The Potential of Elephant Grass (*Pennisetum purpureum Schum*), An African Indigenous Grass, in Bioethanol Production: A Decarbonization Alternative for the Shipping Industry

Kuroshi, Lawrence
WMU, Sweden

1. Introduction

Biofuel: Fossil Based Energy, Time up?

- Its usage however carbonizes the earth's atmosphere (emits carbon dioxide (CO_2), a principal GHG.
- The transportation sector is the highest contributor of this GHG
- The impact of global warming is alarming
- Renewable and alternative energy sources are key mitigation measures (e.g. Biomass for bioenergy, hydroenergy. Solar, wind e.t.c)
- Plant diversification strategy

Introduction

Elephant grass (*Pennisetum purpureum Schum*)

- An **Indigenous African** lignocellulose plant
- Africa is very rich in Biomass *'When it comes to biomass production for biofuels, the tropics have the edge' (Sanchez, 2008)*
- A C4 photosynthetic grass – very **efficient in biosequestration** (better than C3 grasses)
- **Replacement/alternative** to food crops such as maize, cassava, sugarcane , rice etc.
- Morphologically, like the **sugarcane plant**

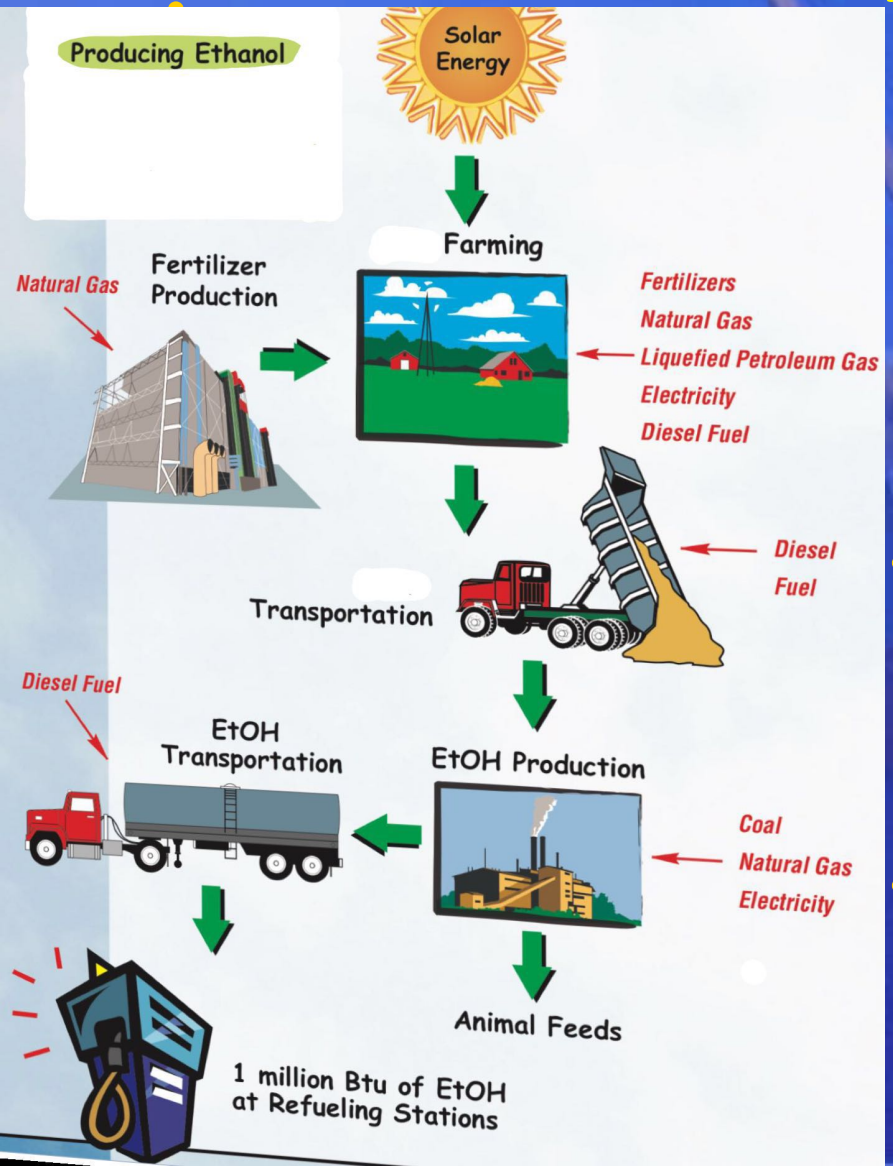
Introduction

Bioethanol

- Ethanol alone accounts for about 90% of total biofuel production
- Biofuel however requires careful and systematic studies in order to establish the most favorable processes for their conversion to the desired products.

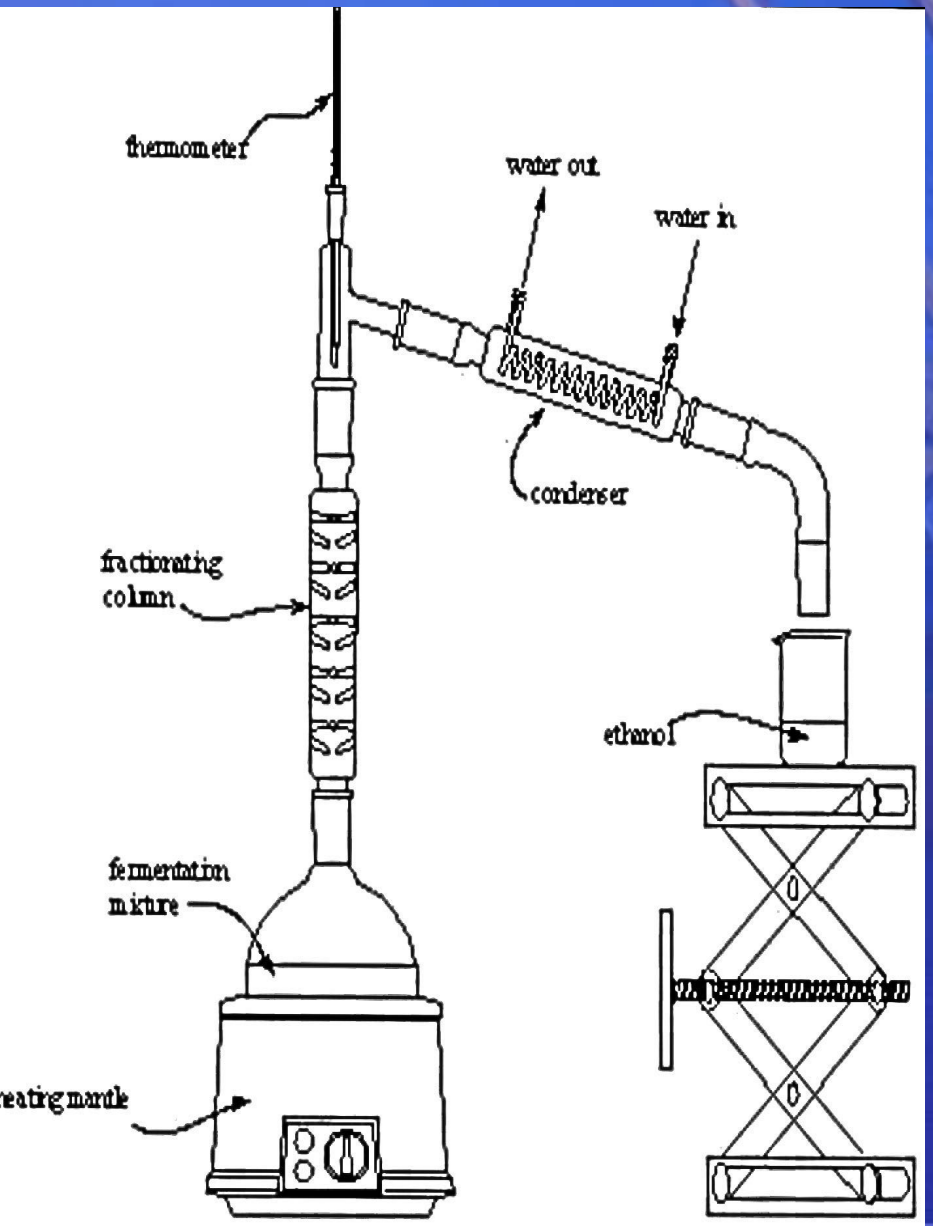
Introduction

Objectives



- To determine the total carbohydrate content (TCC) in the elephant grass feedstock by conducting proximate composition analysis of the feedstock
- To evaluate the yield of ethanol from the fermentation of the of the grass feedstock.
- To examine the effect of feedstock concentration and fermentation time on ethanol yield

2. Methodology



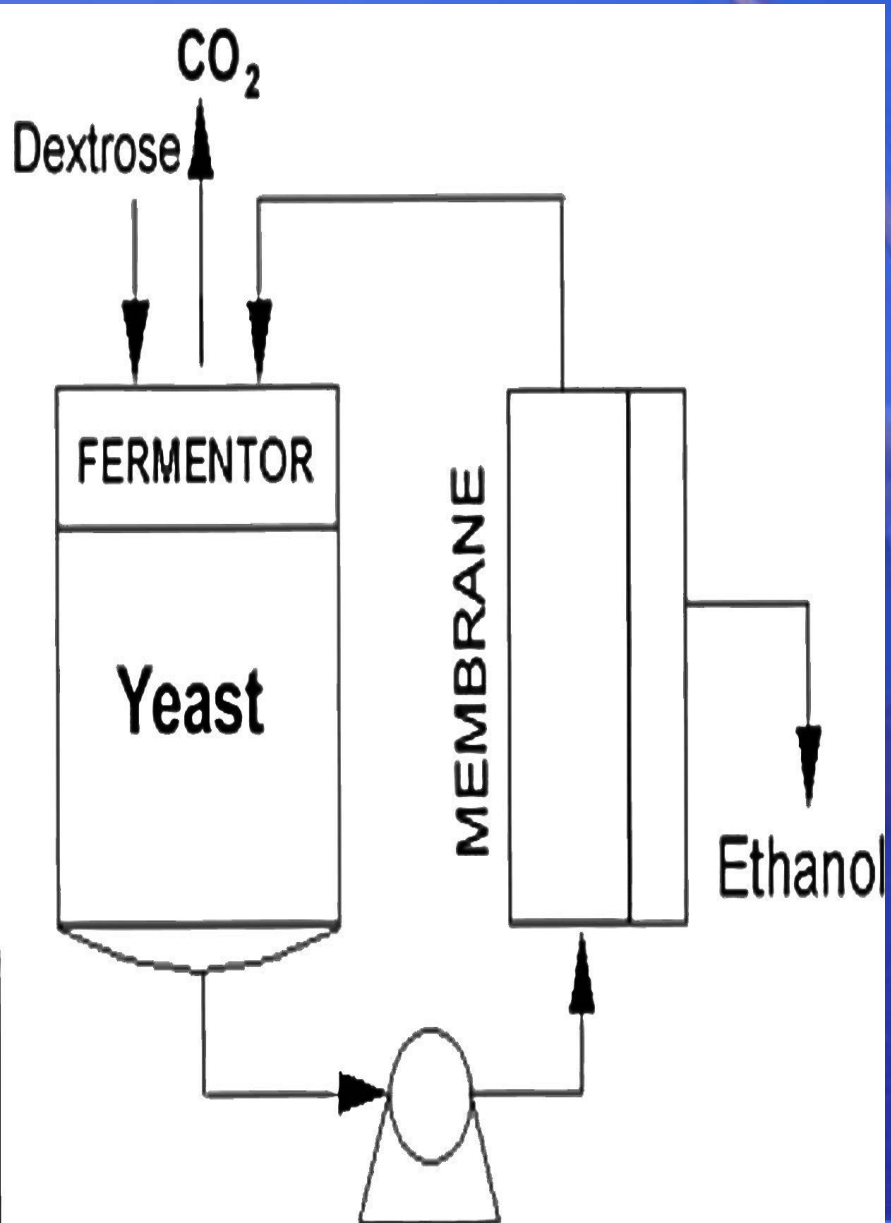
Sample Collection –

- Harvesting of (stems and leaves) of the Elephant grass
- Taken to the Laboratory for sample preparation exercises.

Sample Preparation

- Cut into smaller bits (to ease drying process) and weighed.
- oven dried at 70^{o}Cfor a day.
- Ready for laboratory analyses

Methodology...cont



Sample Preparation-

A) Proximate composition analysis of the feedstock

- **Moisture content**
- **Fat lipid content**
- **Ash content**
- **Protein content**
- **Total carbohydrate content**

B) Hydrolysis, fermentation & distillation processes

- **Acid hydrolysis of feedstock using 0.5M dil H2SO4 for 10g, 15g & 20g of feedstock**
- **Distillation at 78.3oC & observed for 1,2,3,4 &5 days**

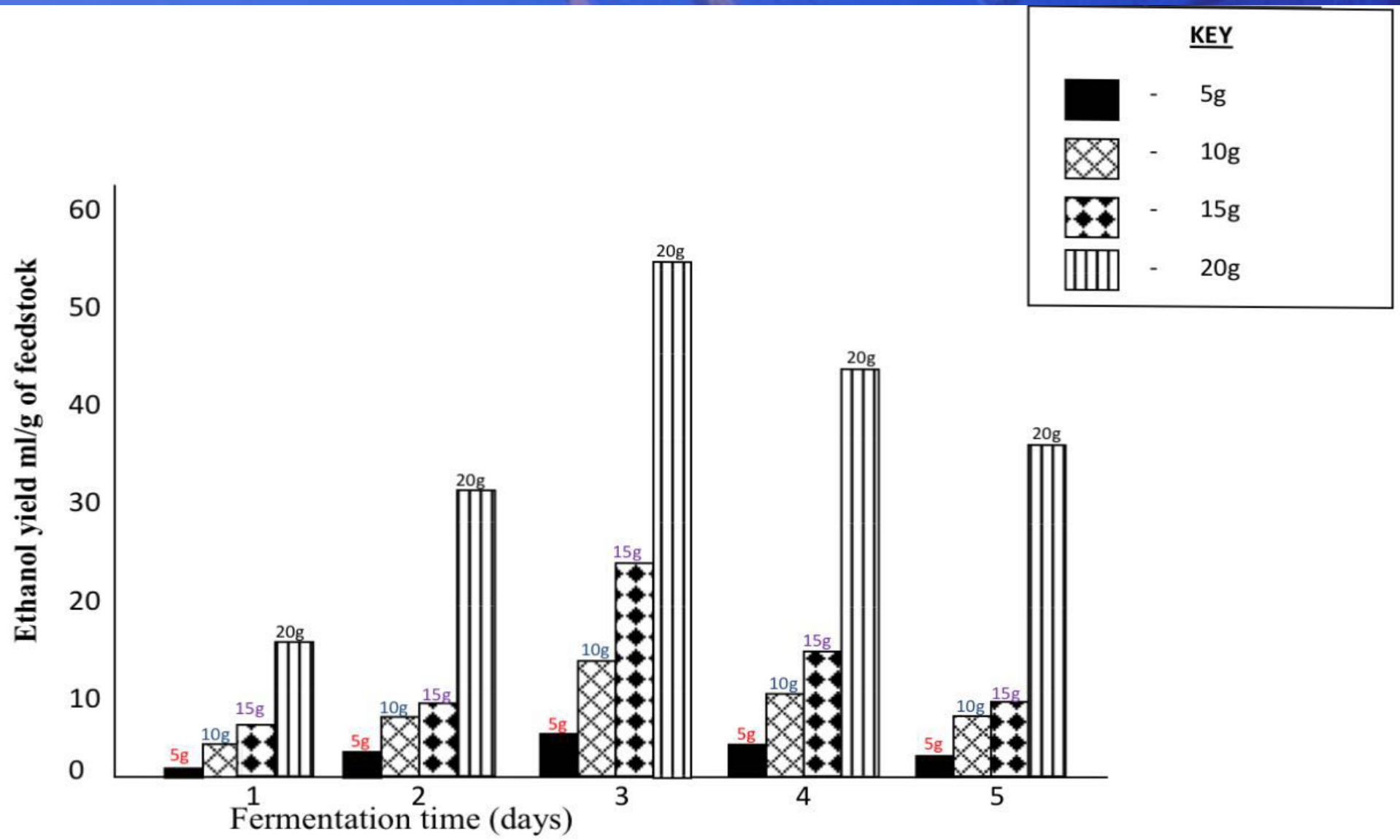
3. Results

Proximate composition-

Parameter (%)	Sample 1	Sample 2	Average
Moisture content	0.25	0.26	0.26
Fat content	3.35	3.27	3.31
Ash content	9.04	9.18	9.11
Crude Protein content	13.44	12.81	13.13
Total Carbohydrate Content (TCC)	**73.92**	**74.48**	**74.20**

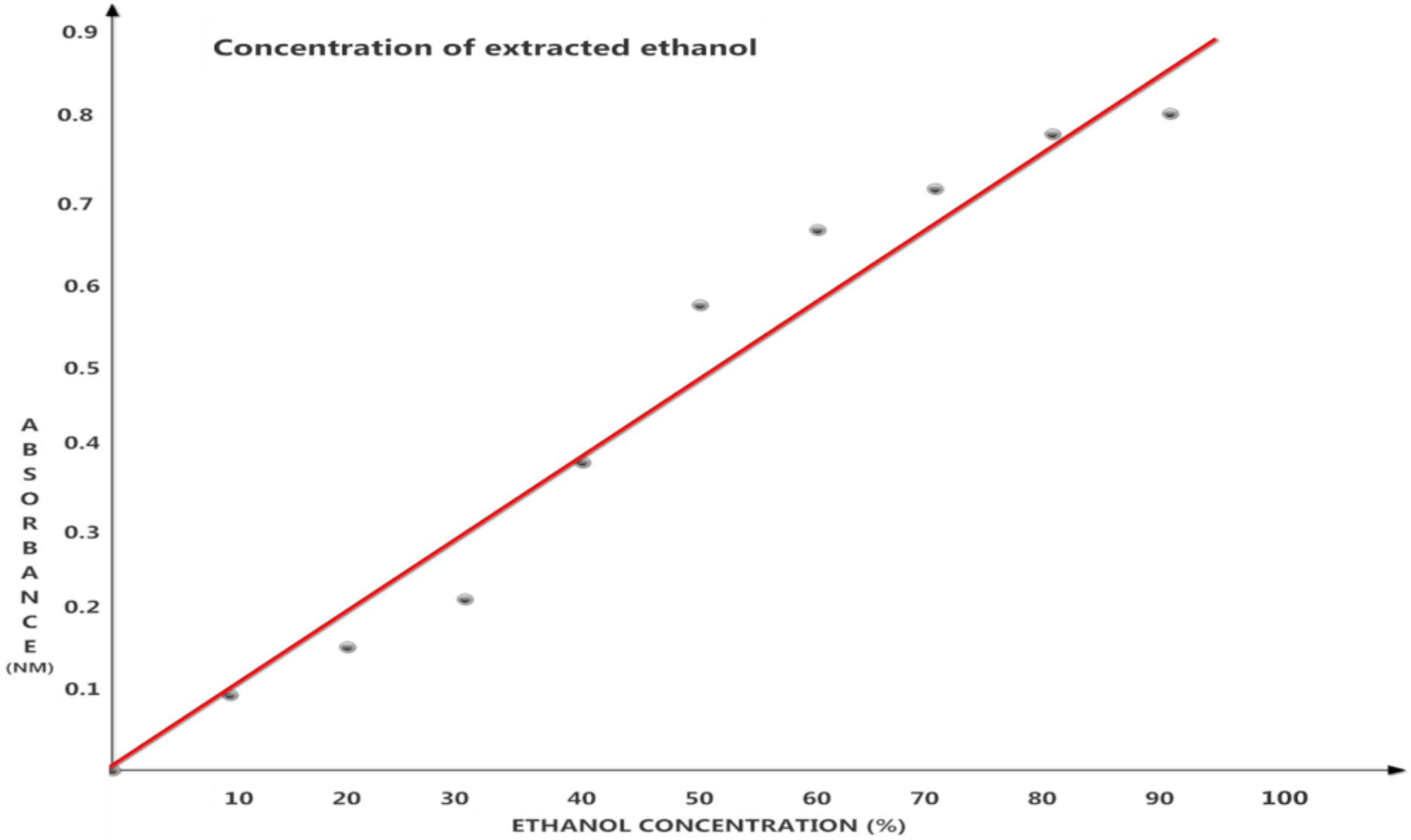
Results

Effect of Feedstock Concentration & Fermentation Time on Ethanol Yield



Results

Standard Plot for Absolute Ethanol at 205nm wavelength



4. Discussion & Conclusion

Discussion-

- For an industry standard, proximate includes five (5) constituents: moisture, fat, ash, crude protein and carbohydrates.
- The carbohydrate content is the substrate upon which reducing sugars and ethanol are produced through the processes of hydrolysis and fermentation respectively.

Discussion & Conclusion

Discussion-

- The **total carbohydrate content is 74.21%** from the elephant grass feedstock.
- The **carbohydrate content is impressive** for conversion into bioethanol as supported Christian *et al*.,(2002);Farrel *et al*.,(2002) and Soares *et al.,* (2011) in their separate studies reported the high carbohydrate content of switchgrass.

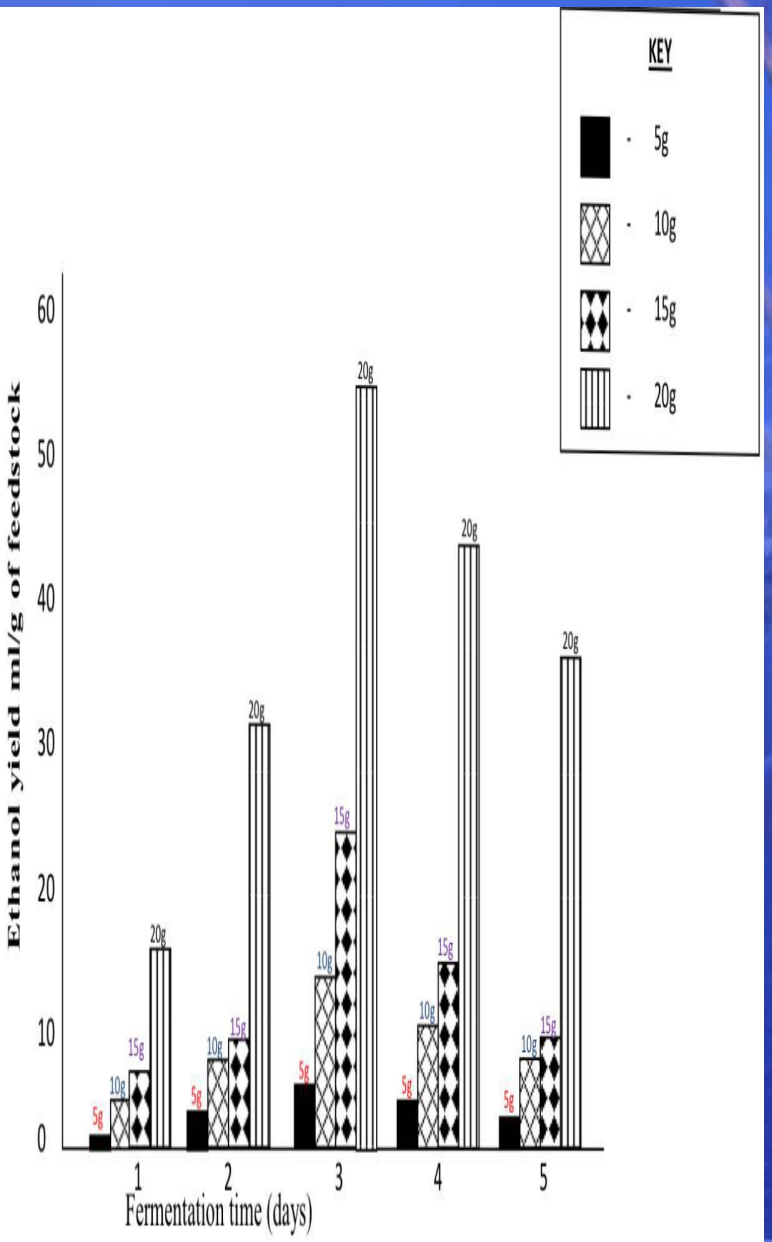
Discussion & Conclusion

Discussion-

The **carbohydrate content** from the **elephant grass** feedstock is **higher than** that of the highly rated temperate **switchgrass** (Mick, 2008) While switchgrass is of American origin, elephant grass is of African origin).

The **ethanol yield increased with increasing substrate** or feedstock concentration of 5g to 20g.

Discussion & Conclusion



Discussion-

- Ethanol yield increased from day 1 to day 3 after which there was a decrease in the yield from day 4 to day 5 . Indicating day 3 or 72 hrs as the optimum period for microorganism activities in the fermentation
- However, increase in fermentation time after day 3 (72hrs), gave a decrease in ethanol yield (day 4 to day 5). It could be deduced that the ethanol produced after 72hrs as production peak could inhibit the activity of the yeast, hence a drop in yield.

Discussion & Conclusion

Conclusion-

- The carbohydrate content is high enough to favorably support the processes that lead to bioethanol production

THANK YOU FOR YOUR ATTENTION!

???