Kasetsart J. (Nat. Sci.) 36 : 63 - 68 (2002)

A Comparative Study on Pretreatment Processes of Canned Whole Kernel Sweet Corn

Kulvadee Trongpanich, Siriporn Stonsoavapak, Doungchan Hengsawadi and Ngamjit Lowitoon

ABSTRACT

The effects of pretreatments on yield and qualities of canned whole kernel sweet corn were studied Average yield, drained weight, pH, total soluble solids, and the heating and cooling parameters were determined. The processed canned samples were analyzed for nutrients. It was found that non-blanching process showed more advantages than the process with blanching. The average of yield of the corn kernels, drained weight, total soluble solids, and the nutrient retention of the non-blanching process were higher than the process with blanching, while the weight of the waste residue was lower. However the blanching process has advantage in resulting higher initial temperature (It), shorter rate of heating (fh), rate of cooling (fc) and process lethality at the geometrical center of the can (Fc) from which may result in the shorter thermal process required for the product.
Key words: pretreatment process, canned whole kernel corn

INTRODUCTION

Sweet corn (*Zea mays saccharata L.*) is now becoming an important crop of Thailand. The average production yield per the cultivated area is increasing every year. There are two main markets of the fresh sweet corn, in Thailand, from the field. Seventy percent of the total crop goes to local markets for fresh consumption, while the other 30% is used as the raw material in canning industries. The important exported corn products are canned whole kernel sweet corn and frozen sweet corn. In 1997, the exported volume of sweet corn products was 19, 283 tons with the value 488.9 million baht. In 1996, Thailand was the sixth canned sweet corn exporting country of the world and had a share in the market at 3.6% of the world volume. However, the expanded volumes of Thai sweet corn products during 1991-1996 were about 7.8-13.4% annually. In 1998, there were 16 sweet corn canning factories in 11 provinces in Thailand, from which built up the demand for fresh sweet corn of 185,251 tons/year. Factories in Kancha-naburi were the major group which used sweet corn up to about 80,000 tons/year or about 43.2% of the country's total demand for fresh sweet corn as raw material (Suriyo *et al*., 1999).

Since canned sweet corn is one of the important canned vegetables, it is included in the proposed Draft Codex Standard for Certain Canned Vegetable 2002 which was prepared by France and Thailand. In the draft standard of step 3, scope, description, essential composition and quality factors, food additives, contaminants, hygiene, labelling, weight and measures, and analysis and sampling methods of the products were established

Institute of Food Research and Product Development, Kasetsart University, Bangkok 10900, Thailand.

(FAO/WHO/CODEX 2002). Nowaday most consumers are interested in reading the nutrition labelling of canned foods. From randomization, about 58% of consumers read nutrition labelling on canned foods before deciding to buy (Shine *et al*., 1997). Although , there are no present mandatory nutrition labelling requirements for food in the Southeast Asian region, except for special catogories of foods and when nutrition claims are made. There is, however, increasing interest among authorities in the region in formulating regulations for nutrition labelling for a wider variety of foods (E-Siong-Lee, 2,000). The consumer requirement for nutrition labelling may increase more later on, depending on consumers' education and well being. In order to upgrade the canned products' quality, improvement of the canning process is necessary.

Nowaday, there are two different pretreatment processes in canning of whole kernel sweet corn in Thailand. These processes are no blanching and blanching of whole kernal sweet corn before canning (Figure 1). Although each pretreatment process is set to suit the available machines in the factories, the advantages and disadvantages of the processes are not certainly known.

Thus, the purpose of this study is to find out the advantages and disadvantages of the pretreatments, in order that canning processors can decide to manage their canning line of canned whole kernal sweet corn for better quality canned products.

MATERIALS AND METHODS

1. Materials

1.1 Fresh sweet corns (Insee 1) from the National Corn and Sorghum Research Center, Kasetsart University, Pakchong, Nakhon Ratchasima, Thailand.

1.2 Tap water for preparing the packing medium, blanching and cooling.

1.3 Lacquer coated metal cans, number 2 A (307 × 409).

1.4 Four different brands of commercial canned whole kernel corns were sampled from the west, central, north-east and north of Thailand for microbiological and nutrients analysis.

2. Methods

2.1 Fresh corns were husked, divided and separately followed the processes of canned whole kernel sweet corn as indicated in Figure 1. The blanching time was 5 minutes, filled weight of corn was 350 gm/can and packing medium was boiling water. The filled cans were 5 minutes exhausted in a steam exhaust box and the thermal process was 20 minutes at 121.1°C in a small vertical retort (Taylor).

2.2 Samples were also heated with

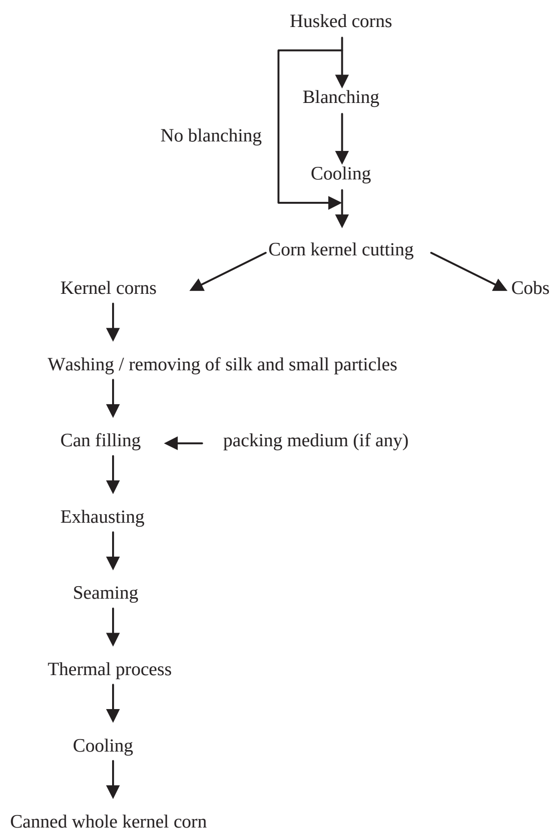

Figure 1 The process chart of canned whole kernel sweet corn with blanching and no blanching.

thermocouples inserted at the geometrical center of the cans for heat penetration studies. These samples were also exhausted, lid closed and processed at 121.1°C Can temperatures were recorded every minute until the cooling process finished. The data obtained were used to plot heating and cooling curves on 3-cycle logarithmic papers. The rate of heating (fh) and cooling (fc), initial temperature (IT) and the process lethality at the geometrical center (Fc) of the cans were obtained.

2.3 The canned samples from 2.1 and the commercial samples were examined for the presence of microbiology by the use of total plate count,and for mesophilic aerobic sporefor-mers,thermophilic flat sour sporeformers, mesophilic anaerobes, thermophilic anaerobes and sulfide spoilage (Kautter *et al.*, 1992)

2.4 For physical examination, 2-week stored canned samples were determined for net weight and drained weight (drained on a sieve with the openings 2.8 mm × 2.8 mm. for 5 mins). The canned net content was blended in an electric blender for 3 mins., and determined for pH (Orion pH-meter) and brix (Atago hand refractometer). Enough samples were sent to IQA-Norwest Labs for analysis of nutrients, in percentages. The analysis methods were as follows:-

Calories and Calories from fat (by Calculation)
Total Fat (AOAC 2002, 922.06)
Saturated Fat (AOAC 2000, 963.22)
Cholesterol (J AOAC, 1993)
Sodium (AOAC (2000), 968.08)
Total Carbohydrate (by Calculation)
Dietary Fiber (AOAC (2000), 985.29)
Total Sugar (JAOAC, 1992)
Protein (N×6.25) (AOAC (2000), 981.10, and Tecator Application Note)
Vitamin A (In-house method based on Liquid Chromatography and Analysis of Food and Beverages, Vol.2)
Vitamin C (JAOAC, 1992)
Calcium (AOAC (2000), 968.08)
Iron (AOAC (2000), 968.08)
Ash (AOAC (2000), 942.05)
Moisture (AOAC (2000), 950.46 B)

2.5 The canning experiments were done in duplicate. The data obtained was statistically analysed for significantly differences at $p<0.05$ by Analysis of Variance Program.

RESULTS AND DISCUSSION

From Table 1, we can compare the yields of the whole kernel corn from the different pretreatment processes. The blanching prior cutting process showed a little less in yield than the unblanching process, this might be due to the loss of some soluble solids during / after blanching the corns However, there was no significant difference ($p<0.05$). The weight of cobs passed blanching was heavier than that of non-pretreated process. This might be due to the water-absorbing of the substances, mostly celluloses, of the cobs during blanching and cooling. However, there was no significant difference ($p<0.05$). The heavier weight of the waste due to water absorbing rendered further

Table 1 The weight of the whole kernels and cobs after the different pretreatments (based on the weight of fresh raw material).

Treatment	% weight	
	Whole kernel	Cob
No blanching	60.20[a]	39.80[a]
Blanching	59.92[a]	45.79[a]

In a column, means with the same letter are not significantly different ($p<0.05$).

problem in the waste disposal with faster rate of decomposition, and consequently induced undesirable smell.

Table 2 showed the average drained weight, pH and °B of the canned samples. With the equal filling weight, the blanched cans showed smaller drained weight than the non-blanched one. This might be due to heating process which changed some insoluble substances such as pectic substance, starch, cellulose, etc., to soluble substances and streamed out to the surrounding liquid. The blanched sample passed more heat treatment and cooling so that more weight loss and total soluble solids (as °B) occured. Normally pH of the foodstuffs is lower than 7, due to the acidity of the food constituents. Loss of some food constituents, especially volatile acids, during blanching will raise the pH of the food toward neutral (Meyer, 1960)

Table 3 showed the thermal process parameters. The average initial temperature of the blanched canned samples were significantly higer than the unblanched one. This might be due to the heat from blanching was leftover. Even the blanched corn was cooled down, it may be difficult for the heat to transfer from the gelatinized starch in the inner part of the kernel. However, this is the advantage of the blanching treatment, because it caused the rate of heating (fh) and the process lethality (Fc) faster than the unblanching process. Blanching also has another advantage in reducing the number of microorganisms contaminated with the raw material, resulting in lower process-time needed than the unblanching process. After heating, most of constituents have changed, thus during cooling, the rate of cooling (fc) was slower than fh. The rate of cooling of the blanched treatment from which contained lower drained weight and lower soluble solids was significantly shorter than fc of

Table 2 The average of drained weight, pH and °B of the two pretreated canned whole kernel sweet corn samples.

Treatment	Average drained weight, %	Average pH	Average total soluble solids (°Brix)
No blanching	63.34	6.56	6.8
Blanching	62.74	6.91	6.0

Table 3 Some thermal process parameters of canned whole kernel sweet corn samples.

Treatment	Average IT,°C	RT, °C	Come-up time,(min)	Average fh (min)	Average fc (min)	Average Fc (min)
No blanching	84.6^a	121.1	5	5.3^a	22.3^a	7.80^a
Blanching	86.3^b	121.1	5	4.5^a	16.0^b	7.25^a

In a column, means with the same letter are not significantly different($p<0.05$).

Note IT = initial temperature of the canned samples
RT = retort temperature
Come-up time = the time required to reach retort temperature after the steam is turned on
fh = heating rate of the canned samples at the geometric center
fc = Cooling rate of the canned samples at the geometric center
Fc = Process lethality at the geometrical center of the cans

the unblanched treatment.

The microbiological examination of the canned samples which had processed for 20 mins. at 121.1°C was shown in Table 4. There was negative test on the microbial growth. All the commercial samples had also negative test.

Table 5 showed the range of nutrient content of the commercial canned samples and the average nutrient content of the prepared canned samples. There were factors affecting the difference in nutrients of the commercial samples,such as the corn's varieties, maturity, location of plantation, post harvest treatment, process pretreatment, strength of packing medium (which may be brine, syrup or water) etc. However, with the comparison between the non-blanched and the blanched prepared

Table 4 Microbiological examination of canned whole kernel sweet corn samples.

	Commercial samples	No blanching	Blanching
Total plate count (CFU/g)	none	none	none
Mesophilic aerobic sporeformers	negative	negative	negative
Thermophillc flat sour sporeformers	negative	negative	negative
Mesophilic anaerobes	negative	negative	negative
Thermophilic anaerobes	negative	negative	negative
Sulfide spoilage	negative	negative	negative

Table 5 The average nutrient content of the commercial canned samples and the prepared samples.

Nutrient	Commercial samples per 100 g	No blanching per 100 g	Blanching per 100 g
Calories, cals	77.1-95.8	74.23	74.25
Calories from fat, cals	10.26-20.2	16.38	14.33
Total fat, g	1.14-2.25	1.82	1.60
Saturated, fat, g	0.12-0.54	0.32	0.26
Cholesterol, mg	0	0	0
Sodium, mg	117-252	1.12	1.26
Total carbohydrate, g	14.36-17.99	11.67	12.21
Dietary fiber, g	2.96-4.12	3.11	3.15
Sugars, g	4.33-7.81	3.13	2.91
Protein (N×6.25), g	2.35-2.83	2.79	2.76
Vitamin A, IU	ND	ND	ND
Vitamin C, mg	0.49-2.60	2.36	1.38
Calcium, mg	1.80-2.61	3.89	7.63
Iron, mg	0.17-0.33	0.29	0.27
Ash, g	0.57-0.98	0.39	0.36
Moisture, g	77-81.3	83.4	68.1

ND = Not detected at a lower limit of detection samples, the non blanched samples showed higher nutrient content than the blanched samples, except in the content of dietary fiber, sodium and calcium.

CONCLUSION

Non blanching process of canned whole kernel sweet corn showed more advantages than the process with blanching. The yield in weight of the corn kernels, drained weight, total soluble solids, and the nutrient retention of the non-blanching process were higher than the blanching process. Moreover the weight of cobs which was the waste residue was less in the non blanching process, thus providing ease in the waste treatment.

However the blanching process has advantage in the higher initial temperature, shorter rate of heating and cooling, and process lethality from which may result in the shorter thermal process required for the product.

ACKNOWLEDGEMENT

The project was funded by the National Research Council of Thailand under the project “Integrated Development of Green Corn and Popcorn Production for Industrial Purpose.” The researchers would like to thank Kasetsart University for providing all necessary facilities in doing the research.

LITERATURE CITED

AOAC, 2000. Official Methods of Analysis. Vol.. 2. 17th ed. AOAC International Suite 500, Maryland, USA. 58 p.

E-Siong-Lee 2000. Labelling, nutrition and health claims : What’s happening in Southeast Asia ? Food-Australia 52 (6) : 249-251.

JAOAC, 1992. Journal of AOAC International. The Scientific Association Dedicated to Analytical Excellence. May / June 1992, Vol. 75, No 3, Arlington, Va., USA. 590 p.

JAOAC, 1993. Journal of AOAC International. The Scientific Association Dedicated to Analytical Excellence. July / August 1993, Vol. 76, No 4, Arlington, Va., USA. 943 p.

Kautter, D.A., W.L. Landry, A.H Schwab, and G.A. Lancette, 1992. Examination of canned foods, pp. 259-280. *In* Food and Drug Administration, Bacteriological Analytical Manual, 7th edition. AOAC International, Arlington, VA.

Meyer, L.H. 1960 Food Chemistry. Reinhold Publishing Corporation, New York. Charles E. Tuttle Company, Tokyo. 379 p.

Shine, A, O’. S. Reilly, and O’. K. Sullivan, 1997 Consumer attitudes to nutrition labelling. British Food Journal 99(88) : 283-289.

Suriyo, S., J. Boonmaak, and N. Wuthiwan, 1999 The extension of sweet corn production of Dept. of Agricultural Extension. Presented in The 6th Seminar of Corn Industry Aug. 4-6, 1999. Pakchong Landmark Hotel, Pakchong, Nakhon Ratchasima, Thailand (in Thai) 13 p.

The Proposed Draft Codex Standard for Certain Canned Vegetable, step 3 (2002). FAO/WHO (CODEX) 19 p.

Received date : 3/01/02
Accepted date : 29/03/02