

Comparative analysis on the production of oxalic acid from rice husk and cocoa

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ABSTRACT

comparative analysis of oxalic acid produced from rice husk and cocoa seed was carried out by nitric acid oxidation of carbohydrates in order to ascertain which waste sample produced a better yield. The results obtained showed that $\text{HNO}_3:\text{H}_2\text{SO}_4$ acid ratio of 50:50 for rice husk sample gave a percentage yield of 48.0, 63.2, and 49.3 at temperatures of 55°C, 75°C, and 85°C respectively. At 60:40 acid ratio, the percentage yields were 47.8, 67.8 and 46.6 at the three different temperatures respectively. At 80:20 acid ratio, the percentage yields were 50.2, 67.0 and 45.4 at the three different temperatures. For cocoa seed, a percentage at 50:50 acid ratio, were 44.6, 54.7 and 47.4 at temperatures of 55°C, 75°C and 85°C respectively. At 60:40 acid ratio, the percentage yields were 45, 54.8 and 46.4 at these three different temperatures. At 80:20 acid ratio, the percentage yields were 47.6 51.3 and 45.8 at the above stated temperatures. The variable ratio of 60: 40 gave the maximum yield at the maximum temperature of 75°C for the both samples. But in comparison, it was found that the oxalic acid produced from rice husk gave higher yield by 13% than that from cocoa seed. The use of these raw materials to produce oxalic acid will minimize environmental pollution.

Keywords: oxalic acid, rice husk, cocoa seed, acid oxidation.

INTRODUCTION

Oxalic acid, $\text{C}_2\text{H}_2\text{O}_4$ or ethanedioic acids, molecular weight 90.04g/mol, is the simplest of the dicarboxylic acids [1]. The anhydrous form is odorless, hygroscopic, and white to colorless. Oxalic acid is available commercially as solid dehydrate, $\text{C}_2\text{H}_2\text{O}_4 \cdot 2\text{H}_2\text{O}$, molecular weight 126.07g/mol [2][3]. Oxalic acid is manufactured using cellulosic materials, usually waste products such as sawdust, grain hulls, cocoa seeds and others by nitric acid oxidation [1]. The raw materials used in this work are rice husk and cocoa seed. Rice, *oriza sativa*, belongs to class of cereals[4]. Rice that still contains its husk is called paddy. These are harvested directly from the nursery, winnowed and milled to produce rice. The waste obtained during milling is called rice husk[5].

These rice husks are usually dumped at a site as waste materials which constitute nuisance to the environment[6]. However, the main objective of this project is to determine the optimum yield of oxalic acid and its properties by comparing the yields produced from rice husk and cocoa seed.

MATERIALS AND METHODS

The raw materials used in this work are rice husks and cocoa seeds collected from rice mill in Aguleri and Ihiala market respectively. These samples were screened and sieved to remove unwanted materials like stone, weeds,

sticks, straws ,dead seeds ,dust, etc. The sieved rice husks and cocoa seeds were charged in the oven for drying at temperature of 70°C to evaporate moisture for 24hr, after they were ground to powdered. The ground powdered materials were kept for analyses.

10g of rice husks were weighed using electric weighing balance. The samples were poured in distillation apparatus. 50ml of H₂SO₄ (98%) and HNO₃ (68%) was measured respectively using measuring cylinder and both were emptied into the distillation apparatus. 0.5 g of manganese was added to speed –up the reaction and was heated in an electro mantle at a temperature of 55°C. The experiment lasted for one and half hour in a fume cupboard. At the end of the reaction, colorless liquor was obtained which was allowed to cool for 2hr and then transferred into a centrifuge to enhance crystallization. The centrifuge was set at 3500rpm for 15 minutes, At the elapse of 15 minutes, crystals of oxalic acid were obtained. During the reaction, evolution of brownish gas was observed, which was suspected to be nitrogen oxide (NO_x). The oxalic acid produced from each substrate was characterized to determine their density, pH and refractive index.

RESULTS AND DISCUSSION

Table 1: showing oxalic acid content in rice husk and cocoa seed

DIFFERENT RATIOS OF HNO ₃ : H ₂ SO ₄	%YIELD AT DIFFERENT TEMPERATURES (RICE HUSK)			% YIELD AT DIFFERENT TEMPERATURES(COCOA SEED)		
	55°C	75°C	85°C	55°C	75°C	85°C
50:50	48.0	63.2	49.3	44.6	54.7	47.4
60:40	47.8	67.8	46.6	45.0	54.8	46.4
80:20	50.2	67.0	45.8	47.6	51.3	45.4

The result obtained from the analyses of oxalic acid from rice husks and cocoa seeds showed similarities in their physical properties such as density, color and appearance. It could be seen that there were differences in yield as shown in Table I. The value obtained revealed that yield increases with increase in temperature, with maximum yield at 75°C.

At 55°C, the yield for rice husk at 50 : 50 was 48%, while that of cocoa seed at the same temperature was 44.6%. When temperature was increased to 75°C the yield from rice husks was increased to 65.2% while that of cocoa seed was 54.7%, then at 85°C, the yield decreased in both samples with values of 49.3% and 47.4% rice husk and cocoa seed respectively.

At 60:40 ratio, yield for rice husk gave 47.8% while Cocoa seed gave 46.6% of oxalic acid .There was increase in yield at 75°C for both, rice husk value was 67.8% and cocoa seed 54.8%. At 85°C, the percentage yield of the two samples obtained were 46.6% and 46.4% for oxalic acid and cocoa seed respectively.

At the ratio of 80 : 20 the oxalic acid yield at 55°C were 50.2% and 47.6% for rice husk and cocoa seed respectively. Rice husk gave 67.0% and cocoa seed gave 51.3% at 75°C. When the temperature was increased to 85°C, the yield decreased to 45.4% and 45.8% for rice husk and cocoa seed respectively.

Generally it was observed from the results that maximum yields occurred at 75°C for both samples. But in comparing the yield, rice husk was seen to be 13% higher in yield than cocoa seed, though from literature [8], cocoa fruit appeared to be higher in oxalate, nevertheless, this research has shown that rice husk has a better yield for the production oxalic acid than cocoa.

CONCLUSION

The ratio of 60 : 40 gave the highest yield with rice husk having the highest value. The low value of cocoa seed may be as a result of the source of the samples, or the method used, even the specie used may be a factor. It is important to note that both samples are good source of oxalic acid and using them in oxalic acid production will help reduce environmental pollution of our environment.

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