BERKELEY PUBLICATION
AND RESEARCH INTERNATIONAL
03.31.2023
Journal of Health, Metabolism & Nutrition Studies Vol. 21 No. 3

BIOETHANOL POTENTIALS FROM GUINEA CORN HUSK AND RICE HUSK: A COMPARATIVE STUDY

ELINGE, COSMOS MOKI; ATIKU, FAROUQ ABUBAKAR; IGE, AYODEJI RAPHAEL; BIRNIN YAURI; ABUBAKAR UMAR; & MISITURA LAWAL

Department of Pure and Applied Chemistry, Kebbi State University of Science and Technology, Aliero, Nigeria

ABSTRACT

High rate of growth and easy availability of agro wastes has made it as vibrant newable carbon source for biofuel production. The present study was undertaken to screen the possibility of using guinea corn husk and rice husk as a substrate for bioethanol production by microbial fermentation using monocultures of *Aspergillus niger* and *Zymomonas mobilis* isolated from palm wine using acid hydrolysis with $2MH_2SO_4$. Ethanol yield was ($26.91cm^3$) from guinea corn husk and ($18.35cm^3$) rice husk respectively was maximum at 120^{th} hours and lowest ($2.08cm^3$) and ($4.83cm^3$) at 24 hours respectively.

Introduction:

Global depletion of fossil fuels at an unprecedented rate and element for the want of cheap energy for the world's economy has prompted significant research efforts recently in searching a viable and sustainable alternative (Chang et al, 2011). Among the various alternative options, biomass conversion to biofuel has gained attention of liqnocellulosic biomasses to biofuels. Currently, bioethanol production from corn and sugarcane has posed a threat to food

ISSN: 1213-4406

Keywords: Bioethanol, Fermentation, Guinea Corn husk, Rice husk, *Aspergellus Niger, Zymonoras mobililis*

Supply (Curagain et al., 2011) and the cost of these raw materials accounts for up to 40 to 70% of the production cost (Quintero et al., 2008).

Technologies for the possible conversion of guinea corn husk and rice husk to bioethanol using microbial extra cellula enzymes have been documented from developing nations (Idress *et al*., 2013). *Aspergillus niger* and *Zymomonas mobilis* has been identified as a germination agents in the large scale production of ethanol from cellulosic biomass. These organisms are capable of utilizing hexose sugars efficiently, but not the pentress, which are the second dominant sugar source in lignocellulosic biomass (Bhatlachara *et al*., 2013). From research that has been conducted earlier, *P. stipitis* instead of the traditional yeast have been proposed (Singhal and Rai 2003, as they have been shown to ferment under fully anaerobic conditions with faster specific rates of pentose sugar uptake and ethanol production as well as ethanol yields chose to theoretical yield. The current study was carried out therefore, to screen the feasibility of using hexose and pentose ultilizing fungal strains for the effective conversion of guinea corn husk and rice husk biomass into ethanol.

MATERIALS AND METHODS

Sample Collection

Guinea corn and rick husks were collected from waste dumping site in Aliero metropolis respectively. The sample were grounded to powder form using a warring blender (Bina tone) *asperigillus niger* was isolated from palm wine and identified following standard procedure as described by (Cheesbrough, 2008). The medium is supplemented with actiochione to inhibit yeast growth. One (1ml) of palm wine was serially diluted

deconized water and a ligouts of the dilution were put in the medium using the pour plate technique. The agar plates were incubated at 37^{0}C in an anaerobic jar for 24 hours.

After incubation, the bacteria that grew on the agar plates were counted using a colony counter and expressed as colon forming units of sample colonies differing in size, shape and colour were selected from different agar plates and subculture on standard solid medium by the streak plate's technique. The agar plates were incubated at 37^{0}C in an anaerobic jar for 24 hours. The subsequent pure were mainlined on agar slant for further characterization and identification.

Hydrolysis

One hundred grams (100g) of guinea corn husk were weighed into seven conical flasks and 1 litre of 2MH_2SO_4 was added to each conical flask. The flasks were covered with cotton wool wrapped in aluminum foil, heated for 2 hours in a water bath and then autoclaved for 30 minutes at 121^{0}C. The flasks were allowed to cool and then filtered through paper and the pH adjusted to 4.5 and 0.4 NaOH. The same procedure was repeated for rice husk

Fermentation

The fermentation was carried out along with saccharification (simultaneous saccharification and fermentation (ISSF) as described by Kroumov et al., 2006). The flasks containing the hydrolyzed samples were covered with cotton wool, wrapped in aluminum foil, autoclaved for 15 minutes at 121^{0}C, and allowed to cool at room temperature. *Zymomonas mobilis* and a spore suspensions of aspergillus niger and were aseptically inoculated into each flask and incubated at 30^{0}C. Two flasks of each

samples (guinea corn husk and rice husk) were removed after every 24 hours, for seven days.

Fractional distillation

The fermented broth was dispensed into round-bottom flasks fixed to a distillation column enclosed in running tap water. A conical flask was fixed to the other end of distillation column to collect the distillate. A heating mantle with the temperature adjusted to 78^0C was used to heat the round-bottom flask containing the fermented broth.

Results and discussion

The organisms used for fermentation were *aspergillus niger* and *zymomonas mobilis* showed a black nycelium on the agar medium, it had septate hyphae, long and smooth canicliospores and long unbranched porangiospores with a large and round head.

Table 1: Daily and cumulative production gathered from guinea corn husk and rice husk

Volume of ethanol produced (cm^3)	Cumulative production (cm^3)	Time (hr)
4.82	4.82	24
7.22	12.04	48
15.26	27.30	72
21.28	48.58	96
26.91	75.49	120
20.88	96.37	144
14.45	110.82	168

ISSN: 1213-4406

Table 2: Daily and cumulative ethanol production rice husk using 100g

Volume of ethanol produced (cm^3)	Cumulative production (cm^3)	Time (hr)
2.08	2.08	24
3.99	6.07	48
10.04	16.11	72
14.94	31.05	96
18.31	49.36	120
13.63	62.99	144
8.96	71.95	168

Discussion

In the results from Fig. 1 and 3 shows that the daily ethanol production from guinea corn husk and rice husk after acid hydrolysis with $2MH_2SO_4$ and simultaneous saccarification with *aspergillus niger* and *Z. mobilis*. The highest volume of ethanol produced (26.91cm^3) was obtained at 120th hr of fermentation followed by (21.28cm^3) at 96th hour and the lowest of (4.82cm^3) was obtained at 24 hour of fermentation for guinea corn husk. The highest volume of ethanol (18.31cm^3) was produced at 120th hour of fermentation followed by (14.94 cm^3) at 96th hour, the lowest volume of ethanol was produced at 24th hour respectively. This is due to the presence of higher level of bacteria and starch in the samples, the higher level of bacteria, the higher volume ethanol produced.

The cumulative production of ethanol from guinea corn husk were highest (110.82cm^3) was obtained at 168th hour and (96.37cm^3) at 168th of fermentation respectively as shown by Figure 2 and 4. Also for the rice husk, the highest volume is (71.95cm^3) was obtained at 168th hour of fermentation followed by the (62.99cm^3) and the lowest (2.08cm^3) was produced at 24th hour of fermentation respectively. This shows that the

higher the volume production daily basis, the higher the cumulative production of ethanol. This is in agreement with the works of (Aquilejika *et al*., 2005) that the alcohol dehydrogenase of *Z. mobilis* appears to facilitate continuationof fermentation at a higher volume of ethanol. The maximum volume of ethanol (26.91cm^3) produced from guinea corn husk and rice husk (18.31cm^3) in this study at 120th hour, who also reported that the maximum volume of ethanol yield at 120th hour from fresh fruit (64.01cm^3) and waste fruit (21.14cm^3) using *Z. mobilis* and *aspergillus niger*. The higher ethanol yield from fresh fruit can be attributed to the higher presence of fructose and glucose levels in fresh fruits as stated by (Michael and Rosaline, 2000). The maximum volume of ethanol produced from guinea corn husk (26.91cm^3) is also in agreement with the works of (Leknett *et al*., 1994). Reported that they observed the yield of (27.7cm^3) sweet sorghum.

It was observed that the highest volume results obtained in this study are both lower than the (59cm^3) reported by (Cunaskaran and Chandra, 2007) at 120th hour from cassava starch hydrolasate. This is due to the higher carbohydrate content of cassava starch then guinea corn husk and rice husk which could fermented to ethanol. The volume of ethanol produced from guinea corn husk was higher than that of rice husk. This can be attributed by the high carbohydrate content in guinea cornhusk compared with rice husk which could be fermented to ethanol.

Conclusion

The results revealed that the ethanol could be produced from agricultural residues such as guinea corn husk and rice husk, using *zymomnas mobilis* and *aspergillus niger* as fermenting organisms. Considering the cost effectiveness being means to control environmental pollution, the use of

guinea corn husk and rice husk for ethanol production is considered as a worthwhile venture.

Tremendous progress has been made technologically in the last few years in the area of biofuel production fuelled by ever increasing price and shortage of crude oil and concerns about global warming and climate change, consecutively that a significant amount of these materials would biogemically use as a biofuels would simply be a better use of an ecofriendly fuels. The guinea corn husk has a better yield than rice husk for ethanol production. Bioethanol is blended with gasoline to form an E10 blend (10% broethanol and 90% gasoline) but it can be used in higher concentration such as E85 and E95.

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Bayero University, Kano, PMB 3011, Kano State, Nigeria. +234 (0) 802 881 6063,
ISSN: 1213-4406