ENCAPSULATION OF VITAMIN C FROM PINEAPPLE SKIN JUICE USING DRIED JELLY

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***Abstract*—The production of fruit-based products with a good nutritional, have a long shelf life and easy to consume is a new trend of food consumption nowadays. In this study, the Vitamin C dried jelly from Yankee pineapple skin juice is produced by using freezing and oven drying process at -18°C and 40°C respectively for 24hours. Varies amount of dried jelly powder (3g, 5g and 7g) mixed with 100mL of pineapple skin juice and 10g of maltodextrin is used. The qualities of the Vitamin C dried jelly is observed in the aspects of shrinkage, colour changes and moisture loss. The observation indicated that the Vitamin C dried jelly which contains 7g of dried jelly powder show the best structure of dried jelly.**

Keywords*— *Pineapple skin juice, oven drying, dried jelly, maltodextrin

I. INTRODUCTION

Pineapple also known as Ananas Comosus is well-known tropical fruit which consist of high vitamins, enzymes and antioxidant. In the global tropical fruits production volumes, pineapple is rank third after the banana and citrus [1]. During the peak season which are months of April and June, largest amount of pineapple will flood the market and this kind of situation make the food industry to keep develop new products from its [2]. The fresh fruit and juice of the pineapple is known as a rich natural source of Vitamin C, potassium, magnesium and other mineral [1].

Table 1: Nutritional value of nutrients in 100g of pineapple [3]

Nutrients	Value	Nutrients	Value
Calcium	16 mg	Potassium	150 mg
Energy	52 Calories	Vitamin A	130 I.U
Carbohydrates	13.7 gm	Vitamin B1	0.0079 mg
Dietary Fibre	1.4 gm	Vitamin B2	0.031 mg
Iron	0.28 mg	Vitamin B3	0.489 mg
Magnesium	12 mg	Vitamin B6	0.110 mg
Protein	0.54 g	**Vitamin C**	**24 mg**
Phosporus	11 mg	Zinc	0.10 mg

In the food industry, pineapples usually export in term of fresh and processed fruits such as juice, canned pineapple and pineapple pulp. During the processing of pineapple, the crown, core, stem and peel are removed as a waste, the waste that rich in nutritious substances which can be employed in human diets usually not used [4]. In order to minimize the impact of the residues toward the environment, there are several process can be use to convert the residues into the valuable products and yield financial gain towards the food industries.

Nowadays, the trend of food consumption is changed due to the fast economic development where the diet nutrient enrichment is more important than the calories assurance. The new generation is more aware with the important of Vitamins [5].

The residues of the pineapple such as skin contains highly Ascorbic acids or Vitamin C. Vitamin C has many advantages towards our health such as impaired of collagen synthesis and important medium in the making of tissues like blood vessels, skin, tendons and cartilages [6].

Advancement in technology has improved the textural and types of the Vitamin C which usually found in the form of tablets and liquid. The attractive, easy to consume and has long shelf life of products is the main criteria of choice for peoples in today's world [7]. Other than in the tablets and liquids form, the Vitamin C also can be produced in the form of dried jelly. Therefore, to turn the pineapple wastes into the more valuable products, Vitamin C in the pineapple skin juice can be developed into the Vitamin C dried jelly by using dehydration process.

The development of fruit-gel product by using hydrocolloids has been studied in several researches. Previous study by Agnieszka C. et al. from University of Life Science, Poland, strawberry jelly is produced by using the Low-Methoxyl Pectin as a hydrocolloid and freeze drying as dehydration process.

Dried jelly (Agar) which plays an important role in the gelling properties is a rigid polysaccharide gel that has many benefits for our daily life. The benefits of the dried jelly are a simple compound, show the widely stability when involved to temperature and pH, easily removed without any special clearance methodologies when act as solvent gel, having a long shelf life when it is in powder form, inexpensive and widely available [8].

Maltodextrin is used as stabilizer such as bulking modifier and texture in the emulsion of food. Besides, maltodextrin also has an ability to bind the fat and flavor of foods and reduce the permeability of oxygen of wall matrix. However, the structural integrity of wall matrix may be reduced due to the low glass transition temperature which leads to formation of crystal [9].

Dehydration is a process of water loss from a food product. By using different dehydration method such as oven drying, freeze drying and spray drying, fresh fruit can be transformed into dry particulates [10]. Oven drying is a process conducted with the universal oven to remove the moisture content or water from the food substances by applying the hot air [2]. The products that have undergone the oven drying process can go through the undesirable structural changes and color.

Thus the objective of this study were to encapsulate the Vitamin C (Ascorbic Acid) from the pineapple skin juice using dried jelly and to observe the shrinkage, colour changes and moisture loss of

vitamin C dried jelly at different amount of dried jelly powder used.

II. METHODOLOGY

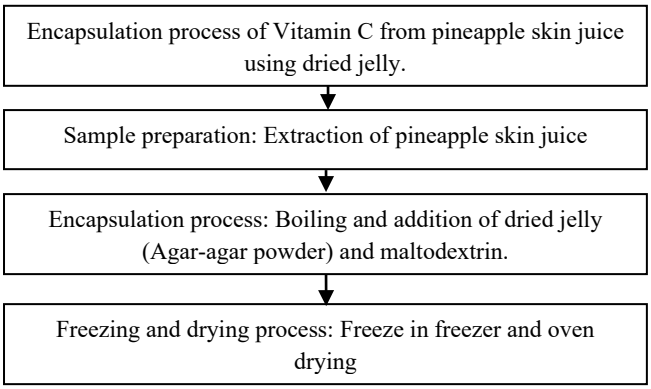

Fig. 1: Flow chart of production of Vitamin C dried jelly

A. Materials

The mature, fresh and fully ripe of 'Yankee' pineapples and dried jelly powder is purchased and maltodextrin provided by the Food Preservation Technology Laboratory is used.

B. Pineapple skin juice preparation

Fresh 'Yankee' pineapple is washed to remove the adhering dirty. Then the pineapple is peeled off and the skin is cut into small pieces [11]. 250g of pineapple skin is boiled with 850mL of distilled water at 200°C for 1 hour. The pineapple skin is blend by using the blender until it become smooth. To produce the pineapple skin juice, the blended pineapple skin juice is filtered.

C. Encapsulation process

Encapsulation is the process to produce the pineapple skin juice Vitamin C in the form of dried jelly. The process of boiling and addition of dried jelly powder (agar-agar powder) and maltodextrin is conducted.

Addition of dried jelly powder and maltodextrin into pineapple skin juice:

Table 2: Parameters of each sample.

Samples	Pineapple skin juice (mL)	Dried jelly powder (g)	Maltodextrin (g)
1	100	3	10
2	100	5	
3	100	7	

The sample of the pineapple skin juice, dried jelly powder and maltodextrin is weight by using analytical balance and mixed together then boiled by using heater until the temperature reached 90°C and kept for 1 minute. The solution is placed in the silicone mold then cooled down to the room temperature (20 – 25 °C).

Freezing process:

The pineapple skin juice jelly then placed in the refrigerator at the optimum temperature for 24 hours. This process is conducted before the drying process. The freezing process is to make the structure of the jelly of the sample more firms.

Drying process:

Drying process is used to dry the pineapple skin juice jelly. In this study, Universal oven (Model UFE500) is used to dry the pineapple skin juice jelly cubes. The temperature for the oven is set to 40°C and the sample is dried for 24 hours.

D. Moisture loss

The moisture loss of each samples of the Vitamin C dried jelly from the pineapple skin juice is calculated using the equation below [2]:

$$\text{Moisture loss (\%)} = \frac{(W1-W2)}{W1} \text{ X } 100 \qquad \text{…Eq.1}$$

Where,
W1: Weight (g) of sample before drying
W2: Weight (g) of sample after drying

III. RESULTS AND DISCUSSION

A. Process during conducting experiment

Pineapple (Ananas Comosus) is well known source of bromelain the proteolytic enzyme. This type of enzymes found most in the pineapple wastes such as peels, leaves and core compared to the fruits and stem. [11] According to study of Tapre A.R. et al., (2014) the degradation of complex molecules in the fruit pulp caused by the enzymes called pectin which responsible for the turbidity in pulp and occurred as structural polysaccharides. When the pectinases added into the fruit juice, the enzymes will react with it. The press ability of the fruit juices will be improved, the structure of jelly will disintegrate, and the viscosity of the fruit juice will drop. [12]

Based on the previous study, it showed that the enzyme has affected the jelly setting of the formation dried jelly. In this research, the same situation has occurred at which the enzymes in the pineapple skin juice has affected the jelly setting of the Vitamin C dried jelly. The enzymes in the pineapple skin juice might breakdown the small amount of protein in the dried jelly powder solution and making them smaller. This reaction make the jelly disintegrate and cannot be in the firm shape. In order to make the Vitamin C dried jelly, the pineapple skin has been boiled at the temperature of 200°C for 1 hour. The purpose of boiling process is destroyed or stops the reaction of enzyme in the pineapple skin. After the boiling process, the pineapple skin juice able to be mixed with the dried jelly powder and form Vitamin C jelly before it continue with the drying process to form Vitamin C dried jelly.

B. Colour Changes

Table 3: Colour changes of samples after drying.

Properties	Sample 1	Sample 2	Sample 3
Vitamin C dried jelly before drying			
Vitamin C after drying			

The colour of the dried products normally affects the attractiveness and quality of the products. For the consumers, the most attractive and high quality of products is close to the colour of raw materials. [7] In this research, the colour of raw Vitamin C dried jelly before entering the oven drying process for 24 hours at 40°C is light yellow for sample 1, 2 and 3 as shown in Table 3. It is

a normal colour for pineapple skin juice as known in our daily life. After going through the drying process, the colour of the Vitamin C dried jelly change from light yellow to dark yellowish-brown for all of the samples as shown in Table 3. According to Jittanit W. et al. (2010), the changes of colour from light to dark may be because of the occurring of non-enzymatic browning reaction such as caramelization and maillard during the drying process. This reaction occurred because of high heat supplied to the Vitamin C dried jelly during the drying process and sugar content or maltodextrin in the pineapple skin juice solution. [13]

C. Moisture loss

Table 4: Results of moisture loss of samples.

Properties	Sample 1	Sample 2	Sample 3
Weight of sample before drying (g)	12.49	13.44	14.98
Weight of sample After drying (g)	3.76	4.24	5.20
Moisture loss (%)	69.90	68.45	65.29

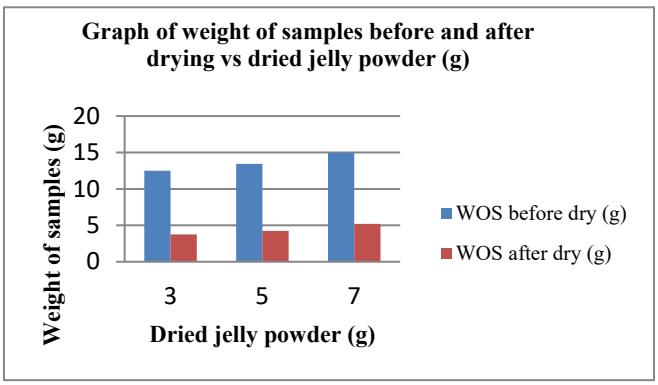

Fig. 2: Graph of weight of sample before and after drying process vs amount of dried jelly powder.

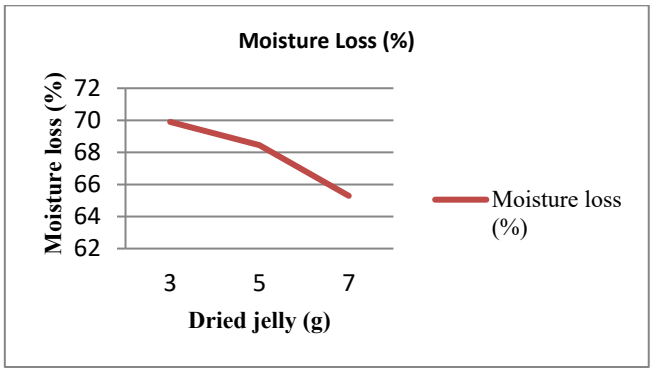

Fig. 3: Graph of moisture loss vs amount of dried jelly

The amount of water loss in Vitamin C dried jelly was identified by the weight of samples before and after the drying process. The moisture loss is important to make sure the Vitamin C dried jelly can be keep at a good quality condition. [14] Fig. 1 shows the graph of weight of samples 1, 2 and 3 before and after the drying process. From the graph, the value of moisture loss is calculated using Eq. 1. The percentage of moisture loss of the Vitamin C dried jelly after drying process is shown in Table 4 and Figure 2. The results showed that the moisture loss at sample 1 contains 3g of dried jelly is highest compared to the sample 2 and sample 3 which contains 5g and 7g dried jelly respectively. Small portion of dried jelly powder added into the pineapple skin juice decreases the total solid content and the amount of the water evaporation. Hence, it will increase the moisture loss of the Vitamin C. These also mean that Vitamin C dried jelly with higher moisture loss could be obtained by decreasing the amount of dried jelly powder added into the pineapple skin juice solution.

D. Shrinkage

Table 5: Shrinkage of the samples

Properties	Sample 1	Sample 2	Sample 3
Vitamin C dried jelly before drying			
Vitamin C after drying			
Shrinkage	Less	Moderate	More

Shrinkage is a common phenomenon occurred in all dried products. [7] It is used to improve the stability of foods, since it control the water activity of the products and reduces the microbiological activity. [15] The results of shrinkage investigation for oven drying samples with dried jelly were shown in Table 4. Based on the observation, the less and more shrinkage of the Vitamin C dried jelly is found in the sample 1 and sample 3 which contains 3g and 7g of dried jelly powder respectively. Besides, the sample 2 of Vitamin C dried jelly which contains 5g of dried jelly powder characterized as normal or average shrinkage. According to Mayor L. et al. (2004), the shrinkage happened because of the drying process and loss of water which cause stresses in the cellular structure of the foods leading to decrease in dimension and change in shape. [15] In this research, the shrinkage of Vitamin C dried jelly might be caused by the amount of dried jelly powder added into the solution. The higher amount of the dried jelly powder used in sample 3 produced more shrinkage products. Other than that, sample 1 which contains less amount of dried jelly powder produced less shrinkage and a bit crack on surface of products. The surface cracking happens when shrinkage is not uniform and lead to the unbalanced stresses formation during the drying process. [15] Sample 2 that contains 5g of dried jelly powder has a normal shrinkage than the sample 1 and 3 which mean sample 2 is the best Vitamin C dried jelly produced in this research.

IV. Conclusion

The results obtained confirm that the different amount of dried jelly powder used in the experiment give an impact toward the formation of the Vitamin C dried jelly. Among the different amount of dried jelly powder used, sample 2 of which contain 5g dried jelly powder found to be the best in the Vitamin C dried jelly in this research. The shrinkage and moisture loss of the sample 2 is normal and 68.45% compared to the shrinkage and water loss of sample 1 and 3. As a conclusion, the smallest amount of dried jelly powder could be obtained high moisture loss of the Vitamin C dried jelly.

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