score of higher than 6 points of the baby corn juice was also higher than the juice from the mixed raw materials. Thus we may conclude that the young baby corn leaves can not be used or mixed with baby corn for juice production due to its bitter taste, dark green color and the greeny odor.

Formulation preference test

From the public taste preference test, 67% of 279 Thai peoples preferred the acidified baby corn juice sample and the left over, 33%, of the tasters preferred non - acidified sample with the interested recommendation that the taste of acidified sample like the taste of spoiled corn juice. The two samples, were also tasted by 4 foreigners (2 Americans, one Danish and one French). All tasters liked the non - acidified sample.

However, the color of the acidified sample was better than that of the non - acidified one.

Table 1 The percentages of baby corn and its young leaves in the purchased samples and the characters of the raw juice extracted.

Types of raw materials	Portion in the purchased sample (%)	Juice extracted (%)	Original ^{o}B	Soluble protein (%)	Crude fiber (%)	Ash (%)	Moisture (%)
Baby corn	58 - 65	23.1 - 38.0	8 - 10	0.71	0.18	0.46	94.39
Young leaves	30 - 33.5	35.6 - 58.6	7 - 9	0.59	0.37	0.38	96.09
Baby corn and young leaves	98 - 98.5	35.2 - 42.1	-	-	-	-	-
Waste (Trimming out)	1.5 - 2	-	-	-	-	-	-

Table 2 The scores of the preference test of the juice samples from 20 panelists.

	Color		Odor		Taste		Texture		Acceptability	
	A*	B*	A*	B*	A*	B*	A*	B*	A*	B*
Average score	5.85	6.65	6.00	6.35	4.80	6.60	5.90	5.95	4.85	6.20
% of the judgement (score higher than 6)	60	90	60	85	40	58	60	65	30	75
The frequency of the scoring										
Score of 9	0	0	0	0	0	1	0	1	0	0
8	1	6	4	4	1	6	1	3	1	4
7	7	6	4	5	3	3	7	4	3	5
6	4	6	4	8	4	7	4	5	2	6
Lower than 6	8	2	8	3	12	3	8	7	14	5
Total numbers of the judges	20	20	20	20	20	20	20	20	20	20

A* = The juice sample from baby corn and young leaves

B* = The juice sample from baby corn

Extraction and dilution test

1. No comparison between samples treatment. The result of the preference test for the juices and drinks were shown in Table 3. The yellowish color of the juices got the highest preference and the scores of this character were decreased as the dilutions increased. The tasters seemed to prefer the clear juice and drink than the turbid ones as the scores of the juice and drink from pulper were mostly lower than the juice and drink from another extraction method. The turbidity of the juice and drinks can also be indicated by the infrared light absorbance (Figure 2), as the dilution increased the light absorbance decreased. The percentage of the light absorbance of juice and drink from pulper was higher than those of juice and drink from the screw and hydraulic press.

Table 3 The average sensory scores of color, odor, taste, mouthfeel and overall acceptability of baby corn juice and drink samples. (No comparison between samples)

Characters	Pulper				Screw & Hydraulic Press			
	Juice	Drink			Juice	Drink		
		75%	50%	25%		75%	50%	25%
Color	7.14	7.00	5.29	5.57	7.00	6.57	6.43	6.29
Odor	5.57	6.57	5.71	5.86	6.86	6.15	5.57	6.71
Taste	3.86	5.71	4.00	5.86	6.57	5.29	5.29	6.43
Mouthfeel	5.29	6.29	5.29	6.00	7.00	5.57	5.43	6.57
Overall acceptability	4.14	5.86	4.57	5.71	7.00	5.29	5.43	6.43

Note : 1 = Disilike very much
5 = Neither like nor dislike
9 = Like very much

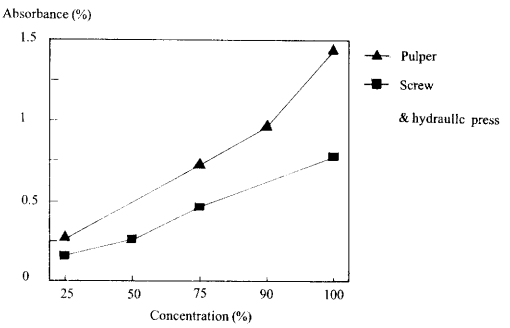

Figure 2. The percentage of Infrared Absorbance of juices and drinks from different extraction methods.

The statistical analysis of the organoleptic test was also done (Table 4). It was found that there was no statistical significant difference in color, odor and mouthfeel between samples ($P < 0.05$) but there was statistical significant difference at 0.05 in taste. With the analysis of varience of the factors affected the taste of the samples (Table 5), it was found that the extraction method, percentages of water used in extraction and the reaction between these two factors had statistical significant difference at 0.05. The average taste preference scores of the samples from pulper and the press were 4.86 and 5.90 respectively which indicated that the Thai tasters preferred the samples from the hydraulic press to the samples from the pulper.

2. With comparison between samples. The preference scores between drinks were shown in Table 6. *The tasters preferred the color of the more concentrated samples than the diluted ones,* which was very obvious in the samples from pulper. However, there was no significant difference between samples at $P < 0.05$ in color and odor while there were significant differences between samples in taste and acceptability. *Most Thai tasters preferred the clear and more diluted drink (25% both from pulper and the press and 50% from the press)* than the more turbid and concentrated juice, which differred from the westerners' taste.

Table 4 Analysis of variance of sensory scores for color, odor, taste and mouthfeel qualities.

Source of Variations	df	Mean Squares			
		Color	Odor	Taste	Mouthfeel
Adjusted treatment	7	2.03^{NS}	1.60^{NS}	7.23*	2.35^{NS}
Total					
Effective error	35	1.69	1.71	1.70	1.78

NS = Non significant difference

* = Significant difference at $P < 0.05$

Table 5 Analysis of variance of the factors affecting the taste of the samples.

Source of Variations	df	SS	MS
Extraction method (A)	1	17.90	17.90*
% Water used in extraction (B)	3	16.46	5.49*
A × B	3	16.29	5.43*
Effective error	35	43.75	1.70

* = Significant difference at $P < 0.05$

Table 6 The average sensory scores of color, odor, taste and acceptability of baby corn drink with comparison between samples. (RCB planning design)

Characters	Pulper (A)			Screw & Hydraulic Press (B)		
	75%	50%	25%	75%	50%	25%
Color	5.08^{NS}	4.75^{NS}	4.50^{NS}	5.08^{NS}	5.58^{NS}	4.33^{NS}
Odor	4.17^{NS}	4.17^{NS}	4.75^{NS}	4.58^{NS}	4.92^{NS}	4.58^{NS}
Taste	3.75ab	3.25b	4.83a	4.08ab	4.75a	5.00a
Acceptability	3.75ab	3.42b	4.75ab	4.75ab	4.92a	4.67ab

NS = Non significant difference at $P < 0.05$ within replications and treatments

Score of 1 = Dislike very much

4 = Neither like nor dislike

7 = Like very much

The numbers followed with similar letters were not significant difference $P < 0.05$

Thermal processing characters of the canned baby corn juices and drinks.

The heating and cooling characters of the baby corn juice and drink were shown in Table 7. The juice and the more concentrated drink need longer time for heat to penetrate to the slowest heating point in the can. This is the main factor for the processors to consider the process time of the juice and drink. However, the minimun process time of the samples was tested to be 25 min. for the juice and 20 min. for the drinks at 115°C with the IS value between 5.21 - 6.69.

Nutritive values

The results of proximate analysis and nutritive values of the baby corn juice and drink were shown in Table 8. Most nutritive values were decreased with the increase in dilutions. However, there were factors affected the nutritive value of the juice and drink. Those factors were variety of raw materials, type of containers used, chance for the metal and oxygen contamination and some other errors occur in the processing line.

CONCLUSION

The baby corn juice and drink were produced by using two extraction processes. The products from the pulper extraction contain more soluble substances than the products from the screw and hydraulic press which were confirmed with the percentages of light absorbance of these products.

Dilution was the main factor affecting the rate of heat transfer which results in the processed time of the canned products, character and quality of the juice and drink. However, most Thai tasters preferred the diluted drink than the juice itself which was quite different from the westerners.

It is possible to produce the baby corn juice and drink which has advantages in using up the waste from the whole baby corn canning and building up the new high nutritious juice and drink. However, more marketing study is needed.

Table 7 Heating and cooling characters of baby corn juice and drink samples at the retort temp. 115.6°C.

Treatment	Avg. T_{ih} (°C)	Avg. f_{ch} (min)	Avg. T_{ic} (°C)	Avg. f_{cc} (min)	IS values
100% B	72.4	4.2	115.8	7.1	
100% A	69.6	4.0	115.9	9.0	
75% B	70.8	3.2	116.1	7.5	
75% A	66.9	3.8	115.6	8.8	5.21 - 6.69
50% B	73.4	3.2	115.9	8.3	
50% A	67.6	3.5	115.8	7.8	
25% B	73.5	3.0	116.1	7.4	
25% A	75.1	3.3	115.7	7.5	

A = Pulper B = Screw + Hydraulic Press

Table 8 The proximate analysis and nutritive values of baby corn juice and drinks.

Treatment / Items	Pulper					Screw & Hydraulic Press			
	100%	90%	75%	50%	25%	100%	75%	50%	25%
Moisture, %	87.82	88.75	89.77	87.93	90.92	89.85	88.84	88.45	89.32
Protein, %	3.26	3.15	2.74	3.17	2.86	2.66	3.04	3.07	3.26
Fat, %	1.09	1.03	0.83	1.09	0.92	0.91	0.92	0.68	0.52
Crude fiber, %	1.44	1.52	1.04	1.46	1.69	0.68	1.21	1.87	1.52
Ash, %	0.51	0.44	0.40	0.39	0.26	0.52	0.50	0.61	0.44
Carbohydrate % (by difference)	5.87	5.10	5.22	5.96	3.35	5.39	5.49	5.31	4.93
Calcium, ppm*	-	4.75	-	2.25	2.50	4.75	2.50	2.75	2.25
Phosphorus, ppm*	-	11.50	-	6.00	0	16.50	7.00	5.00	0
Iron, ppm*	-	3.00	-	2.50	1.45	3.80	2.00	1.80	4.75
Vitamin C, ppm	-	-	-	0	-	21.0	-	-	-
Vitamin B_1, ppm	-	-	-	0.20	-	0.40	-	-	-
Vitamin B_2, ppm	-	-	-	0.40	-	0.60	-	-	-
Niacin, ppm	-	-	-	5.60	-	6.90	-	-	-

* Analysed by Division of Food Analysis, Dept. of Medical Science, Ministry of Public Health, Thailand.

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