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Comparative Analysis of Sulphuric Acid (H₂SO₄) and Ammonium Hydroxide 1.0 (NH₄OH) Concentrations on the Release of Cellulose from Isolated Cell Wall Component of Corn Husk and Corn Cob

Safiya Yakubu¹, Halima Ibrahim², Kasim Muhammed³, Ya'u Anas⁴, Umar Umar Uwais⁵
^{1,2,3,4,5} Department of Biological Sciences, Kaduna State University, P.M.B. 2339, Kaduna State, Nigeria

Corresponding Author's Email & Phone No.: safiya.yakubu@kasu.edu.ng; +2348039681865

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ABSTRACT

The scarcity and high price associated with fossil fuel has motivated countries to research resources for alternative energy sources. Biofuels like bioethanol produced from lignocellulosic biomass (corn cob and corn husk) are considered potential alternatives. Cellulose composition from isolated cell wall material of corn cobs and corn husk were studied under two different pre-treatments using H₂SO₄ and NH₄OH at concentrations of 5%, 10%, 20%, 30% and 40%. Cell wall not treated acted as control. Colorimetric anthrone-assay followed by absorbance reading at 625nm revealed the presence of fermentable sugar (glucose) in corn cob (19.30µg/ml) and corn husk (17.25µg/ml) with corn cob showing more cellulose content. The analysis of variance (ANOVA) indicated significant differences between pre-treated samples and untreated (control) corn cob samples at p≤0.05. Acid pre-treatment showed better glucose yield compared to alkali pre-treatment with results revealing 20% (19.37µg/ml) H₂SO₄ to be the optimal concentration producing highest glucose yield. Results for corn husk showed a pattern of increased yields with pre-treatment. Analysis of variance (ANOVA) showed significant difference at p≤0.05 between treated and control samples for both sulphuric acid and alkaline pre-treatment of corn husk. Alkaline-based pre-treatment slightly favoured more glucose yield in corn husk compared to acid-based pre-treatment with optimum yields obtained at 40%; 19.00µg/ml and 18.77µg/ml respectively. The study reveals the potential of corn cob and corn husk as a lignocellulosic feed stock for biofuel production.

Keywords: Biomass, Cellulose, Plant cell wall, pre-treatment.

1.0 INTRODUCTION

Environmental degradation associated with the use of fuels of fossil origin is becoming of great concern. The finite supply and green-house gas emission associated with fossil fuels has resulted in global warming and changes in weather pattern among other challenges. This has strengthened the need to investigate alternative sources of fuel. Lignocellulosics from edible food materials such as corn seed and other edible grains has been viewed as possible alternatives to fossil fuels. It is reported that 1.4 billion bushels of corn valued at a cost of 2.9 billion dollars was converted to ethanol in 2005 (NCGA, 2005). This poses a threat to food security particularly in the developing world.

Lignocellulosic biomass from agricultural waste constitutes a substantial renewable substrate for biofuels production that do not compete with food production and animal feed. This biomass can be obtained on a large scale from different low-cost raw materials such as agricultural residues, municipal and industrial wastes (Cardona *et al.*, 2007). Such biomasses typically

consists of the polysaccharides cellulose and hemicellulose along side lignin (Himmel *et al.*, 2007).

Maize constitutes one of the most largely cultivated grass family plants (Graminaea) in Northern Nigeria with Nigeria emerging as the largest maize producer in Africa and the tenth largest in the world according to a 2012 report (IITA, 2012). Production has seemed to increase since 2013 with the development of new varieties and pest control measures (FOA, 2017). Lignocellulosic biomass from agricultural wastes as substitutes for fuel production can serve as a renewable, inexpensive and readily available natural resource.

Corn cob is a central cylindrical woody part of the maize in which grains are attached and constitutes one of the major agricultural wastes that go untapped yearly in Nigeria from maize cultivation. Corn husk on the other hand is the leafy outer covering of corn, and adds substantially to the overall plant weight. Both

corn cob and husk are often discarded upon maize consumption and harvest from the farm with some amount added to animal feed but a bulk remain untapped. Both waste types can serve as a renewable biomass that could be investigated for application in biofuel production (Loannidou *et al.*, 2009).

Corn cob and husk represent lignocellulosic materials made up of cellulose, hemicellulose and lignin (Carrier *et al.*, 2010). The characterization and the quantification of lignocellulosics particularly the cellulose and lignocellulose fractions is a necessary first step for choosing a feedstock for application in bio refining. Accurate measurement of biomass cellulose content is of prime importance because it is directly proportional to bioethanol yield in the biochemical conversion process (Aden, 2002)

Cellulose is a major component in plant cell wall. It is a biopolymer consisting of glucose monomers arranged in linear chains (Carroll and Somerville, 2009; Hu and Wen, 2008; Lewin and Roldan, 1971; Reddy *et al.*, 2014). Its

2.0 MATERIALS AND METHOD

2.1.1 Planting of Corn (*Zea mays*)

Corn (*Zea mays* L.) cultivation was conducted in the botanical garden, Department of Biological Science, Kaduna State University, Kaduna, Nigeria. Corn (SAMMAZ-9) obtained from Institute of Agricultural Research (IAR), ABU,

2.1.2 Freeze Drying of Corn Husk and Corn Cobs

Corn Husk and Corn cobs were taken to the National Research Institute for Chemical Technology (NARICT), Zaria for freeze drying. Freeze drying method offers the advantage of removing only moisture while retaining the quality of biomass that can be lost from using other methods of drying requiring high amounts of heat. Freeze-dried samples were then grinded using a grinding machine. The particles obtained were passed through a 0.6mm mesh separately to attain a uniform particle size before cell wall isolation.

2.1.3 Cell Wall Isolation of Corn Husk and Corn Cob

The method of Foster *et al.* (2010) was adopted with modifications. For each experimental

composition consists of (1,4)-D-glucopyranose units which are attached by β (1-4) glycosidic bond. In bio refining process, the cellulose found in cell wall needs to be decrystallized and released in order to enhance biofuel yield. This has made the pre-treatment step of utmost importance. Pre-treatment is required to alter the biomass structure and expose the lignocellulosic fractions for easy access to enzyme hydrolysis for increased yield of reducing sugar (Alvira *et al.*, 2010).

In this research, we hypothesize that biomass type/properties may influence solvent ability to increase cellulose solubility and yields in isolated cell wall material as this has been debated that the choice of a pre-treatment solvent will depend largely on the biomass (Yousuf, 2012).

This study aims to elucidate the influence of two different chemical pre-treatment methods; alkali and acid treatment on their efficacy to release cellulose from isolated cell wall material of two different lignocellulosic fractions; corn cob and corn husk for further hydrolysis step.

2.1 Sample Preparation

Zaria was planted and harvested during the corn planting season from May-September, 2019. Harvesting of corn was done at the late maturation stage and corn husks were removed. Seeds were then removed to obtain the cobs as experimental samples.

sample (corn husk and corn cob). Exactly 70mg of the sieved biomass was weighed into a sarstedt tube (18 sarstedt tubes were used for both acid and alkali pre-treatments respectively for both biomass material_corn husk and corn cob) and 1.5ml of 70% aqueous ethanol was added. The mixture was vortexed thoroughly and centrifuged at 10,000 rpm for 10min to pellet the alcohol insoluble residue. The supernatant was aspirated and 1.5ml chloroform/methanol (1:1 v/v) solution was then added. Tubes were shaken to re-suspend the pellet. Suspensions in each tube were centrifuged at 10,000rpm for 10min and the supernatants were aspirated. Each pellet in each tube was re-suspended in 500 μ l of acetone and allowed to evaporate on bench top at room temperature until dried.

To initiate the removal of starch from samples, pellets were re-suspended in 1.5mL of a 0.1M sodium acetate buffer of pH 5 and tubes were capped and heated for 20mins at 80°C in a heating block followed by suspending in ice box. 35µl of 0.01% Sodium azide (NaN₃) was added and tubes were capped and vortexed thoroughly followed by incubation overnight in an orbital shaker set at 37°C with tubes oriented horizontally to aid mixing. Samples in the tubes were then transferred into a heating block set at 100°C and heated for 10mins to terminate digestion. Content in each tube was subjected to centrifugation at 10,000rpm for two minute. The supernatant (containing the solubilized starch) was discarded. Residual pellet left in tubes were subjected to washing thrice by adding 1.5ml of water and each time, subjecting the content of each sarsdedt tube to vortexing, centrifugation and decanting making sure no pellet is lost. 500µL of acetone was then added and evaporated on bench top at room temperature until dried. The dried material represents the isolate cell wall material of corn cob containing the lignocellulosics.

2.1.4 Sample Pre-Treatment

The sulphuric acid solutions were prepared by dilution of H₂SO₄ (99%) with appropriate amount of sterile distilled water to make five (5) different H₂SO₄ concentrations in v/v (5%, 10%, 20%, 30% and 40%). For ammonia pre-treatment, ammonia hydroxide solution at 5 different concentrations (5%, 10%, 20%, 30%, and 40%) were also obtained by dilution with appropriate amount of sterile distilled water. Exactly 70mg of isolated cell wall material in sarstedt tube was used for each concentration by transferring into samples, 1ml of each dilution. Samples were allowed to stand for 3 hours at room temperature. This was followed by washing thoroughly with sterile distilled water making sure no trace of pre-treatment solution is left and no sample is lost from the tube. Samples were allowed to stand at room temperature until dried.

2.2. Extraction of Crystalline Cellulose from Isolate Cell Wall Material Of Corn Husk and Corn Cob

To the cell wall material in each tube, 1ml of updegraff reagent was added (Acetic acid:Nitric acid:Water, 8:1:2 v/v), vortexed and capped . Samples were heated at 100°C for 30mins in a heating block to remove other lignocellulosics and leaving cellulose behind in the pellet. After

heating, samples were cooled in an ice box to room temperature and centrifuged at 10000 rpm for 15mins. The supernatants were discarded ensuring no pellet is removed by leaving about 150µl of supernatant in the tube and the content of each tube was washed with 1.5ml of water by adding the said amount of water and then shaking, centrifuging and discarding the supernatant. The washing procedure was repeated thrice with 1ml acetone and the pellet was air dried. The pellet (Crystalline cellulose) was hydrolysed via seaman hydrolysis by adding 175µl of 72% H₂SO₄ and incubated in an oven at room temperature for 30min. Samples were vortexed and incubated for another 15mins and 825µl of water was added and vortexed. Samples were centrifuged at 10000rpm/min and some brown insoluble material (lignin) was observed in the tube. Glucose content in the supernatants were analysed using colorimetric anthrone assay.

2.3. Glucose Quantification by Colorimetric Anthrone Assay

This is also a modification of Foster *et al.* (2010) method where polystyrene microtiter plates made up of wells were replaced with regular test tubes.

2.3.1 Preparation of Standard/Samples

Exactly 1mg of glucose was measured into 1 ml of sterile water to make a glucose stock solution. Stock solutions were stored at 0°C in an air tight container. Duplicate standards of 0,2,4,6,8 and 10µg were created by pipetting 0,2,4,6, 8, and 10µl from the stock solution of 1mg/ml into separate test tubes. Each test tube was made up to 1ml (100µl) with water. To separate test tubes, 10µl of sample supernatant, and 90 µl of water was added. This was followed by adding 200µl of freshly prepared Anthrone Reagent (2mg anthrone + 1ml sulphuric acid w/v)). Anthrone reagent was added to both standards and samples and heated for 30 minutes at 80°C in an oven. Glucose-containing samples were turned from yellow to blue-green.

2.3.2 Absorbance Reading of Samples

Samples in the test tube were allowed to cool to room temperature, shaken thoroughly and transferred into a cuvette. Absorbance reading which represents the amount of glucose in each sample was read using a spectrophotometer set at a wavelength of 625nm. Glucose (Crystalline cellulose) was calculated based on absorbance readings obtained from samples to the standard

curve plotted from readings obtained from standard samples. Below (Figure 1), is a flow chart showing the sequential steps of the procedure used.

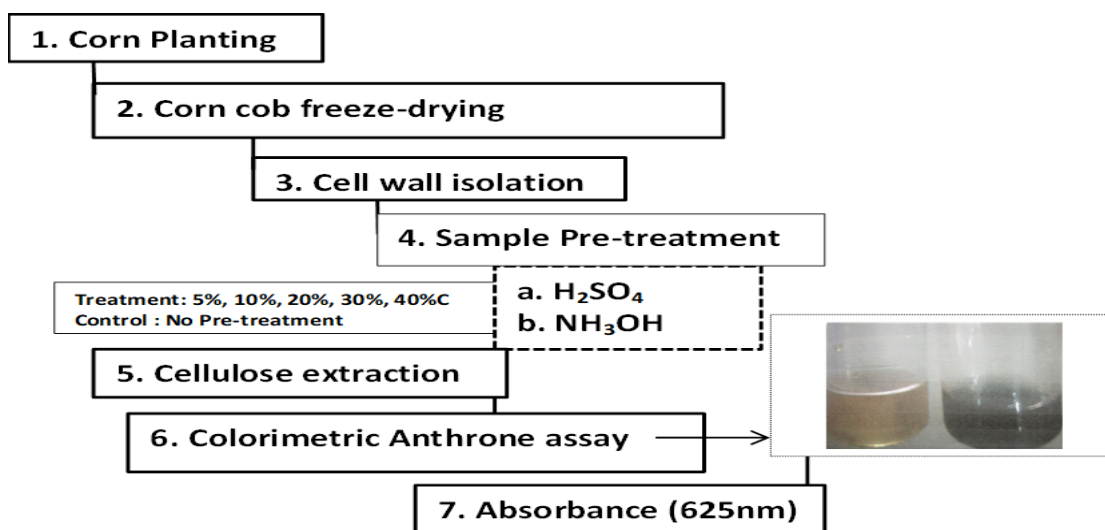


Fig.1. Summary of method used (Foster *et al.*, 2010) with modifications

3.0 RESULTS

The readings (Table 1), show the data obtained for each glucose calibration point in nanometre (nm). The calibration curve obtained from the data in table 1 (Figure 2) shows an r^2 value of 0.9934 which shows good correlation between the glucose concentration and absorbance. To convert the wavelength values to $\mu\text{g/ml}$ the

equation as shown in the calibration curve was used as illustrated below.

$$y = 0.1007x + 0.0043$$

To find x,

$$x = \frac{y - 0.0043}{0.1007}$$

Where y=The wavelength value for each sample read at 625nm

Table 1. Glucose concentration against absorbance

Glucose Conc.($\mu\text{g/ml}$)	Absorbance at (625nm)
2	0.181
4	0.449
6	0.592
8	0.814
10	1.005

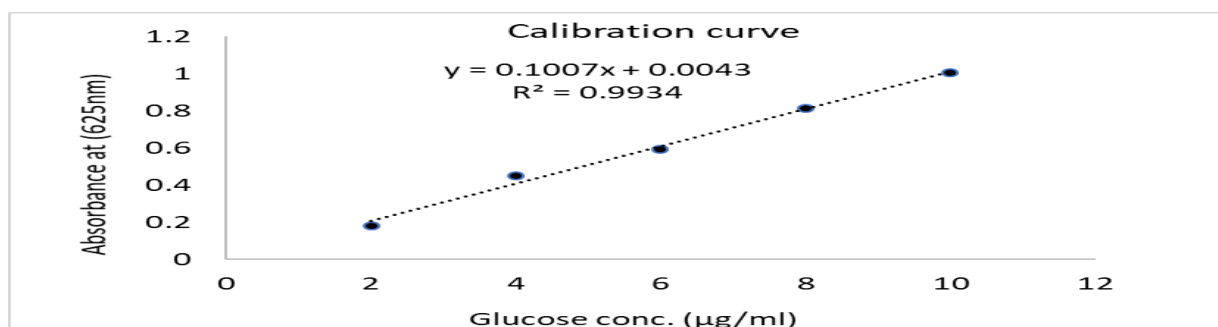


Figure 2: Calibration curve of glucose concentration against absorbance read at 625nm

3.1 Effect of Acid Based Pre-Treatment on Cellulose Content of Corn Cob

The data in Figure 3, shows the quantitative analysis of cellulose in corn cob at different

concentrations of sulphuric acid as pre-treatment. Lower cellulose values were observed in samples when corn cob cell wall material was treated with 5%, 10%, 30% and 40% H_2SO_4 . The amount of cellulose recorded was seen to increase with increasing acid concentration at lower H_2SO_4 concentrations of 5% (19.03), 10% (19.18), and 20% (19.37). Lower cellulose values were obtained at higher H_2SO_4 concentrations of 30% (19.02), and 40% (18.31). Optimum cellulose

release from cell wall was observed at an acid concentration of 20% (19.37). The effect the acid-based pre-treatment at varying concentrations of H_2SO_4 on the release of cellulose was found to be significantly different however; no significant difference was observed for the optimum cellulose value at 20% (19.37) to that of the control samples (19.30) at $P \leq 0.05$.

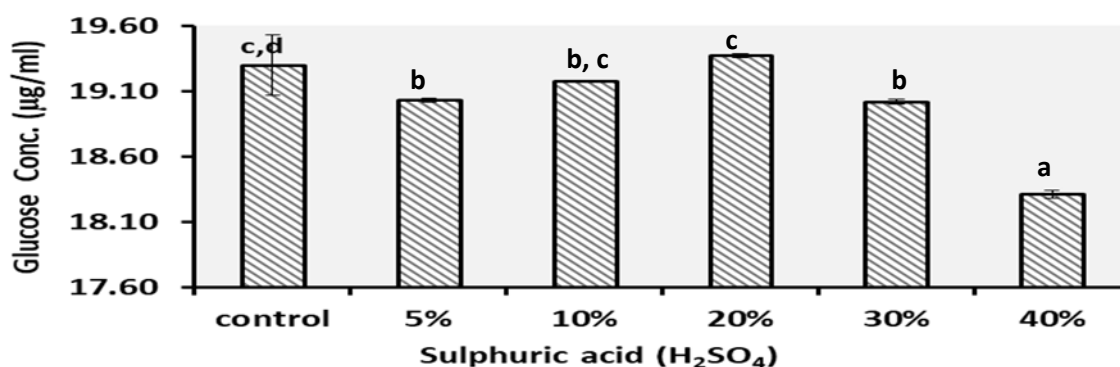


Figure 3: Sulphuric acid (H_2SO_4) pre-treatment of 70mg isolated cell wall material of corn cob. Mean with different superscript indicate significant differences at $P \leq 0.05$. Data represents Mean \pm SD (n=3).

3.2 Effect of Ammonia-Based Pre-Treatment on The Cellulose Content of Isolated Cell Wall Material of Corn Cob

The effect of NH_4OH at different concentrations on the release of cellulose from corn cob cell wall material was found to be significantly different at $P \leq 0.05$. All ammonia concentrations showed lower cellulose values compared to the control (19.30). Highest cellulose values for treated

samples were obtained at 10% (19.15) and 30% (19.15) ammonia concentrations. Lower cellulose values were recorded at 5% (19.13), 20% (19.13) and 40% (18.89) ammonia pre-treatment as shown in Figure 4. No enhancement in cellulose yield was observed in NH_4OH pre-treatment compared to control

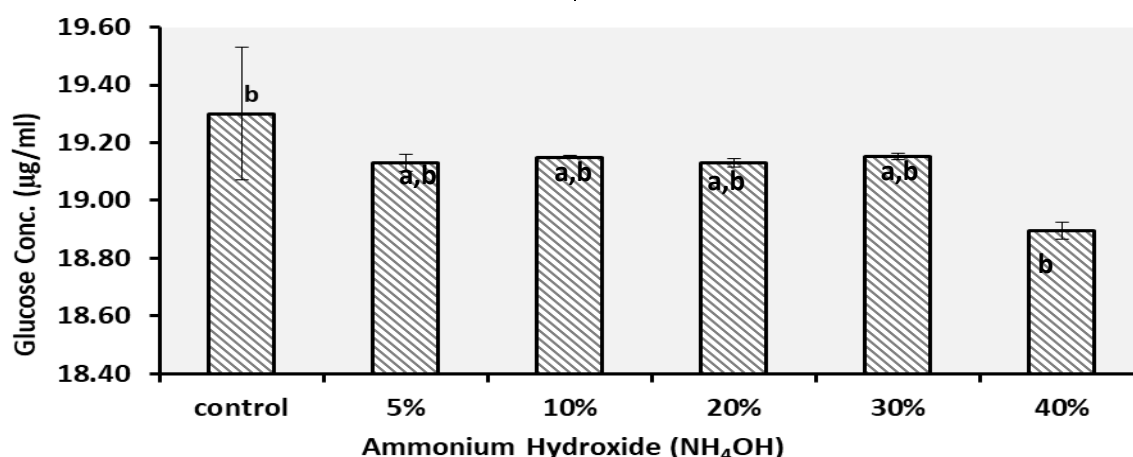


Figure 4. Ammonia Hydroxide (NH_4OH) pre-treatment of 70mg isolated cell wall material of corn cob. Mean with different superscript indicate significant differences at $P \leq 0.05$. Data represents Mean \pm SD (n=3).

Comparing both acid and ammonia-based pre-treatment reveal a drop in cellulose yield when biomass was treated with 5% for both solvents.

Cellulose yield was later noticed to plateau as the concentration of NH_4OH was increased at 10, 20, and 30% respectively. On the other hand a rise in

glucose concentration was observed when sulphuric acid concentration was increased from 5%, 10% and 20% with maximum cellulose yield (19.37µg/ml) attained at 20% H₂SO₄ concentration. High concentrations of both

solvents at 30% and 40% did not favour the release of cellulose from cellulose cell-wall as an overall drop in glucose values was observed (Figure 5

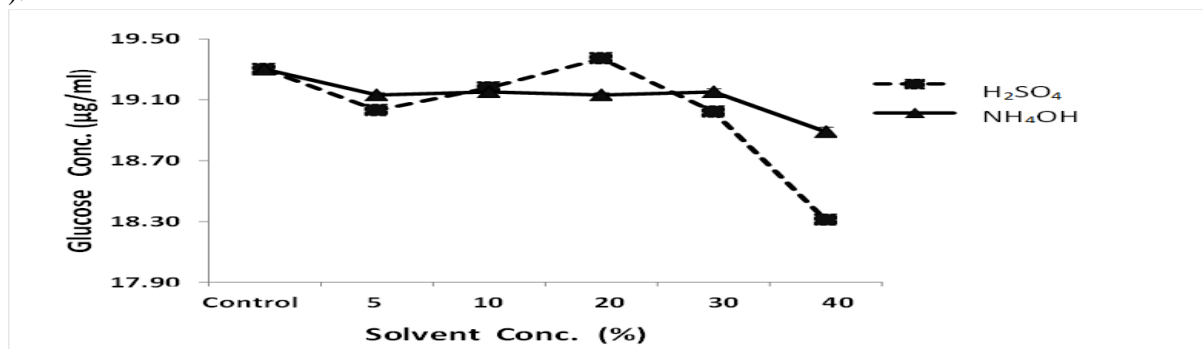


Figure 5: Comparison between Ammonia and acid based pre-treatment of 70mg isolated cell-wall material of corn cob. Data represents mean ± SD (n=3)

3.3 Effect of Acid-Based Pre-Treatment on The Cellulose Content of Isolated Cell Wall Material of Corn Husk

The results for corn husk acid-based pre-treatment showed lowest cellulose content in untreated corn husk of 17.25µg/ml. Values were generally higher in pre-treated samples. Optimum concentration of acid treatment for the release of

cellulose was observed at 40% v/v (18.77µg/ml). Less cellulose content was observed for 5% (18.76µg/ml), 30% (18.61µg/ml), 10% (18.45µg/ml), and 20% (18.43µg/ml) as seen in Figure 6. Overall, a significant enhancement in glucose yield was observed between the acid based pre-treated samples and control at p≤0.05.

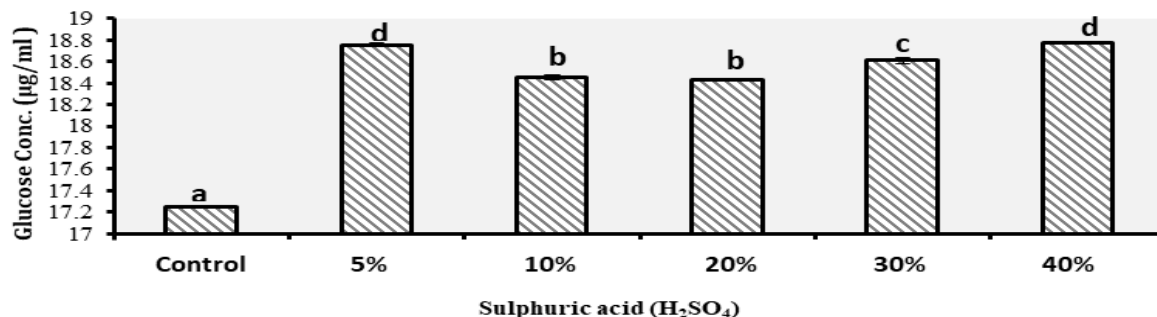


Figure 6: Sulphuric acid (H₂SO₄) pre-treatment of 70mg isolated cell wall material of corn husk. Mean with different superscript indicate significant differences at P ≤0.05. Data represents Mean ± SD (n=3).

3.4 Effect of Ammonia-Based Pre-Treatment on The Cellulose Content of Isolated Cell Wall Material of Corn Husk

Cellulose yield in corn husk was revealed to be enhanced by ammonium hydroxide (NH₄OH) treatments concentrations except at 30% (17.02µg/ml) where a lower values was recorded

compared to control sample (17.25µg/ml). Optimum glucose concentration was obtained at 40% (19.00µg/ml) ammonium hydroxide (NH₄OH) pre-treatment of isolated cell wall material. Values were found to be significantly differently at P ≤0.05 as shown in Figure 7.

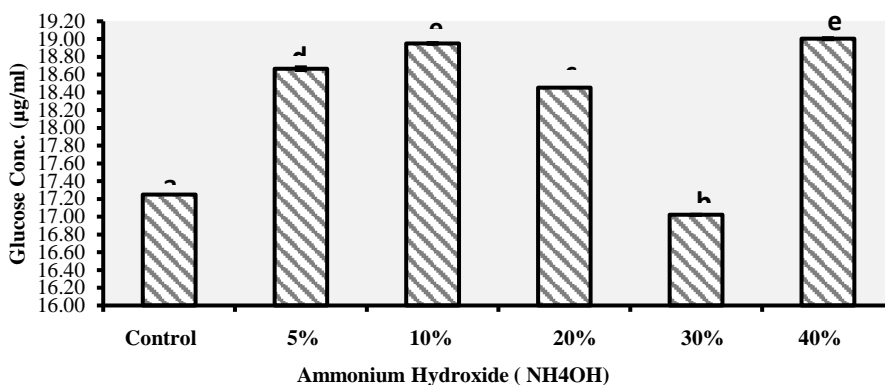


Figure 7: Ammonium Hydroxide (NH₄OH) pre-treatment of 70mg isolated cell wall material of corn husk. Mean with different superscript indicate significant differences at $p \leq 0.05$. Data represents Mean \pm SD (n=3).

Comparing both acid and ammonia-based pre-treatment on corn husk reveal a rise in cellulose yield when biomass was treated with 5% for both solvents. A slight decrease in cellulose yield (0.30 µg/ml) was recorded when the concentration of H₂SO₄ was increased to 10% whereas as an increase of 0.28µg/ml was recorded for NH₄OH. Cellulose yield was seen to plateau upon further increase in acid

concentration to 20% and slightly increasing by 0.32µg/ml from 20-40% (Figure 8). Cellulose yield for Ammonium Hydroxide-based pre-treatment was seen to decrease by 0.5µg/ml upon a rise in concentration from 10% to 20% and further reducing steeply by 1.43µg/ml from 20 to 30%, further attaining optimum yield of cellulose at 40%. Overall no clear pattern was observed for in both solvents on corn husk.

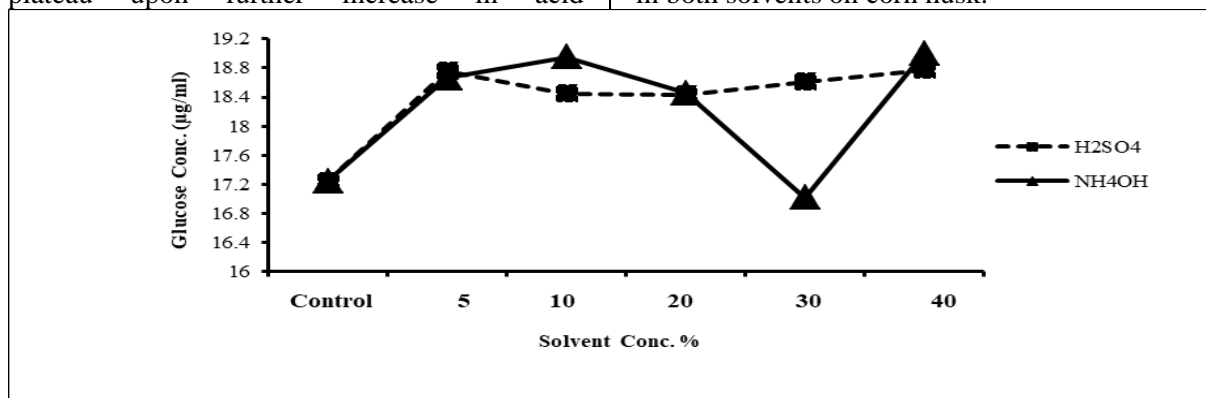


Figure 8: Comparison between Ammonia and acid based pre-treatment of 70mg isolated cell-wall material of corn husk. Data represents mean \pm SD (n=3)

3.5 Comparison of Acid-Based Pre-Treatment on The Cellulose Content of Isolated Cell Wall Material of Corn Cob and Corn Husk

The graph (Figure 5) shows cellulose contents of two different biomass materials for both control and at different concentration of sulphuric acid treatments. A difference in cellulose quantity was observed in corn cob (19.30µg/ml) and corn slight increase followed by a gradual drop in cellulose. Corn husk on the other hand revealed an initial steep increase in cellulose yield. At cellulose concentration in corn husk exceeding that of corn cob by 0.46µg/ml at 40% sulphuric acid concentration

husk (17.25µg/ml) isolated cell wall material with corn cob samples depicting more cellulose accumulation. Acid-based pre-treatment initially lowered the cellulose content of isolated cell wall material of corn cob. Further enhancing the concentration of sulphuric acid from 5% to 40% showed a pattern of

increasing concentrations of sulphuric acid from 5% to 40%, a pattern of slight lowering, followed by a gradual increase was observed with

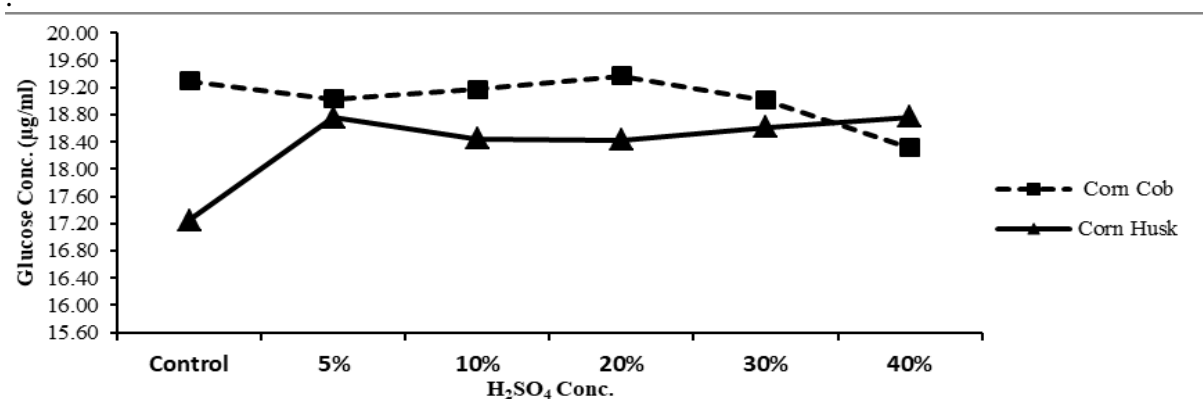


Figure 9: Comparison of acid-based pre-treatment of 70mg isolated cell-wall material of corn cob and corn husk on cellulose yield. Data represents mean ± SD (n=3)

3.6. Comparison of Ammonia-Based Pre-Treatment on The Cellulose Content of Isolated Cell Wall Material of Corn Cob and Corn Husk

The graph illustrates (Figure 6) the cellulose contents of two different biomass materials for both control and at different concentration of ammonium hydroxide based pre-treatment of corn cob and corn husk. A difference in cellulose quantity was observed in corn cob (19.30µg/ml) and corn husk (17.25µg/ml) isolated cell wall material with corn cob samples recording more cellulose accumulation. Cellulose content was

seen to be affected slightly negatively by NH₄OH treatment with values showing slightly lower concentrations cellulose. The effect was generally different for corn husk. At 5% to 10 % a rise in glucose yield was observed followed by a steep drop between 10% to 30% NH₄OH concentration. A final rise in glucose concentration to 19.00µg/ml was later observed at a concentration of 40%. No clear pattern was observed on the effect of ammonium hydroxide on the isolated cell wall material of corn cob with regards to the release of glucose.

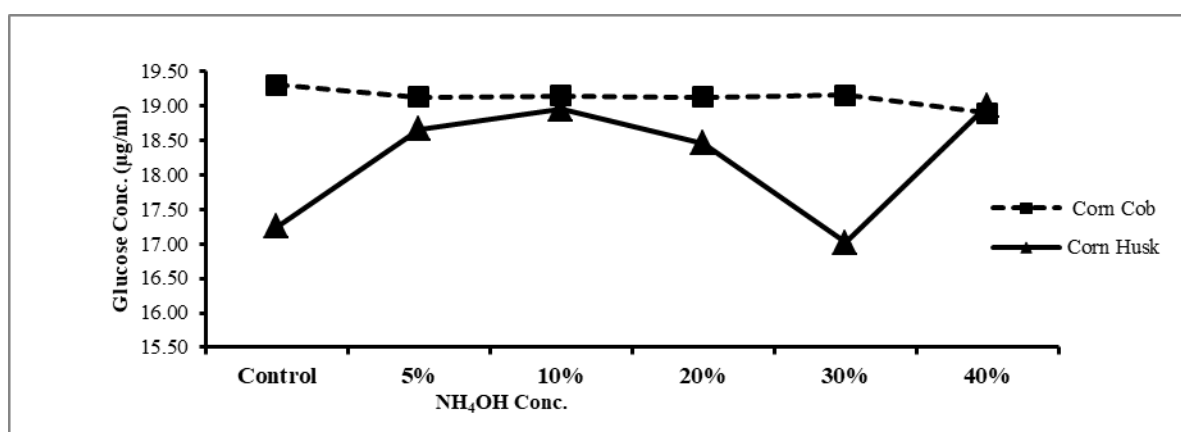


Figure 10. Comparison of ammonia-based pre-treatment of 70mg isolated cell-wall material of corn cob and corn husk on cellulose yield. Data represents mean ± SD (n=3)

The result obtained from this experiment showed that the acid based pre-treatment using sulphuric acid at low concentration (20% v/v) favoured

4.0 DISCUSSION

cellulose yield compared to the ammonia based pre-treatment with 20% being the optimum. This is in accordance with the studies of Badal *et al.*

(2005) where maximum yield of monomeric sugars from wheat straw were recorded when dilute H_2SO_4 (7.83% w/v) was used. It will be observed in our study that there was an initial and steady increase in cellulose yield as the concentration of H_2SO_4 used for pre-treatment increased (5 to 20%). This may be attributed to morphological changes made to cellulose by converting it to its monomeric glucose sub-units as well as cell wall modifications that helped making cellulose more accessible as reported in Sun *et al.* (2016) Results from their work using biomass from rice straw revealed major morphological changes in cell wall structure between control and treated samples in scanning electron micrographs. Surface cell wall morphology of pre-treated samples showed cracked separated fibres/fiber bundles while control samples exhibited smoother and more rigid surface structure which aided the release of cellulose. This may be the case exhibited at the optimum glucose concentration observed at 20% acid pre-treatment. Further increasing acid concentration beyond 20% reduced glucose yield in this study. This pattern of reduced yield with increasing acid concentration has been observed and reported in previous works (Lee and Jeffries, 2011; Sun *et al.*, 2016) and has been attributed to degradation and cellulose conversion to other by-products such as furfural, formic acid, acetic acid, levulinic acid, lactic acid, hydroxymethylfurfural in reaction media (Lee and Jeffries, 2011). Analysis of liquors obtained from reaction media in some studies has revealed their presence. Thus, dilute H_2SO_4 pre-treatment though may seem to be a promising method may require some further processing to identify associated by products formed alongside cellulose. For ammonia based pre-treatment, lower cellulose yields were recorded for all concentrations of treatment samples compared to the control. Mittal *et al.* (2011) via x-ray diffractograms revealed a conversion of cellulose to other forms such as cellulose III. Though pre-treatment with aqueous ammonia has shown positive results in some studies, it seems not to be the ideal pre-treatment method for corn cob. Corn husk isolated cell wall material showed less cellulose content compared to corn cob, indicating that different components of a biomass material may contain different amounts of cellulose or reducing sugars. Thus, the distribution of reducing sugars within a biomass is not always same despite maintaining uniform

particle size. Studies by Aboagye *et al.* (2017) showed variations in glucose concentration among the different fractions of corn stover (cobs, stalks and leaves). Their findings revealed highest glucose concentration in corn cob in dilute acid pre-treatment and alkaline pre-treatments while altering parameters such as temperature and retention time. Similar trend was reported in the studies of Li *et al.* (2016) where corn cob recorded highest sugar content and enzymatic digestibility. Corn husk has been reported to have a higher content of lignin among the lignocellulose content (Sharma *et al.*, 2018) which can act as hinderance to the release of cellulose during pre-treatment and enzyme hydrolysis step. A biomass fraction with more lignin content could potentially slow down the decrystallization of cellulose in pre-treatment processes therefore causing lower yield.

Corn husk cellulose content was found to be enhanced for both acid and alkali (Ammonium hydroxide-based pre-treatment) as all values for pre-treatment concentrations were substantially higher than the control except for 30% ammonium hydroxide pre-treatment. The cellulose crystallinity study via x-ray defraction (XRD) of corn husk biomass in the work of Sharma *et al.* (2018) showed a before and after pre-treatment difference of 11.4 % ; thus showing a significant reduction in cellulose crystallinity when dilute sulphuric acid and dilute Sodium hydroxide was used for pre-treatments. In addition, distortion of cell wall architecture in Scanning Electron Micrographs (SEM) was evident in pre-treated samples using dilute alkaline; a phenomenon attributed to lignin and hemicellulose degradation. Studies by Kashav *et al.* (2016), revealed a 85.7% lignin removal from corn stalk following a 3% sodium hydroxide pre-treatment. Therefore the increased yield in cellulose content obtained for both acid and alkaline pre-treatment of corn husk compared to the control may be linked to the degradation and decline in the amorphous part (lignin and hemicellulose) of the corn husk biomass alongside the the decrystallization of some part of the cellulose which was initially lower than that of corn cob. Overall in our studies, there was no clear pattern of increase and decrease in cellulose yield in corn husk with increasing concentration of H_2SO_4 and NH_4OH . However, more concentration points of 10%, 20%, and 40% for NH_4OH favoured more glucose

concentration/release compared to H₂SO₄ where only 2 concentration points of 5% and 30% favoured the release of cellulose in the form of glucose compared to the alkaline pre-treatment. The fact that cellulose concentration was maintained at higher concentration of solvents for corn husk compared to corn cob showed that there was less conversion of cellulose to by-products such as furfural, formic acid, acetic acid, levulinic acid, lactic acid hydroxymethylfurfural in reaction media. Thus the nature/characteristic of a biomass may also influence cellulose recovery for conversion into biofuel when working with pre-treatment solvent which can in turn affect general yield of the target biofuel.

5.0 CONCLUSION

In conclusion, the presence of cellulose in corn cob and corn husk reveal their potential as feedstock options. However, it was revealed in our study that pre-treatment solvent choices for a lignocellulosic biomass can largely influence the yield of these sugars which can as well affect the

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yield of the target biofuel. While NH₄OH tended to be a more ideal solvent for corn husk biomass, dilute acid-based pre-treatment was more ideal for isolated cell wall material of corn cob.

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