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CHARACTERISATION OF SOLID AND LIQUID PINEAPPLE WASTE

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Abstract

The pineapple waste is contain high concentration of biodegradable organic material and suspended solid. As a result it has a high BOD and extremes of pH conditions. The pineapple wastes juice contains mainly sucrose, glucose, fructose and other nutrients. The characterisation this waste is needed to reduce it by recycling to get raw material or for conversion into useful product of higher value added products such as organic acid, methane , ethanol, SCP and enzyme. Analysis of sugar indicates that liquid waste contains mainly sucrose, glucose and fructose. The dominant sugar was fructose, glucose and sucrose. The fructose and glucose levels were similar to each other, with fructose usually slightly higher than glucose. The total sugar and citric acid content were 73.76 and 2.18 g/l. The sugar content in solid waste is glucose and fructose was 8.24 and 12.17 %, no sucrose on this waste

Keywords: *characterization, liquid pineapple waste, solid pineapple waste*

INTRODUCTION

Food processing operation also uses enormous quantities of water which are consequently discharge as a polluted effluent. The waste are contain high concentration of biodegradable organic material and suspended solid. As a result it has a high BOD and extremes of pH conditions (Kroyer, 1991). The solid waste from pineapple canning process was estimated about 40 - 50 % from fresh fruit as pineapple peals and core (Buckle, 1989). The pineapple canning process and wastes production was shown in figure 1.

If these wastes discharge to the environment untreated they could cause a serious environment problem. Beside their pollution and hazard aspects in many cases, food processing waste such as pineapple waste might have a potential for recycling to get raw material or for conversion into useful product of higher value added products, or even as raw material for other industries, or for use as food or feed after biological treatment (Chandapillai and Selvarajah, 1978).

This waste contains valuable components which are mainly sucrose, glucose, fructose and other nutrients (Sasaki, et al., 1991; Krueger et al., 1992). The first stage in the optimisation of waste reduction is to identify and characterised the wastes (solid and liquid) produced. The aim of this investigation was to examine the characteristic of solid and liquid pineapple waste.

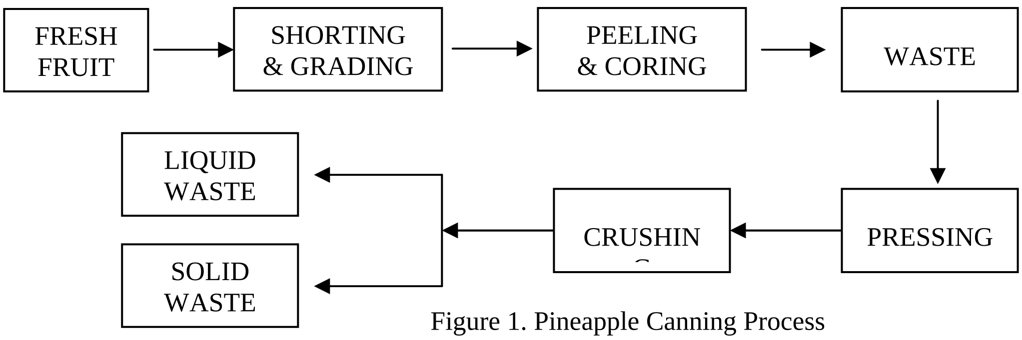

Figure 1. Pineapple Canning Process

MATERIALS AND METODS

Substrate

The solid and liquid pineapple waste obtained from Malaysian Cannery of Malaysia Sdn. Bhd. The liquid waste contained suspended particulate matter, before used the solution boiled for 5 minute resulting particulate flocks and settled rapidly upon cooling to room temperature and centrifuge at 4000 rpm for 15 minute. The clear supernatant was determined the physical and chemical compositions (Lazaro, 1989). The solid waste was dried with oven at 55^{o}C for a week, reduces the size by blender and then screened with screener (Lazaro, 1989; Bryan, 1990). To analyse the sugar content in solid waste by weighing 10 g sample, add 100 ml alcohol and water (1:1) and weigh. Place in 80-85^{o}C water bath for 25 minute and stir occasionally. Cool to room temperature and add alcohol to original weigh. Centrifuge 5 minute at 3500 rpm and filter through 0.45-0.7 μm. The filtrate was used to determine the sugar content in solid waste (Zygmunt, 1982).

Methods

Liquid waste characterization

The organic acid content in the sample was measured by HPLC (Waters TM 600). A 250 mmX4.6 mm ID Spherisob Octyl column (Waters) with UV detector (210nm) were used. The eluent used was 0.2 M phosphoric acid at flow rate of 0.8ml per minute and temperature of 25^{o}C.

The sugar content was also measured by the same HPLC, using a 300 mm x 4 mm ID μ Bondapak/Carbohydrate column (Waters) with RI detector. The eluent used was a mixture of acetonitrile: water (80:20) at flow rate of 2ml per minute and temperature of 25^{o}C.

Reducing sugar was measured by Alkaline 3,5-dinitrosalicilioc acid (DNS) method and total sugar was measured by hydrolyse non reducing sugar (sucrose) to reducing sugars (glucose and fructose), and determine by DNS method (Ceirwyn, 1995).

Cations were measured by using the Direct Air-Acetylene Flame method by using the Atomic Absorption Spectrometer (AAS) model PU 9200 and associated equipment supplied by Philips Company. The cations were determined by using AAS according to the standard method (Clesceri et al, 1989). Anions were measured by using the Ion Chromatography model LC20 with electric chemical detector ED40.

Total Nitrogen was measured by Kjeldahl method (Malaysian Standard, 1973). Soluble protein was measured by Lowry method (Ceirwyn, 1995). Phosphorus was measured by the molybdenum blue colorimetric method (Ceirwyn, 1995) and the pH was measured by the Cyberscan 1000 pH meter supplied by the chemopharm Sdn, Bhd.

Solid waste characterisation

Moisture content, total solid, ash, fat, crude protein and fibre will be carried out according to Malaysian Standard (1973). To analyse the sugar content in solid waste by weighing 10 g sample, add 100 ml alcohol and water (1:1) and weigh. Place in 80-85^{o}C water bath for 25 minute and stir occasionally. Cool to room temperature and add alcohol to original weigh. Centrifuge 5 minute at 3500 rpm and filter through 0.45-0.7 μm. The filtrate was used to determine the sugar content in solid waste (Zygmunt, 1982).

RESULTS AND DISCUSSION

The Characteristics of Liquid Pineapple Waste.

The physical and chemical composition of pineapple waste juice can be seen in table 1. Analysis of sugar indicates that liquid waste contains mainly sucrose, glucose and fructose. The dominant sugar was fructose, glucose and sucrose. The fructose and glucose levels were similar to each other, with fructose usually slightly higher than glucose. These result are similar to those for pineapple juice concentrate observed by Krueger (1992), but not similar was reported by Sasaki (1991) for pineapple waste juice indicates that the sucrose content higher than glucose and fructose smaller than glucose. The different of sugar composition might caused process to obtain this waste and also depend with season, area and pineapple canning factory. Analysis of soluble protein and total nitrogen were obtained 1.13 and 0.64 g/l, respectively. The waste contains very little nitrogen and soluble protein and elements such as Fe, Ca, Mn , Zn, Cu , Cd, Na, and K, and potassium is the highest element in the pineapple waste. The ion chlor is higher than sulphate and nitrate, but the phosphate ion is nil.

The pH of pineapple waste is 4.0, the pH of pineapple juice was reported by Moon (19) at range value 3.6-4.6, it similar which reported by Sasaki (1991). The total acidity is expressed as gram per litre of citric acid. Organic acid analysis by liquid chromatography indicates that most of the acidity is due to citric acid, with a significant contribution made by malic acid. Krueger (19927) has been reported that citric acid in pineapple juice is the dominant acid and the ratio was by ranged value from 1.8 to 8.2. The value of acidity in pineapple waste was 2.95 g/l with ratio of citric acid and malic acid was 7.1. The major constituent of cation in pineapple waste is potassium at 526 mg/l, it lower than the potassium content in pineapple juice have been reported by Krueger (1992) at range from 830 to 1410 mg/l.

Table 1. The Characteristics of Liquid Pineapple Waste

Compositions	Parameters	This Work	Sasaki, 1991
Sugars	Reducing sugar (g/l)	40.40	39.20
	Sucrose (g/l)	16.75	40.10
	Glucose (g/l)	19.72	23.60
	Fructose (g/l)	20.62	14.0
	Total Sugar (g/l)	73.76	100.00
Proteins	Soluble protein (g/l)	1.13	0.90
	Kjeldahl nitrogen (g/l)	0.64	0.20
Organic acids	Acidity, as citric acid (g/l)	2.95	-
	Citric acid (g/l)	2.18	-
	Malic acid (g/l)	0.29	-
Cations	Fe (mg/l)	3.30	5.43
	Ca (mg/l)	194.0	3.31
	Mn (mg/l)	3.60	13.97
	Mg (mg/l)	47.70	62.50
	Zn (mg/l)	5.80	-
	Cu (mg/l)	1.40	2.02
	Cd (mg/l)	0.00	0.00
	Na (mg/l)	294.0	8.61
	K (mg/l)	526.0	-
Anions	SO_4^{-2} (mg/l)	25.60	169.7
	PO_4^{-3} (mg/l)	0.00	223.8
	NO_3^{s}(mg/l)	8.20	-
	Cl^{-1} (mg/l)	256.0	-
	Phosphorus (mg/l)	27.40	-
pH		4.30	4.00

The Characteristics of Solid Pineapple Waste.

The composition of solid pineapple waste in this work and different author were given in table 2. The moisture content of solid waste obtained was 87.5%, the different of moisture content might be due the sample were obtained from various geographical origins and of varying degree of ripeness. Ash and phosphorus content is 4 and 0.1%, it similar which reported by Chandapillai (1978) because the waste obtained from similar origin area (Johor). The nitrogen total content in waste is 0.9%, it similar which has been reported by researcher previously. The sugar content in solid waste is glucose and fructose 8.24 and 12.17%, no sucrose on this waste because during the drying process at pH 4.0, the sucrose by inversion converted to glucose and fructose and degradation and polymerisation of sucrose resulting the glucose polymer with brown colour formation (Chen, 1993). The highest of mineral constituent in the waste is potassium at 3%, it similar with have been reported by researchers previously.

CONCLUSIONS

Analysis of sugar indicates that liquid waste contains mainly sucrose, glucose and fructose. The dominant sugar was fructose, glucose and sucrose. The fructose and glucose levels were almost similar with fructose slightly higher than glucose. The total sugar and citric acid content were 73.76 and 2.18 g/l. The sugar content in solid waste is glucose and fructose was 8.24 and 12.17 %, but no sucrose on this waste.

The chemical composition appears to be a good nutrient for cultivation of bacteria. It can potentially be used as carbon source for organic acid fermentation.

Table 2. The characteristics of Solid Pineapple Waste

Composition (%)	This Work	Bardiya	Viswanath	Chandapillai
Moisture	87.50	92.80	87.69	89.70
Total solid	12.50	7.80	12.31	10.30
Ash	4.05	10.60	6.20	3.90
Organic carbon	-	51.85	38.90	-
Total carbohydrates	-	35.00	-	-
Reducing Sugar	20.93	-	-	-
Glucose	8.24	-	-	-
Fructose	12.17	-	-	-
Sucrose	0.00	-	-	-
Cellulose	-	19.80	-	-
Crude Fibre	10.57	-	-	14.70
Hemicellulose	-	11.70	-	-
Total soluble	-	30.00	-	-
Total nitrogen	0.83	0.95	0.90	0.97
Crude Protein	5.18	-	-	6.10
Fat	0.15	-	-	0.20
Phosphorus	0.14	-	0.08	0.10
Fe	0.20	-	-	-
Ca	0.26	-	-	-
Mn	0.01	-	-	-
Mg	0.40	-	-	-
Zn	0.02	-	-	-
Cu	0.03	-	-	-
Cd	0.00	-	-	-
Na	0.30	-	-	-
K	3.00	-	-	-
SO_4^{-2}	0.23	-	-	-
PO_4^{-3}	0.00	-	-	-
NO_3^{s}	0.06	-	-	-
Cl^{-1}	0.38	-	-	-

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