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Physicochemical Properties Analysis of Three Indexes Pineapple (*Ananas Comosus*) Peel Extract Variety N36

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Abstract

Pineapple peel is a major waste in pineapple canning industry. It has limited data on the physicochemical properties of pineapple peel for several ripening stages. It has high added value in many areas of study and approach to green technology development. For such industrial processes to be technically and economically feasible, it is important to have the analysis data of the physicochemical properties. Thus, physicochemical properties study of pineapple peel extract is very important in fruit waste extract technology. This study examined the physicochemical properties of the pineapple peel extract variety N36 for three different ripening stages: indexes 1, 2 and 3. Physicochemical properties such as total soluble solids (TSS), pH, titratable acidity (TA), absorbance and pulp content of pineapple peel extract were determined. It was found that the physicochemical properties: TSS, pH values, TA, absorbance and pulp content were significantly increased at the 5% level with the increase in ripening stages. These new data on ripening changes occurring in pineapple (*Ananas comosus*) peel variety N36 can contribute to further development in the agricultural sector.

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Keywords: PINEAPPLE N36; PINEAPPLE PEEL; PINEAPPLE PEEL EXTRACT; RIPENING STAGES; PHYSICOCHEMICAL PROPERTIES

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1. Introduction

Pineapple (*Ananas comosus* L. Merr.) is a member of the Bromeliaceae family (monocotyledons) and comprises about 2000 species with an annual worldwide production of over 14 million tons; it is the eighth most abundantly produced fruit in the world [1]. It is one of the most important commercial fruits of the world. This excellent fruit was probably indigenous to Brazil, and it had spread to other parts of tropical America by the time of Columbus who took it to Europe. Nowadays, it is found to grow throughout the tropical and subtropical regions of the world [2]. Pineapple has long been one of the most popular of the non-citrus tropical and subtropical fruits, largely because of its attractive flavour and refreshing sugar-acid balance [3]. N36 Pineapple is famous among Malaysian especially people who live in the state of Johor. The N36 pineapple is a hybrid selected from a cross between 'Gandul' (Spanish) and the 'Smooth Cayenne'. This variety is developed by Malaysian Agricultural Research and Development Institute (MARDI) has some special characteristic where it is suitable for export by sea using reefer container.

Agricultural waste is a renewable resource of great variety of biotechnological potential. It should be non toxic, abundant, totally regenerable, non-exotic, cheap and able to support rapid growth and multiplication of the organisms resulting in high quality biomass [4]. Pineapple peel is a by-product resulting from the processing of pineapple into slices and represents about 10% (w/w) of the weight of the original fruit [5]. Chandapillai and Selvarajah (1978) reported that in pineapple canneries, nearly 75% of the fruit in the form of peeled skin, core, crown end, etc. is not utilized and is discharged as wastage causing problems of disposal and pollution. The dry matter content of pineapple waste is around 10%, composed of about 96% organic matter and 4 % inorganic matter. The waste contains high concentration of biodegradable organic material and suspended solid. Besides 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 [6]. In particular, pineapple waste contains sufficient quantities of simple and complex sugars that may be used for bioethanol [7].

Fruit maturation is characterized by changes in physiological, biochemical and morphological traits of the fruit, which determine the qualitative characteristics of any cultivar and finally its depreciation during senescence [8]. Murwan SabahelKhier *et al.* (2010) reported that the physical, chemical and sensorial characters of pineapple show significant difference at several maturation stages [9]. Fruit growth and development involve many changes that include its morphology, anatomy and physiology and biochemistry. When a fruit matures the changes associated with it includes changes in rind texture, juice composition and taste [10]. Thus, this study examined the physicochemical properties analysis of three indexes pineapple (*Ananas Comosus*) peel variety N36.

2. Material and Methods

2.1. Preparation of samples

The harvested pineapples of N36 variety at three different ripening stages were obtained from Pineapple Estate, Lee Peninsular Plantation Sdn. Bhd. located at Simpang Renggam, Johor, Malaysia. The crown from the fruits were first removed, peeled, and the central core. The peel was then crushed in a blender (Waring, United States). Then, the pineapple peel extract was extracted using muslin cloth and keep frozen at -20°C before analyses of TSS, pH values, TA, absorbance and pulp. Fresh three replicates for each of the three varieties were sampled for physicochemical analysis.

2.2. Physicochemical analyses

The physicochemical analysis of pineapple peel N36 variety at three different ripening stages was done using the following methods:

2.2.1. Total soluble solids (TSS)

Soluble solids were determined using a refractometer (Digital ABBE Refractometer, Kruss Optronic) (AOAC 932.12; 1995). A drop of the solution was squinted on the prism of refractometer. The percentage of TSS was obtained from direct reading of the instrument.

2.2.2. pH

pH of the pineapple peel extract was determined using a pH meter (pH 211 Microprocessor pH meter Hanna) at room temperature.

2.2.3. Titratable acidity (TA)

Titrate acidity was assessed as outlined by AOAC 962.12 method. The pineapple peel extract contains a number of organic acids, which are readily neutralized by strong bases and can be titrated against standard bases such as sodium hydroxide. A 10ml sample of pineapple peel extract was weighed. Then, the sample was transferred to a 500 ml Erlenmeyer flask. The sample was diluted to 250 ml with deionised water. Using a standard solution of 0.1 N sodium hydroxide, the sample was titrated to the end point. The end point was determined using a phenolphthalein indicator. One ml of phenolphthalein indicator was added to the sample and titrated until faint pink end point was observed. The volume of 0.1 N sodium hydroxide used was recorded. The total acidity can be calculated using equation and expressed as concentration of citric acid (g/l). The measurement was repeated at least three times. The percentage of citric acid was calculated according to the following expression:

$$\% \text{ Acid (as anhydrous citric acid)} = \text{Volume of 0.1 N NaOH (ml)} \times 0.64 / 10 \quad (1)$$

2.2.4. Clarity (Absorbance)

Absorbance was determined by UV-Vis Spectrophotometer (Lambda 35 UV/Vis Spectrometer Perkin Elmer) at 660 nm wavelength and distilled water was used as blank. The clarity was expressed in absorbance value (abs).

2.2.5. Pulp content

The pulp content was centrifuged (Eppendorf Centrifuge 5804) at 360 x g for 10 minutes before the pulp was weighed.

2.3. Data analysis

Data were analyzed by Statistical Package for the Social Science (SPSS). Analysis of variance (ANOVA), correlation and Duncan's multiple range tests were performed. The mean values and the standard deviations were calculated from data obtaining triplicate trials. These data were then compared with the least significant difference test.

3. Results and Discussion

The results have been presented and discussed and possible interpretations have been given under the

following figures and headings:

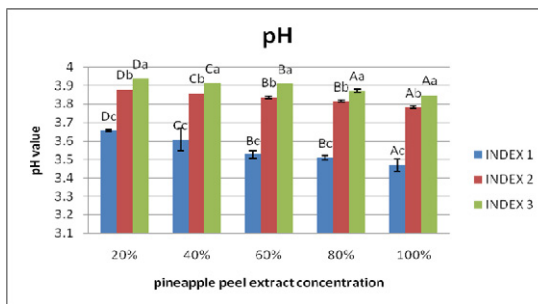
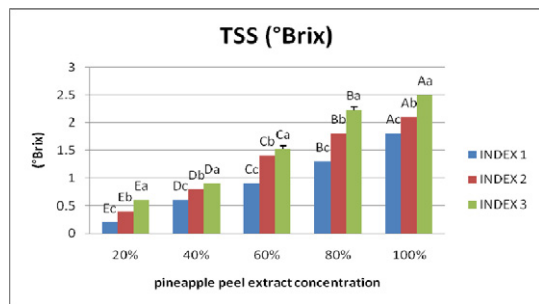


Fig. 1. Relationship between total soluble solids (TSS) of pineapple peel extract and pineapple peel extract concentration for different ripening stages

Fig. 2. Relationship between pH of pineapple peel extract and pineapple peel extract concentration for different ripening stages

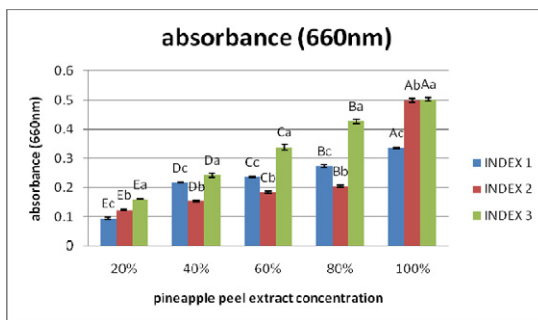
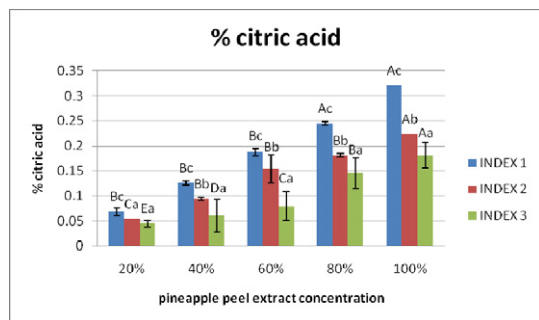


Fig. 3. Relationship between titratable acidity (TA) of pineapple peel extract and pineapple peel extract concentration for different ripening stages

Fig. 4. Relationship between absorbance of pineapple peel extract and pineapple peel extract concentration for different ripening stages

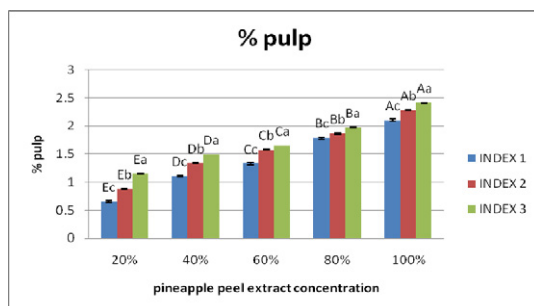


Fig. 5. Relationship between pulp content of pineapple peel extract and pineapple peel extract concentration for different ripening stages

3.1. Total soluble solids (TSS)

In the present experiment, the TSS content of the pineapple peel extract significantly increased at the 5% level with the increase of every ripening stage and for every pineapple peel extract concentration. Fig 1 shows that pineapple peel extract index 3 contained the highest TSS value which is 2.5%, whilst it was the lowest in the index 1 which is 1.8% and both at the 100% concentration of pineapple peel extract. The result shows that as the ripening stages increased, the sugars in the pineapple peel extract was increased. TSS in pineapples was positively correlated with total sugars [11]. During fruit ripening and softening process, starch is broken down to the simple soluble sugars and also the amount of soluble pectin will increase, leading to fruit softening [10]. During pineapple fruit development, glucose and fructose were the predominant sugars until 6 week before harvesting sucrose begin to accumulate rapidly and ultimately exceeded the glucose and fructose concentration. Glucose and fructose remained relatively constant throughout development [12]. The solids included soluble sugars sucrose, glucose and fructose as well as acids [10]. TSS increases with maturity [13] as the TSS value for index 3 was higher than the other two indexes of ripening stages. TSS content of fruit is related to the light levels during fruit maturation [12]. TSS is an important quality factor for many fruits during ripening. The soluble solids content is also used as an indication of fruit maturity and quality. Senescence is enhanced by increasing sugar content in fruits. Soluble solids are also known to impact sweetness index than does the total sugars [14].

3.2. pH

pH of pineapple peel extract with different ripening stages and concentrations are presented. There was significant difference among pH values for both ripening stages and pineapple peel extract concentration at the 5% level. Fig 2 indicates that pH of pineapple peel extract increased with the increasing of ripening stages but decreased with the increasing of pineapple peel extract concentration. It shows that pH of pineapple peel extract for index 3 was 3.85, whilst it was 3.47 in the index 1 which is both at the 100% concentration of pineapple peel extract. As the fruit matured, the pH was increased and contributed less acidity to the pineapple peel extract. While, when concentration increased, the acidity increased due to the increase in hydrogen ions present in the solution. Hydrogen ions determined the degree of acidity. As the concentration of hydrogen ions were reduced, so it was expected pH value to increase. Pineapple peel extract contained weak acids like citric acid and malic acid and sodium, potassium and calcium salts. Fruit pH increases at the high rate of respiration by accelerated acid metabolism and accumulated cations [13]. The pH values obtained also reflected a significant extent to the microbial stability of the various varieties [14].

3.3. Titratable acidity (TA)

TA showed in Fig 3 was decreasing trend for all ripening stages but increasing trends for all pineapple peel extract concentrations. Significant difference among treatments was also observed at all stages with the 5% level. Index 3 contained the maximum (0.32%) total TA while the minimum (0.18%) in index 1 at 100% concentration. TA was evaluated to determine the citric acid in pineapple peel extract. TA reflecting fruit quality and also indicates the sourness. In pineapple, TA is reported as citric acid, not malic acid. It varies primarily with fruit developmental stages but does not relatively respond to short term environmental changes, while the malic acid varies with environmental changes especially the light [11]. Decrease in total acidity and increase in total sugars and TSS during storage at room temperature was also reported recently by Policegoudra and Aradhya (2007) in mangoes. It has been suggested that during storage, fruits utilize organic acids for metabolic activities and this results in a decrease in the TA content during the storage periods. They reported the decrease in acidity coincided with an increase in sugar concentration in the pomegranate fruits. Kulkarni and Aradhya (2005) suggested that a slow decrease in acidity, concomitant with increased TSS and

total sugar content, is an intrinsic process during ripening of fruits to impart the flavour [10]. During ripening, organic acids are respired or converted to sugars and acid levels decline [13]. The TSS and acid content are the factors influencing consumption quality [12].

3.4. Absorbance

In Fig 4, there was significant difference among absorbance of the pineapple peel extract for both ripening stages and pineapple peel extract concentrations at 5% level. The table shows ripening stage 2 had a lowest absorbance value compared with the other two indexes. This indicates that in pineapple peel extract index 2 contains more pectinesterase enzyme. Pectinesterases that catalyze the de-esterification and transacylation of homogalacturonic acid units of pectins are ubiquitous enzymes that can be found in plants, microbial pathogens and symbiotic microorganisms during their interactions with plants [15]. The presence of pectinesterase in citrus fruit particularly in cloud loss of citrus juice is one of the most intensively studied problems in food technology [16]. These enzymes can be used in the integrated treatment of the solid wastes generated during the juice production in order to hydrolyze pectin what would diminish the viscosity of the liquid waste streams, facilitating its treatment [17]. Fruit cell walls are usually highly enriched in pectins, often more than 50% of the wall [18].

3.5. Pulp content

It was observed that the highest (2.4%) pulp content found in index 3 and the lowest (2.1%) in index 1 at 100% concentration as showed in Fig 5. There was a significantly difference in the percentage of pulp content for every ripening stages and for every pineapple peel extract concentration at the level 5%.

From this study it can be concluded that significant differences in the values of TSS, pH values, TA, absorbance and pulp content verified at the 5% level of ripening stages and concentration of pineapple peel extract. These results present new data on the *Ananas comosus* fruits which are useful for future research.

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