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Electrical Performance of Durian Skin Powder Nanoparticles with Addition of EDTA Concentration and Crystal Size Control

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Abstract: One area that interests many researchers is the development of nanoparticle synthesis methods. Nanoparticles can occur naturally or through a synthesis process by humans. Nanoparticle synthesis means making particles less than 100 nm in size and simultaneously changing their properties or functions. Durian skin powder nanoparticles were synthesized using the coprecipitation method. Where the coprecipitation method is one method of synthesis of inorganic compounds based on the deposition of more than one substance together when it passes the saturation point. Coprecipitation is a method that processes using low temperatures and is easy to control particle size so that the time needed is relatively shorter. EDTA is used to control the crystal size (diamin tetra acetate ethanol) is a titrating ligand that is widely used in complexometric titration. EDTA added was varied by 10 drops, 15 drops, 20 drops and 25 drops to see the change in crystal size that occurred. This crystal size control aims to obtain maximum electrical performance in durian leather powder. The maximum electrical voltage obtained by adding EDTA little by little is 5.5 Volt with maximum droplets as well and the crystal size is 4.9 nm. The performance of the partners obtained is not that different from the others. So that it can be said that the voltage will continue to increase when the size of the crystal gets smaller and the addition of EDTA increases the droplets increasing the value of the electrical voltage and reducing the size of the crystals of the durian leather powder.
Keywords: Nanoparticles, Durian skin powder, Electrical performance, EDTA, Crystal size.

INTRODUCTION

At present the development of nanotechnology continues to be carried out by researchers from the academic world from the industrial world. One area that interests many researchers is the development of nanoparticle synthesis methods. Nanoparticles can occur naturally or through a synthesis process by humans. Nanoparticle synthesis means making particles less than 100 nm in size and simultaneously changing their properties or functions. People generally want to understand more deeply why nanoparticles can have different properties or functions than similar materials in bulk. The two main things that make nanoparticles different from similar materials in large sizes are: (a) because of their small size, nanoparticles have a greater value of comparison between surface area and volume compared to similar particles in large sizes [1]. This makes the nanoparticles more reactive. Material reactivity is determined by atoms on the surface, because only those atoms come into direct contact with other materials; (b) when the particle size goes to the nanometer order, the applicable laws of physics are dominated by the laws of quantum physics. Nanoparticles are quantities that state the size of a nanometer (nm) material. When a material is in the form of a nanoparticle, usually the particle has properties that are different from the properties of the previous material. This is what causes the concept of nanoparticles to be a bridge in studying the properties of matter with the properties of the constituent atoms [2]. With this fact, nanoparticles have the potential to be developed to be implicated in everyday life. The material to be made comes from durian leather waste. Durian (Durio zibethinus), nicknamed The King of Fruit, is one of the most popular fruits in Indonesia and the fruit is always there, not knowing the season, especially in North Sumatra which is famous for Medan Durian. Durian is very popular in Indonesia because its delicious taste and affordable prices make the public's interest in durian high, which raises the volume of waste of skin and seeds that can pollute the environment. When viewed, the percentage of the meat is low, only 20-35%, while the skin (60-75%), and seeds (5-15%) have not been utilized optimally. Durian skin contains potassium, sodium, manganese, high folic acid which can be used to drain positive and negative ions. The content of this substance then creates electricity [3].

Therefore it is necessary to take serious handling of the problem of durian skin that is increasing While the need for new energy sources is actively sought and developed along with the development of biomaterials [4].The search for electrical energy sources is also focused on organic materials that are environmentally friendly, safe for humans, easily available and can be continuously updated which will be made in the form of batteries. A material when connected with battery electrodes, an electrochemical reaction will occur and the flow of electric current from the positive pole to the negative pole. With this eco-friendly battery, it can minimize the waste of mercury, cadmium and other heavy metals. The coprecipitation method is one method of nanoparticle synthesis which is quite simple and easy. This method is also one of the "wet methods" because the process involves solution as a medium [5]. The coprecipitation method is a chemical process that carries a solute down so that the desired sediment is formed. In the coprecipitation method the basic materials are deposited together stoichiometrically with certain reactants. Where the coprecipitation method is one method of synthesis of inorganic compounds based on the deposition of more than one substance together when it passes the saturation point [6]. Coprecipitation is a method that processes using low temperatures and is easy to control particle size so that the time needed is relatively shorter. Some of the most commonly used substances as precipitating substances in coprecipitation are hydroxide, carbonate, sulfate and oxalate. The surfactant used in this study was EDTA (diaminine tetra acetate) is a titrating ligand that is widely used in complexometric titration. Diamin tetra acetate (EDTA) is a titrating ligand that is widely used in complexometric titration. EDTA has the following structural formula:

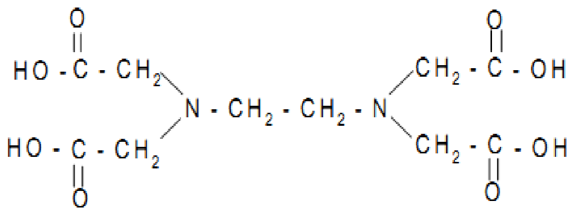

Fig-1: Formula molecular structure of EDTA
Source: [2]

EDTA (diamin tetra acetate ethanol) in this study is used as a complexor or called surfactant in formed crystals whose purpose is that the crystals do not increase due to the effects that occur in the chemical reaction [7]. Chemical reactions that occur will produce colloids. Between particles in the colloid will experience brown motion which results in uncontrolled particle size. For this reason, by deactivating the surface of colloidal particles, the particle size will be stable. If not deactivated, the size of the colloidal particles will usually continue to grow as long as there are remaining precursor atoms in the solution [8]. One method of deactivation that is mostly done is using a surfactant. The surfactant molecule attaches to the created colloidal surface and protects the surface from increasing the number of precursor atoms even though there are still precursor atoms in the colloid that have not reacted[9].

METHODOLOGY

The method used in this study is the experimental method in the laboratory, namely the coprecipitation method [10]. Where the surfactant used is EDTA (diaminine tetra acetate) is used as a complexor or called surfactant in formed crystals whose purpose is that the crystals do not increase due to the effects that occur in the chemical reaction. Durian skin waste is mashed as much as 10 grams mixed with 50 ml distilled water, then adding 50 ml ethanol, the solution is sterilized and synthesized using a magnetic stirrer and heated to 80 ° C [8].

Slowly drop a little by little with EDTA which is 10 drops, 15 drops, 20 drops and 25 drops. After that cool the solution at room temperature for a few moments. Then dry it for 24 hours.

RESULTS AND DISCUSSION

The results of the synthesis of durian leather waste are in the form of powder which is then characterized by XRD (X-Ray Diffraction) to see the size of the crystals formed. The XRD graph obtained is as follows.

Fig-2: Synthesis of durian skin waste samples
Sources: Primary figure

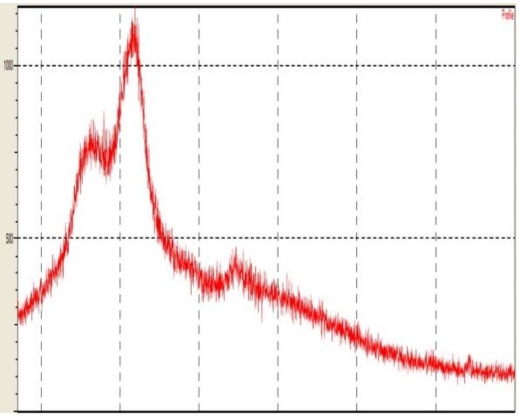

Fig-3: X-Ray Diffraction Chart
Sources: Primary Data

Table-1: Calculation of crystal size with the scherrer grain size equation for samples of durian skin waste powder

Center 2 α	α	Cos α	FWMH	Crystal size
15.6200	7.81	0.96306	2.93340	4.9 nm
16.2600	8.13	0.96000	3.20000	4.51 nm
21.4000	10.7	0.93105	3.56000	4.81 nm
24.6000	12.3	0.90923	3.04000	5.01 nm

Sources: Primary data

The characteristics of using XRD are carried out to determine the crystalline size, so using the scherer grain size equation; we get the crystalline size as shown in the table. It can be seen that the crystalline size of nanometer-sized durian peel waste powder is 4.1 - 5.1 nm for peak peaks which have the highest size of FWHM.

Variation of addition of surfactants

For variations in the addition of surfactants namely EDTA is to see the value of electrical voltage and crystal size. The data generated from this stage are as follows;

Tabel-2: EDTA Addition Data, crystal size and electrical voltage

Addition EDTA	Crystal size	Electrical Voltage
10 drops	5,01 nm	5,27 V
15 drops	4,81 nm	5,35 V
20 drops	4,51 nm	5,4 V
25 drops	4,9 nm	5,5 V

Sources: Primary data

Based on the above table above the value of electric voltage tends to decrease with increasing size of the crystal. So that the size of the crystal which is increasingly towards the nano / small order results in an increasing voltage value. As for the addition of EDTA, the more droplets increase the value of the voltage and reduce the size of the crystals of the LKD powder. The addition of EDTA seems to control the size of the crystal and also controls the value of the voltage to be more stable. This can be seen in the graph graph in the following.

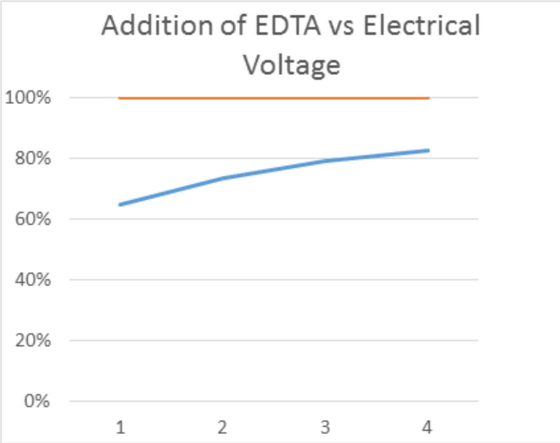

Fig-4: Graph of the relationship of adding EDTA and electric voltage
Sources: Primary Data

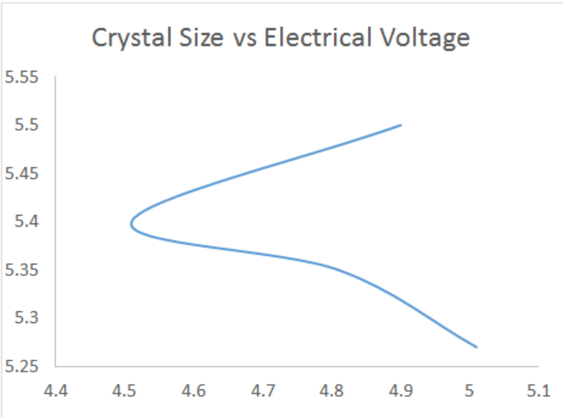

Fig-5: Graph of the relationship between crystal size and electric voltage
Sources: Primary Data

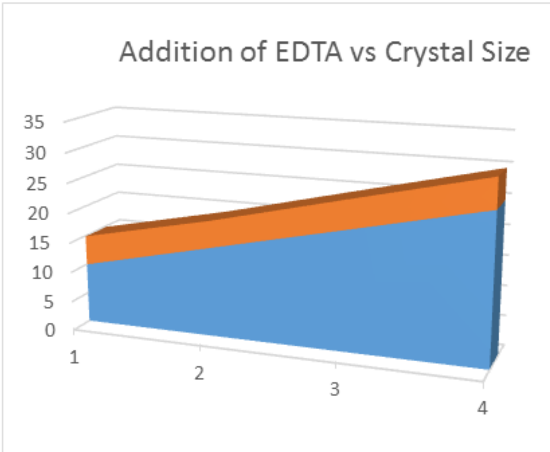

Fig-6: Graph of the relationship of adding EDTA and crystal size
Sources: Primary Data

CONCLUSION

The conclusion obtained from this study is that ion mobility significantly increases due to the crystalline size of the sample. While the electricity voltage will continue to increase when the size of the crystal gets smaller and the addition of EDTA increases the droplets increase the value of the voltage and reduce the size of the crystals of durian leather powder. There is a maximum voltage of 5.5 volts in the addition of 2 drops of EDTA with the smallest kerista size of 4.9 nm

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