Evaluation and Benefit of Physico-chemical Properties of *Physalis Minima Linn* Plant for Food Addictive

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***Abstract*— The evaluation and benefits of physicochemical properties of *Physalis Minima Linn* plant were investigated. To identify these properties, the fruits for this plant need to obtain in powder form. Therefore, the fruit was washed, dried about 24 hours and grinded using a grinder machine with the size of sieve 0.25 mm to obtain *physalis minima linn* powder. The physicochemical parameter of this seed are bulk density, true density, porosity, water absorption index, water solubility index, oil absorption index, swelling index, percentage of solubility, foaming capacity, and foaming stability. It was observed that, the results value are 0.3358 g/mL, 2.1633 g/mL, 0.8466%, 93.673 g/g, 53.6 g/g, 2.9783 mL/g, 1.3424 g/g, 2.3539 g/g, 0.05%, 141.67%, respectively. The moisture content for root, leaf and branch for this plant also were analyzed and the result was obtaining are 90.44%, 88.12% and 94.74%, respectively. Due to high percentage in water absorption and water solubility properties, it helps consumer to relieve diarrhea and avoid constipation.**

Keywords—Foaming, Porosity, Solubility.

I. INTRODUCTION

Based on Food Agriculture Organization (FAO), in year 2050, World's population was expected to reach about 9.1 billion and it will require at least 70% increasing the food production with need net of food for biofuels (FAO, 2009; Mokhtar, Swailam, & Embaby, 2018). The type of food is very important to ensure people live with healthy lifestyle and can avoid from diseases. Nowadays, a lot of owner in industrial food processing used the addictive and flavor in their product to make that food more attractive and more delicious. It is very good for the company to make their product become commercial and well known. However, there will be a problem when dealing with an irresponsible company that used dangerous, addictive or overdose addictive in their product. For food additives, a study about function of plant in the processing food also needs to explore to know their characteristic and properties. A lot of plants have a good potential to enhanced and beneficial to food processing. Nowadays traditional health systems and medicinal plants in solving the health problem of the world are gaining increasing attention (Mohammad Hassan Moshafi & Ameria, 2009). From that, the exploration of plant in processing food need to be done, because it will be beneficial to living things health, especially human that consumed variety of food every day in daily life. Moreover, in our forest, there are a lot of plants that people did not know their characteristics and their advantages. One of the plants that can be explored more is Goldenberry or also known as *Physalis Minima Linn* plant and this plant is from a member of the genus. *Physalis Minima Linn* comes from Solanaceae's family, which is important and produces edible fruits. (Mokhtar et al., 2018). The characteristic of this fruit is a very small, orange and juicy berry. This fruit has many numerous small seeds and this fruit covered by a calyx, which is papery husk. The roots of this fruit are very popular because it can make a tea that can make a medicine to people's health. This plant also used in local crafts, ornamental and food, the most common and most important use is in the preparation of sauces (Sánchez et al., 2008)(Vargas-Arana, 2013). Other than that, this plant also very famous in the medical treatment. It can treat a variety of diseases such as asthma, hepatitis, dermatitis malaria, and rheumatism (Sateesh Poojari, 2014). Although in some article, it states that this plant contains rich of chemical compositions, high nutritional value and suitable to use for production of food. (Nawirska-Olszanska, Stepien, 2017; Ramadan, 2011). *Physalis Minima Linn* fruit is a fruit that has amazing nutrients and they provide something overlooked such as contains vitamins A and C, minerals and carotenoids (Mokhtar et al., 2018; Ramadan, 2011).

The physicochemical properties of this fruit are important that need to be evaluate such as the value of water solubility, water absorption and foaming capacity. These properties like water solubility very useful. It allows and regulate high cholesterol triglycerides. It also controsl blood sugar because if the percentage solubility is higher, it allow and it will relieve diarrhea and can avoid constipation to people.

From that, the exploration for this plant in food processing need to be done, because it will be beneficial to living things health, especially human that consumed variety of food every day in daily life. Moreover, in fact this plant is almost everywhere and easy to find but it was abandoned. Therefore the objective of this study was to evaluate the physico-chemical properties for *physalis minima linn* plant and to identify their physico-chemical benefits to the people especially for addictive in food processing industry.

II. METHODOLOGY

A. Preparation for Physalis Minima Linn powder

This Goldenberry (*Physalis Minima Linn*) was collected from Kedah, Malaysia and the experiment were conducted in University Teknologi Mara (UiTM) in Faculty of Chemical engineering Laboratory. The fruit was separate from their calyxes and washed using tap water. That fruit was rinse and kept dried. This fruit was dried using convective dryer for 24 hours. Air velocity was maintained at 0.6 m/s. After 24 hours dried, it was grinded using a grinder machine with the size of sieve 0.25 mm.

B. Bulk Density

The bulk density of this goldenberry was carry out using the method from (Abiodun Oa, 2014; Mokhtar et al., 2018). Measuring cylinder was filled with powder and was tapped until the volume not increased anymore. Next, the weight and the volume of sample was recorded. By using the formula, the value of bulk density was calculated. The experiment was repeated thrice, and the average result was recorded.

$$\text{Bulk density} = \frac{\text{Weight of sample (g)}}{\text{Volume of sample (ml)}}$$

C. True Density

The true density was measured in a measuring cylinder by using toluene displacement method, which be an accuracy of 0.1 cubic centimeters. Due to ensure the non-absorbance of toluene, a few grams of powder were dipped into toluene and the weight of the sample was recorded. The experiment was repeated thrice, and the average result was recorded.

$$\text{True density} = \frac{\text{Weight of sample (g)}}{\text{Volume by toluene displacement (ml)}}$$

D. Porosity

The porosity of the Physalis Minima Linn plant was calculated by using the value of bulk density and true density. Formula below was used in order to calculate the value of porosity.

$$\text{Porosity, \%} = \frac{\text{True density} - \text{Bulk density}}{\text{True density}} \times 100$$

E. Water Absorption Index & Water Solubility Index

Water Absorption Index & Water Solubility Index was carrying out using the method from (Mokhtar et al., 2018). One gram of the sample was poured into 10 mL distilled water in a centrifuge tube. The Sample was stirred about 2 minutes and continued centrifuge with 3000rpm for 15 minutes. The precipitate was obtained and the sample were transfer into evaporating dish. The precipitated was weight and recorded. The water absorption index and water solubility index was calculated using that formula. The experiment was replicated thrice, and the average result was recorded.

$$\text{Water absorption index} = \frac{\text{Weight of the sediment (g)}}{\text{Weight of the sample}}$$

Water solubility index = (Weight of dry solids from the supernatant (g))/(Weight of the sample)

F. Oil Absorption Index

The value of oil absorption index was carried out according journal (Appiah & Oduro, 2011; Mokhtar et al., 2018). One gram of *physalis minima linn* sample was mixed with 60mL of refined corn oil in centrifuge. The sample was stirred for 1 minute and leave for the 30 minutes. After stirring, that sample was continued by centrifuged about 3000rpm for 20 minutes and after that, the free oil volume was recorded. The experiment was replicated thrice, and the average result was calculated.

$$\text{Oil absorption index} = \frac{\text{Volume of the absorbed oil (ml)}}{\text{Weight of sample}}$$

G. Swelling Index and Percentage of Solubility

Swelling index and percentage of solubility was carry out using a method from (Appiah & Oduro, 2011; Mokhtar et al., 2018). Mix 1 gram of the sample with 10 mL distilled water were put in a centrifuge tube and heat at 80^{o}C for 30minutes. Heat that sample by shaking it continuously. After 30 minutes, remove from the bath, wipe dry, cool at room temperature and supernatant will evaporate. Dried and weight the supernatant to determine the swelling index and percentage of solubility of the powder. The experiment was replicated thrice, and the average result was recorded.

$$\text{Solubility,\%} = \frac{\text{Weight of dried sample in supernatant}}{\text{Weight of original sample}} \times 100$$

$$\text{Swelling Index,\%} = \frac{\text{Weight of wet mass of sediment}}{\text{Weight of dry gel}}$$

H. Foaming Capacity and Foaming Stability

Foaming Capacity and foaming stability will carry out using a method from (Appiah & Oduro, 2011; Mokhtar et al., 2018) with slight modifications. Mix 2 gram of sample in 100mL distilled water and blend using blender. Blend about 5 minutes in high-speed condition. Calculate foaming capacity and foaming stability using that formula. The experiment was replicated thrice, and the average result was recorded.

$$\text{Foaming Capacity,\%} = \frac{V_a - V_b}{V_b} \times 100$$

Where,

Va = Volume of liquid foam (Ml)

Vb = Volume of mixture before blending

The foam stability will be measured in terms of how stable the formed foam lasted at room temperature.

Foaming stability= Volume of foam one hour after whipping

I. Moisture Content

The moisture content of Physalis Minima Linn powder was analyzed by using hot air oven method. Approximately 10-15 g sample was weighed using moisture content can and follow by dried in oven. The temperature and was set 105^0C and the time were set about 24 hours. After completing that drying, the sample was transfer into desiccators and weighed using electronic balance. After that, the sample was dried again about 6 hours until the two conservative reading were same. The value of moisture content was calculated by using this formula below. The experiment was replicated thrice, and the average result was recorded.

$$\text{MC, \%} = \frac{\text{Initial weight of sample- Final weight of sample}}{\text{Initial weight}} \text{ x100}$$

III. RESULTS AND DISCUSSION

A. Physico-chemical properties of Physalis Minimal Lin powder

Table 1: Physicochemical result

Analysis	**Result**
Bulk Density	0.3358 g/mL
True Density	2.1633 g/mL
Porosity	0.8466 %
Water Absorption Index	93.67 %
Water Solubility Index	53.6 g/g
Oil Absorption Index	2.9783 mL/g
Swelling Index	1.3424g/g
Percentage Solubility	2.3539 g/g
Foaming Capacity	0.05%
Foaming Stability	141.67%

B. Moisture Content

Table 2: Moisture content result

Analysis	**Result (%)**
Root	90.44
Leaf	88.12
Branch	94.74

Physico-chemical and Functional Properties of Physalis Minima Linn Plant

Bulk density

The bulk density (g/mL) means that density measured without using of any press or force. It also means measure of powder heaviness, and an important characteristic that evaluates the suitability of powder for food formulations. The data below show that Physalis Minimal Linn plant had low packed bulk density which is 0.3358 g/mL. In a study by (Akubor, 1999), the orange seed flour has very low bulk density and it would be beneficial in the preparation of weaning food formulation. The low bulk density is desirable in infant food preparation and in the formulation of complementary foods (Mokhtar et al., 2018), (Akubor, 1999),(Appiah & Oduro, 2011). The present study revealed that bulk density depends on the particle size and initial moisture content. However, for the high bulk density of powder suggests their suitability for use in food preparations. The value of bulk density is very an important parameter that needs to determine especially in large industry for the ease of packaging and transportation of particulate foods. According to (Nelson, 2007) low bulk density are suitable for infant food preparation. Thus, this plant are suggested could be very useful in infant formulation.

True Density

True or absolute value of density is useful to identify the type and material used for the separation equipment. In industry that related to powder, it is quite difficult to transfer and manage the particle of powder due to stuck in the pipeline. Therefore, the exact value true density need to identify to calculate and design suitable equipment to manage this thing. Absolute density corresponds to the real solid density and does not consider the spaces between particles, in contrast to the bulk density, which takes into account all these spaces (Tonon, Brabet, & Hubinger, 2010). Below shows the value of the true density is 2.1633 g/mL

Porosity

The calculation for porosity depends on the value of bulk and true density, the variation of the ratio of mass seed with respect to the total volume depends on the change of these two properties (Vilche, 2003). Porosity is an important property that need to be known especially in the case of microbrewery where the encapsulated material is harm and cause oxidation (Tonon et al., 2010). The result shown the *Physalis Minimal Linn* plant have high percentage of porosity which is 0.8466.The larger number of spaces between particles implies in higher quantity of oxygen available to degradation reactions, leading to a faster loss of the compound being protected.

Water Absorption Index

The water absorption index for this plant is 93.67%. The powder with high water absorption may have more hydrophilic constituents such as polysaccharides (Swaminathan Santhalakshmy, 2015). Water absorption index is an important processing parameter and has implications for viscosity. From that, it acting as a water absorbing agent, which can increase stool thickness and slow down of food pass through the colon. It will relieve diarrhea. It is also important in bulking and consistency of products, as well as in baking application. According the journal (Chandra, 26 May 2014), high water absorption capacity of composite flours suggests that the flours can be used in formulation of some foods such as sausage, dough, processed cheese and bakery products. According to (Osungbaro, 2010), the distribution mixing of the powder in food processing industry is depends on the value of water absorption index. The higher the water absorption index, the least cost needed to complete the mixing in the dough handling. The relation between water and protein in dealing with food is important to these properties such as swelling power, hydration gelation and solubility (Etudaiye, January 2009). If the water absorption index is higher, it is very useful in food formulation (Appiah & Oduro, 2011).

Water solubility index

Solubility index for this plant is 53.6 g/g. Solubility is very important to determine the level of easy which flour that can dissolve the powder particle in cooking water. It also involves to a

finely dispersed collided system, with consists of a smooth structure and homogeneous macroscopic structure. In food processing industry, the water solubility index very useful to estimate and determine optimum level or situation for the extraction flour. According the (Appiah, 2011) solubility of flour of A.altilis is low and suggested it is digestible and it also suitable for infant food formulation. Due to excellent water solubility, psyllium can absorb water and become a thick, viscous compound that resists digestion in the small intestine. It helps to regulate high cholesterol and manage to relieve diarrhea and constipation.

Oil Absorption Index

The results presented in table below show that the oil absorption capacity of orange seed flour samples was 2.9783 g/g indicating a good ability to physically entrap oil. The oil absorption index is influenced by the lipophilic nature on the granula surface and interior which were influenced for functional properties of starches. The major chemical affecting oil absorption index is protein, which is composed of both hydrophilic and hydrophobic parts. Non-polar amino acid side chains can form hydrophobic interactions with hydrocarbon chains of lipid (Eltayeb et al., 2011) and has implication in functional properties of flours. Oil absorption index is importance since oil acts as flavor retainer and increase the mouth feel of foods, improvement of palatability and extension of shelf life particularly in bakery or meat products where fat absorptions are desired.

Swelling Index

The swelling capacity of each powder depends on size of particles, types of variety and types of processing methods or unit operations (Chandra, 26 May 2014). It also related to protein and starch contain (Tharise, 2014). For the Physalis Minima Linn plant, the swelling index is in range 1.3424 g/g. (Abiodun Oa, 2014) observed that swelling index usually conducted by the strength and behavior of the micellar network within starch granular. High percentage of swelling index is very important characteristic for good quality powder. Therefore, if the swelling index for Physalis Minimal Linn is high, it is very suitable for food production (Appiah & Oduro, 2011).

Foaming Capacity and Foaming Stability

Foam capacity means the amount of interfacial area that can be produce by the protein. Foam is a colloidal of many gas bubbles trapped in a liquid or solid. Small air bubbles are surrounded by thin liquid films. The foam stability (FS) refers to the ability of protein to stabilize against gravitational and mechanical stresses. Data show that, the foaming capacity and foaming stability of powder are 0.05 % and 141.67 % respectively. Powder with high foaming ability could form large air bubbles surrounded by thinner a less flexible protein film. This air bubbles might be easier to collapse and consequently lowered the foam stability.

Moisture content

Moisture content is a significant element of powder, which is equivalent to the drying process. Moisture content in this plant is the main key in determining its flow ability, stickiness, and storage stability (Swaminathan Santhalakshmy, 2015). For this plant, the moisture contains of root, leaf, branch are 90.44%, 88.12% and 94.74 % respectively. In food industry processing, the moisture content need to determine to prevent the microbial growth and any chemical reaction or chemical changes during storage (Tharise, 2014). Reported results were also almost same with (Damla Dag, 2017) showing that the moisture content of the fresh goldenberry juicy was determined as 87.95%. Noted that, the powders were in glassy state at these moisture contents due to decreasing in the water content at the end of heating.

IV. CONCLUSION

The physicochemical properties of *Physalis Minima Linn* plant were determined. According the result and discussion, most of the physicochemical characteristic of this plant are important and can be used as a natural additive in food industry processing. The high-water solubility index in this plant can manage people diarrhea and reduce constipation. It can be concluded that, this plant not only significant in medical treatment, but it also significant in food processing industry. The determination of physicochemical properties not only important of storage and handling but it also can replace the dangerous food addictive to natural addictive that can be beneficial to people.

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