# The Effect of NaOH Concentration and Stem Size in The Making of Oxalic Acid from Banana Stem

**D Purwanto[1], A Rasmito[1], Sihabuddin[1]**
[1] Chemical Engineering Department, Universitas WR Supratman, Surabaya
Email: *didikitats@gmail.com

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***Abstrak***

*Tujuan utama dari penelitian ini adalah untuk mengetahui pengaruh konsentrasi NaOH dan ukuran potongan batang pisang terhadap konsentrasi asam oksalat yang dihasilkan. Prosedur percobaan adalah menambahkan 20-gram batang pisang yang telah dikeringkan ke dalam 200 ml NaOH kemudian dipanaskan dan diaduk pada suhu 100°C selama 1 jam. Kemudian campuran cair tersebut ditambahkan dengan 500 ml air panas, kemudian didinginkan dan disaring. Filtrat diambil dan ditambahkan 100 ml CaCl2. Solusi disaring dan sedimen diambil. Sedimen dimasukkan ke dalam Erlenmeyer dan ditambahkan 200 ml H2SO4 encer kemudian disaring. 10 g karbon aktif ditambahkan ke dalam filtrat larutan, kemudian disaring. Diambil 10 ml filtrat diatas untuk dititrasi. Dari penelitian yang telah dilakukan dapat disimpulkan bahwa semakin besar konsentrasi NaOH maka semakin besar pula jumlah asam oksalat yang diperoleh. Semakin panjang ukuran pelepah pisang maka semakin besar jumlah asam oksalat yang diperoleh. Dan asam oksalat maksimum yang diperoleh adalah 2,99 g yang dicapai pada konsentrasi NaOH 50% dengan panjang daun pisang 2,5 cm.*

***Kata Kunci:*** *oxalic acid, banana stem, NaOH, titration*

***Abstract***

The main purpose of this research is to determine the effect of NaOH concentration and size of banana stem pieces on the concentration of oxalic acid produced. The experiment procedure is add 20 grams of banana stems that have been dried into 200 ml NaOH then heated and stirred at temperature of 100°C for 1 hour. Then the molten mixture was added with hot 500 ml of water, then cooled and filtered. Filtrate was taken and added to 100 ml CaCl2. Solution is filtered and the sediment is taken. Sediment is inserted into the Erlenmeyer and 200 ml dilute H2SO4 added and then filtered. 10 g active carbon is added into filtrate of the solution, then filtered. Taking 10 ml of the filtrate above to be titrated. From the research has been done, it can be concluded that the greater the concentration of NaOH, the greater the amount of oxalic acid obtained. The longer the size of the banana midrib, the greater the amount of oxalic acid obtained. And, the maximum amount of oxalic acid obtained is 2.99 g that reach at a concentration of 50% NaOH with a length of the banana leaf 2.5 cm.

***Keywords:*** *oxalic acid, banana stem, NaOH, titration*

## 1. Introduction

Oxalic acid is a strong organic acid, which belongs to the family of dicarboxylic acids [1][2]. It sometimes occurs as a free acid but more commonly as a calcium salt. Oxalic acid has very wide applications in pharmaceuticals, waste water treatment, food industry and hydrometallurgy. It serves as food preservatives, for example, as anti-browning agents for apple, in postharvest browning of litchi fruit and in postharvest ripening of banana fruit. It is also used for the removal of iron present in kaolin due to its high reduction power [3].

Currently, the majority of Oxalic acid is produced via chemical methods. These methods include oxidation of olefins and glycols, decomposition of formats followed by H2SO4 treatment, oxidation of

carbohydrates with HNO3, fusion of sawdust with caustic soda and radiation processing of carbonate solutions and molasses [4]. It is clear that these methods will impact negatively on the environment and may not be commercially attractive, especially with the recent concern for development of environmentally friendly processes such as the microbial fermentation for Oxalic acid production.

Oxalic acid is commonly found in nature in plants such as spinach, rhubarb and beet root. Its biosynthesis has long been known to occur in a variety of organisms such as bacteria, fungi, plants, and animals [5][6]. Nevertheless, filamentous fungus, Aspergillus Niger, remains the microorganism of choice for Oxalic acid production due to easy handling, ability to ferment a variety of cheap raw materials, and high yields [7]. A variety of substrates have been investigated for Oxalic acid fermentation using A. Niger, which include lactose permeate milk whey, molasses, post-refining fatty acids, lipids, glucose, biodiesel-derived waste glycerol, and sweet potato starch hydrolysate [8][9].

Banana stems are one of the agricultural waste materials, and can be used as raw materials for the manufacture of oxalic acid. Banana plants can be found everywhere, especially in rural areas. Banana plants are easy to grow and have a short lifetime [10]. Fruits and flowers of banana plants is usually consumed by humans or animal. Banana leaves are generally used as food wrappers or handicraft materials. The other part of the banana plant, namely the banana stem, has not been processed into something useful. It is usually just thrown away and become agricultural waste.

Basically, agricultural waste such as banana stem is composed of carbohydrate compounds. The main composition of banana stem is cellulose and lignin. Banana stem when melted using a strong base solution such as NaOH, KOH, will produce oxalic acid. However, research data regarding the operating conditions and the required alkaline solution composition have not been widely published. Therefore, further research on the manufacture of oxalic acid from banana stem is needed [11].

The main purpose of this research is to determine the effect of NaOH concentration and size of banana stem pieces on the concentration of oxalic acid produced.

## 2. Method

### 2.1. Materials

Materials used in this research are: Banana klutuk stem, NaOH solution, dilute H2SO4 solution, CaCl2, Activated carbon and water. The fixed variables are: 1 hour of reaction time, 100°C for temperature reaction, 20 grams mass of banana midrib and 200 ml of NaOH solution used. The various concentration of NaOH (%) were: 10, 20, 30, 40, 50. The length of the banana midrib was variated: 0.5 cm; 1.0 cm; 1.5 cm; 2.0 cm; 2.5 cm. Equipment used in this experiment are: Erlenmeyer, Beaker glass, measuring cup, Glass stirrer, Electric balance, Heater, Filter paper, Thermometer, Buchner funnel, Volumetric flask, Burette and static, Reflux Condenser, three neck flask (see figure 1).

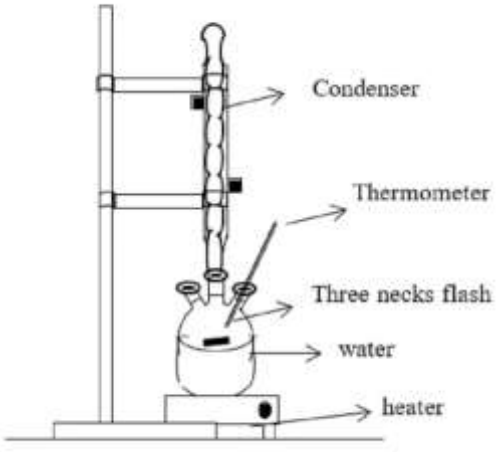


**Figure 1. Main equipment three neck flash**

2.2. Method

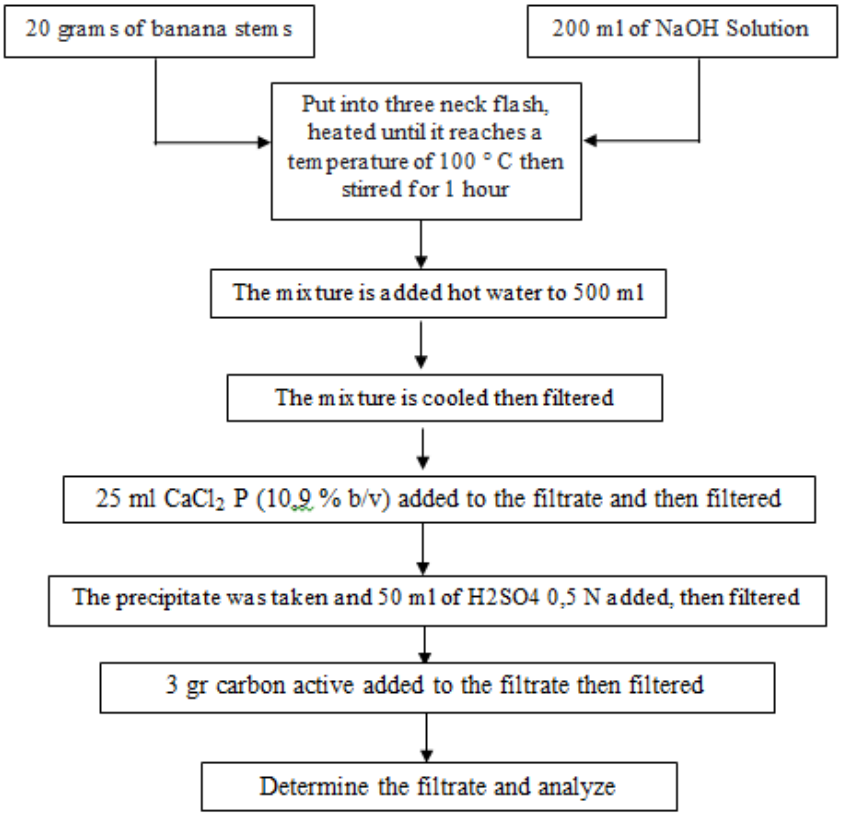


**Figure 2. Steps of experiment**

The process of making oxalic acid from banana tree trunks was started by mixing 20 g of dried banana stems with 200 ml of NaOH solution in a three-neck flask. The mixture was heated for 1 hour, at a temperature of 100°C. Then the mixture was diluted with hot water become 500 ml of solution. After the mixture being cooled, it was filtered using filter paper. The resulting filtrate was added 25 ml of CaCl2 (10.9 % w/v). The resulting mixture was filtered and the precipitate was taken. The precipitate was put into a beaker glass and added 50 ml of dilute H2SO4 (0.5 N) then filtered. The filtrate from the solution was added 3 g of activated carbon, then filtered. 10 ml of the filtered filtrate was taken for titration with 0.1 N NaOH. The step of the making oxalic acid can also be seen in Figure 2.

## 3. Results and Discussion

Titration of the oxalic acid using 0.1 N NaOH solution was carried out to determine the concentration of oxalic acid that was produced from the reaction. From the experimental results it is known that the higher the NaOH concentration, the higher the oxalic acid content obtained. During the hydrolysis process, the higher concentration of NaOH causes the breakdown of cellulose to be better, and causes the reaction to form oxalic acid to be faster.

But in this process, the concentration of NaOH is limited to 50%. In a preliminary experiment to determine the operating temperature limit, it was found that at operating temperatures above 100 °C, heating was too fast and the reaction did not occur completely.

From the experiment on the variable size of the banana midrib, it was found that the amount of oxalic acid tends to increase when the area of the banana midrib is enlarged. This is because the contact between the mixture and carbohydrate compounds becomes longer. However, when the sample length exceeds 2.5 cm, the resulting oxalic acid crystals contain a lot of impurities that affect the quality of the oxalic acid crystals.

Maximum results were obtained at a concentration of 50% NaOH and a banana stem length of 2.5 cm. he best amount of oxalic acid produced is 2.99 gr.

## 4. Conclussion

Based on the results of the research that has been done, the conclusions are: 1) the greater the concentration of NaOH, the greater the amount of oxalic acid obtained; 2) he longer the size of the banana midrib, the greater the amount of oxalic acid obtained; 3) the maximum amount of oxalic acid obtained is 2.99 g that reach at a concentration of 50% NaOH with a length of the banana leaf 2.5 cm.

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