Encapsulation of Vitamin C from Pineapple Skin using Press Technique

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ABSTRACT

Encapsulation technique involving spray drying is commonly utilized for replacing liquid products into powder form to develop a longer time span of usability at ambient temperature, expanding the product accessibility consistently and minimizing the pineapple fruit loss due to its short shelf life. In this study, a number of pineapple powder samples were spray dried under various drying parameters and condition. Pineapple peels solution were added with maltodextrin at 10, 20 and 30% before introduced into spray drier at temperature 130, 150, and 170℃. The samples produced were analyzed in the aspects of percentage yield and moisture content as well. The results specified that the highest yield recorded was at 10% maltodextrin (MD) concentration which is 14.136% under 150℃ fixed temperature. On top of that, the appearance of pineapple powders were yellow greenish color and powdery. In other words, it suitable to be sealed in capsules. Nonetheless, as the time passed, the powder continue to agglomerate and sticky as being exposed to ambient temperature. The lowest moisture content value was observed at drying temperature around 150℃ which is recorded at 4.350% and maltodextrin around 30%.

***Keywords*—encapsulation, pineapple, spray drying, maltodextrin, moisture content.**

I. INTRODUCTION

The Pineapple is a tropical fruit that has been one of the fresh foods that mostly exported and have a lot of demands because of its excellent flavor and taste. Thailand, Philippines, Mexico, Costa Rica and Brazil are some of the major pineapple producing countries. It is a favorite for the lovers of fruits in its fresh form. The fresh pineapple juice is a popular product because aroma favorable, sense, and many functional nature (Rattanathanalerk et al, 2005). In the past, notwithstanding fresh fruit, Americans locals use pineapple, for fiber production and for medical purposes, as an emmanagogue, antiamoebic and for the stomach upset rectification. The greater part of these restorative and medicinal uses is identified with the proteolytic enzyme bromelain of the pineapple (Coppens d’Eeckenbrugge, 1997).

Apart from that, pineapple processing made the particular fruits famous through developed world that is medium. Some international trade product is canned-fruits, concentrated juice and dry pineapple pieces (Jittanit et al, 2009). Until now, the food industry still doing improvement and keep developing new product from pineapple despite the fact that there are various pineapple based items in the market. In any case, the generally short shelf-life of fresh pineapple fruit has constrained early commercial trade to moderately short transportation or some kind of preservation to keep up the quality of the fruits (Rohrbach et al, 2003). In the context of short-shelf life, the pineapple may have lost its nutrients before being exported. So, instead of export it as fresh fruits, there are other ways to export it without having to worry about losing its nutrient or its short-shelf life.

The benefit of some form of preservation or new product development has eventually assisted in minimizing pineapple loss caused by the microorganisms and chemical reaction. On top of that, while peak harvesting season happens, it can also due to enzymatic reaction. Drying or dehydration is one of the processes to preserve the quality of the pineapple and including the moisture content removal from a food product. It can be transformed into dry particulates or powder utilizing some particular techniques, for example, spray drying, freeze drying and oven drying (Wong et al, 2014).

Apart from that, people enjoy pineapple as well as in preserves for examples, jams, jellies and squashes (Debnath et al, 2012). Due to its export value, they are eventually the third most tropical fruit that is essential in world production after banana and citrus (Bartholomew et al, 2003). This is because pineapple is famous for its nutrient such as vitamin C and also a rich source of manganese. Pineapples may be developed from a crown cutting if the fruit, perhaps blooming in about 20-24 months and fruiting in the following half year. It also contains an assortment of minerals, an in addition amino acids, different sugars and polyphenols.

Encapsulation is a process or method by which one material or blend of materials is covered with or within another material or system In other words, it is procedures that coating or enclosing a mixture of materials with other wall materials to provide dry, free-flowing materials. It at first was utilized in food industry to deliver flavoring materials specifically in a dry form. Furthermore, it is to make proper and secure proper protection to those flavoring materials (Risch & Reineccius, 1995). The most common materials covered are in liquid and it could be in a solid and gas phase as well. The covered or coating material are typically referred as membrane, wall material or coating. Many different industries have particularly used encapsulation with a wide variety of processes or techniques involved including food industry. For instance, there are some techniques that are widely used in the industries such as spray drying, air suspension, extrusion coating and centrifugal extrusion (Risch & Reineccius, 1995). Encapsulation initially was used in the sustenance industry to create seasoning materials in a dry state and to give security to those materials. By this way, pineapple product can be developed in a way their quality and nutrients content are not affected and preserved well.

The main objectives of this research is to make and produce a powdered vitamin C from pineapple skin using the process of encapsulation. Press technique is involved to properly encapsulate the powdered product in sealed capsules. Secondly, to analyze the optimum temperature at the inlet and maltodextrin concentration to produce highest powdered fruit product yield.

II. METHODOLOGY

A. Materials

Pineapple peels used in this study were gathered from Klang plantation. The peels were cleaned with tap water to strip off dirt and polluting influences. A measure of pineapple peels were rested before blend and extract into solution. Then, the peels were blended at constant speed and certain time to obtain slurry solution. Using proper filter, the solution was filtered to remove husks or any fine dust.

Aqueous solution of MD concentration were prepared by dispersing MD into 50 gram of hot water. The solution was mixed with 250 gram of the pineapple peels solution that has been filtered. The amounts of MD filled into the hot water were 30, 60, and 90 grams in order to provide 10, 20, 30% of the combination of hot water and pineapple peels solution 300 gram.

B. Method of Spray Drying

The samples prepared were dried in a small scale spray drier model "SD Basic LabPlant". The drying experiment were set up using samples of three MD concentration (10, 20, and 30%) and three drying air inlet temperatures (130, 150, and 170°C) to produce nine different samples. The pump rate utilized is 3. At the end of the drying, the powders were collected, weighed, and kept in the sealed container for quality determination.

C. Yield of Pineapple Powder

The pineapple powder yield was determined based on collected powder in the powder bottle.

$$\frac{weight\ of\ powder\ (g)}{weight\ of\ feed\ (g)} \text{X } 100 = \text{Percent Yield } (\%)$$

D. Moisture Content Analysis

The moisture content of powder was determined using Sartorius moisture analyzer by adding two gram of powder in the moisture analyzer at 105°C for 10 mins. The results were recorded for all the experiment runs.

E. Encapsulation Technique

The spray dried powder was entrapped into miniature capsules and the properties was observed physically.

III. RESULTS AND DISCUSSION

A. Yield of Pineapple Powder

Regarding the percentage yield on the table 1, it shows that increase in temperature can significantly affect the yield of the powdered product. Specifically, the yield obtained at 130 °C is 11.24%, at 150°C is 14.2% and at 170°C is 9.8%. A gradual increase in yield was observed while utilizing 10% maltodextrin concentration as fixed value at the first moment and decrease later. Indicatively, the yield acquired at 150 °C (14.2%) was higher compared to that at 130°C. This is very likely due to the higher heat and mass transfer processes efficiency when high inlet temperature was utilized (Cai & Corke, 2000). However, referring to Leon Martinez et al. (2010), melting of powder and cohesion of powder on the chamber wall of spray dryer at higher temperature can result in lower powder yield. This is shown when a moderate decrease occur at inlet temperature 150 °C (14.2 %) and 170 °C (9.8%).

The inlet temperature 150°C was selected as the optimized or ideal parameter for spray drying of pineapple peels solution. According to (Jittanit et al, 2010), the result from the research shows that the pineapple juice should be dried at 150 °C as well.

Table 1: Effect of inlet temperature to yield

Inlet Temperature (°C)	Powder Yield (%)
130	11.24
150	14.20
170	9.80

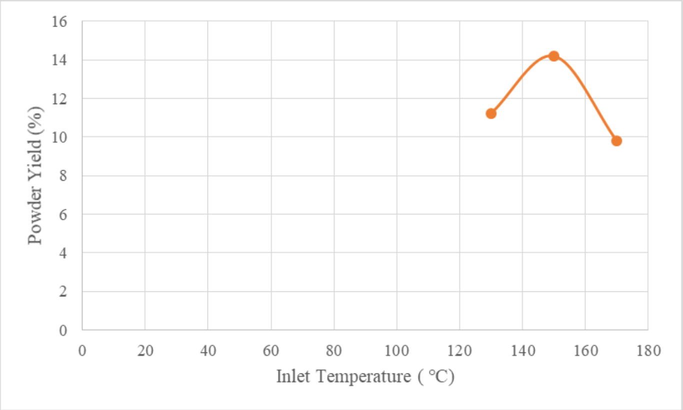

Figure 1: Effect of inlet temperature to yield

According to the results on the table 2 shown below, maltodextrin concentration (MD) affected the product percentage yield. As the concentration of maltodextrin decreases, the percentage yield of the product increases gradually. However, according to (Phisut, 2012), he analyzed and state that insufficient carrier agent which in the context is maltodextrin may produce sticky powder. On top of that, optimum maltodextrin concentration is significant in producing high-yield and non-sticky powder. Referring table 2, the lowest yield percentage of the product is recorded at maltodextrin concentration (30%). The highest yield recorded was at 10% MD concentration which is 14.136%.

The concentration of maltodextrin also influence the powder properties. In other word, low concentration of maltodextrin may obtain stickiness powder. As researched by Quek, et al. (2007), he stated that there were barely any powders accumulated in the collector if maltodextrin was not added to the feed. The particulates produced were very sticky and basically deposited onto the wall of drying chamber and cyclone and could not be recovered. These results also showed that addition of maltodextrin reduce the stickiness and eventually improve the yield of product.

Table 2: Effect of MD concentration to yield

MD concentration (%)	Powder Yield (%)
10	14.13
20	12.20
30	9.76

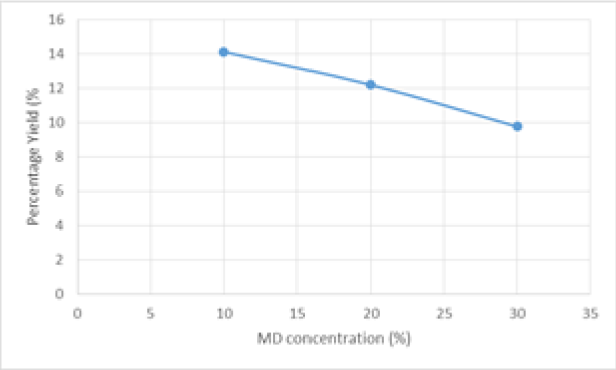

Figure 2: Effect of MD concentration to yield

B. Moisture Content analysis

The outcomes of moisture content for the pineapple powder are presented in Table 3. To obtain the value of moisture content, Sartorius moisture analyzer was utilized until the constant data is achieved. The temperature set was 105°C within 10 minutes time interval.

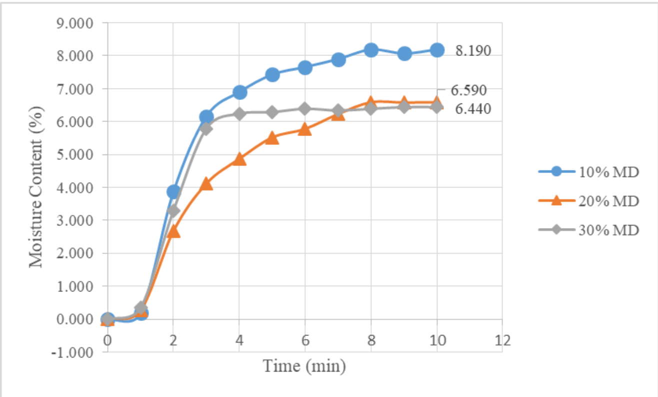

Figure 3: Moisture content at 130°C

Regarding figure 3, the lowest moisture was recorded at 30% maltodextrin concentration which is 6.440% for temperature 130°C fixed temperature. It seems that higher maltodextrin concentration lessen the moisture content of the product respectively.

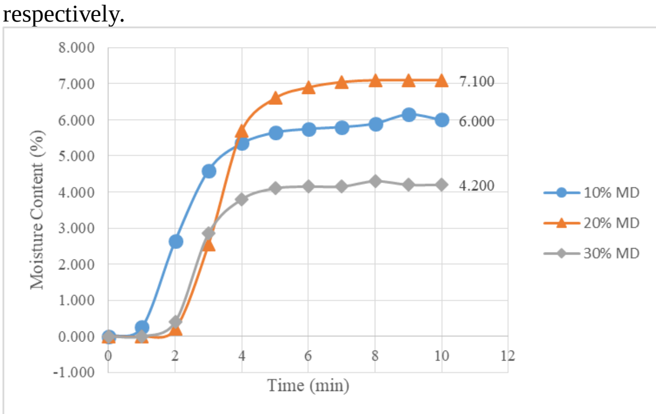

Figure 4: Moisture content at 150°C

Referring to the Figure 4, the results is quite different compared to fixed temperature 130°C , which did not complement the hypothesis which is higher concentration of maltodextrin lessen the moisture content of product powder. From 10% to 20%, the moisture content is 6.000% and 7.100%. At the 30% maltodextrin concentration, the moisture content eventually decreases back to 4.350%. Jittanit et al, (2010) also found the same result at 150°C where the moisture content increase at the first place then eventually fall back.

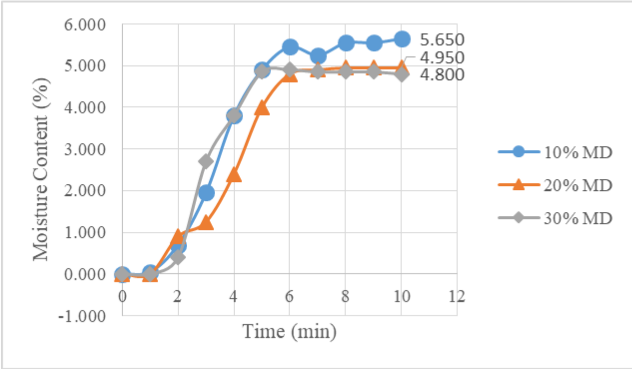

Figure 5: Moisture content at 170°C

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Table 3: Effect of drying temperature and MD content to moisture content

Drying Condition		Moisture Content (%)
Drying Temperature (°C)	MD content (%)	
130	10	8.19
	20	6.59
	30	6.44
150	10	6.00
	20	7.10
	30	4.35
170	10	5.65
	20	5.05
	30	4.85

All of these particular graphs, were tabulated again into Table 3.

The outcomes of moisture content for the pineapple powders are presented in Table 3 above. The results showed that the moisture content of the powders were below 10%. The increasing drying temperature and MD concentration resulted in the lower moisture content. In other words, moisture content was influenced by both independent variables. This result also is in agreement with the work of Quek et al, (2007) that found a decreases in moisture content of spray dried watermelon with increased maltodextrin concentration. The addition of maltodextrin has increased the total solids of the feed and reduced the amount of water evaporation. It was due to the maltodextrin potentiality to hurdle sugars in the fruit powder that have highly hygroscopic nature of absorbing the humidity in the surrounding air (Shrestha et al, 2007). In unlikeness, Goula and Adamapoulus, (2008) reported with the increase of maltodextrin concentration, the moisture content of powder has increased. This study was in accordance with the production of orange juice powder.
Focusing on air drying temperature tested, a significant decrease in the moisture content of the spray dried pineapple powder as the particular temperature increase as recorded in Table 4.8. For fixed 10% maltodextrin concentration, the moisture content reduce from 8.190% to 5.650% from temperature 130°C to 170°C. As stated by Chegini and Ghobadian, (2005), higher temperature of the inlet cause to rapid heat transfer between the products, drying air and water evaporation. This particular situation resulting the reduction of moisture content. In other words, there is a greater gradient of temperature between atomized feed and drying air and it lead to high driving force for evaporation of water. The similar

observation was acquired in the different juice powders for example, watermelon juice (Quek et al, 2007) and tomato juice (Goula & Adamapoulus, 2008).

Nevertheless, when the drying temperature above 170℃ were utilized, a contrast result was observed which is the increase in drying temperature resulted in higher moisture content of the product. This can be assigned to the faster formation of crust that occurred when high temperatures were used, making troublesome the water diffusion to the surface and in this way, bringing about lower water evaporation. Achieving moisture content below 10% is sufficient enough to make sure that the food powder produced is microbiologically safe (Ng, et al., 2012).

As shown in Table 3, the lowest moisture content values were observed at drying temperature around 150℃ which is recorded at 4.350% and maltodextrin around 30%.

a. Pineapple powder physical properties

From the spray drying experiment, the appearance of pineapple powder were yellow greenish in color and powdery as well. Nevertheless, the power of the pineapple fragrance of the powder was reducing along the addition of MD concentration. On top of that, the previous research inferred that when utilizing the MD concentration about 10%, the powder product would be sticky and agglomerated. As a result, these sticky and agglomerated products would deposited onto the wall of drying chamber and cyclone and could not be recovered.

On the other hand, if the powder sealed in capsules within room temperature, the powder would still agglomerated in the course of time as being observed.

However, there are several recommendations that can be follow in order to improve the study of the study of the research which is increase the feed of the slurry solution of pineapple peel to increase the yield of the product. Secondly, use proper speed of the pump to prevent the solution from burned and transformed into sticky powder that stuck on the drying chamber wall leading to less product yield. To improve the product properties, add proper amount of additives to make the product less sticky. Regarding the powder that sealed in the capsules, and still agglomerated as time passes, a better to store the product is on low temperature or in vacuum storage.

C. CONCLUSION

The study is purposely to produce a powdered vitamin C from pineapple skin using the process of encapsulation. The method utilized to produce the powdered product is by spray drying. Another to analyze the optimum temperature at the inlet and maltodextrin concentration to produce highest powdered fruit product yield. Moisture content also one of the parameter that is significant to be tested to make sure the quality of the powdered product. The effect of temperature and maltodextrin concentration utilized are 130℃, 150℃ and 170℃ and 10%, 20% and 30%. The highest yield of the powdered product was recorded at 14.608% at 10% maltodextrin concentration under 150℃. Based on the study conducted, the effect of maltodextrin content and drying air temperature significantly influenced the yield and the moisture content of the powdered product.

ACKNOWLEDGMENT

Thank you to my dear supervisor, Encik Hanafiah Bin Zainal Abidin for all the support and help in completing my research study in the support from Universiti Teknologi Mara on this research project is gratefully acknowledged. And also thanks to Universiti Teknologi Mara for all materials and resource support along finishing the research. The use of chemicals and materials from Universiti Technologi MARA is very helpful and unforgettable. Also not forget to my all research partners for supporting each other in completing the research. All time spend with them are the most precious time and moment to be remembered. They also had given much hand along the research duration. Finally, I want to thanks to my beloved mother and my father for all goods that they had done. Without them, there is nothing I can do in this world. Also to my siblings for all moral support and guidance throughout my research and my study in UiTM Shah Alam.

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