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"UTILIZATION OF BIO-ETHANOL FUEL FROM SWEET SORGHUM"

[1]Hitarth Surati, [2]Dr.Dipak Gosai

[1,2]Mechanical Engineering Department, SVMIT, Bharuch

[1]surati346@gmail.com,

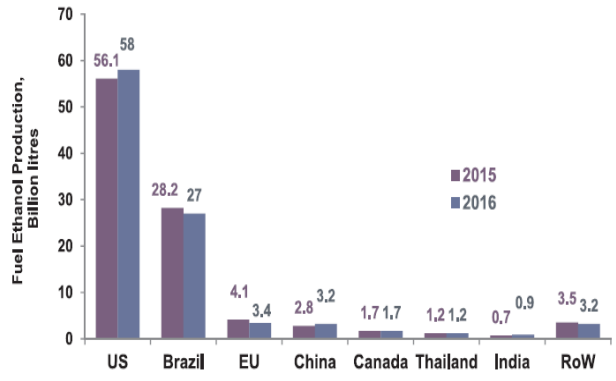
[2]dipak.gosai@svmit.ac.in

ABSTRACT: - The objectives of this research was to enhance the production of ethanol from sweet sorghum molasses using fermentation process. Various amounts of sweet sorghum molasses combined with different concentration of additives like malt extract, glucose, yeast extract, peptone, agar and Saccharomyces Cerevisiae Ncim 3594 to maintain pH up to 4.2 to 4.5. Mashes fermented about 72 hours at 35 Celsius temperature to produce ethanol. Distillation carried out in distillery apparatus at 78 degree Celsius bio-ethanol capture in airtight conical flask and after double distillation carried out for pure bio-ethanol was obtained. After this work concluded that 1 liters sweet sorghum with some additives, 400 ml absolute bio-ethanol.

Keyword- *Renewable energy, Sorghum, Bio-ethanol.*

1. INTRODUCTION

This paper is based on, increasing demand of energy & pollution regulation as a result of population growth and demand of vehicles in the word promote research on the alternative fuel. The investigation have concentrated on decreasing fuel consumption & on lowering the concentration of toxic **component** in combustion product by using non-petroleum renewable sustainable & non-polluting fuel. The alcohol fuel have better advantages over gasoline to control the pollutions & improve performance of engine. There is an alternative fuels use in Internal Combustion engine but Alcoholic fuel have advantages over petrol fuel. There was a two type's alcoholic fuel use in I.C engine. Ethanol & Methanol better alternative fuel for I. C. engine.



[Figure 1.country wise production of bio-ethanol in 2015-16[(1)]]

1.2. Sweet Sorghum

There were a many feed stock available for producing fuel such as sweet-sorghum, so that compare to other feed stock sweet sorghum good for produce Bio-ethanol, in this context, this paper present sweet sorghum as a feed stock foe produce bio-ethanol.

1.1 Bio-ethanol

Bio-ethanol usage as an alternative fuel in internal combustion engine with ethanol-gasoline blending. Global production of ethanol increasing day by day, shown in graph ethanol production in India from sweet sorghum 0.7 billion liters 2015, 0.9 billion liters in 2016. Bio-ethanol production all over world shown in figure (1).

Nowadays bio-ethanol production increases due to increases in ethanol-gasoline blending use as alternative fuel in internal combustion engine .Bio-ethanol may be produced from many high energy crops such as sweet sorghum, corn, wheat, barley, sugar cane, sugar beet, cassava etc. But the sweet sorghum has the potential to reduce carbon emission. In addition, among the plants, sweet sorghum has following characteristics compare to sugarcane & other raw material [3].

i. Sweet sorghum crop has multi uses show in fig (2),

ii. Its concentration of sugar normally between 12 - 21%, from directly fermentable process that is, no starch to ct.

iii. "It can be cultivated in temperate, subtropical and tropical climates".

iv. Its bagasse, after sugar extraction, extra waste used for animals feed.

v. Its growing period is 3 - 4 months & sugarcane 10 - 12 months, and water requirement is 1/3 of sugarcane crop.

vi. Sweet sorghum harvest two times per year by using machine equipment.

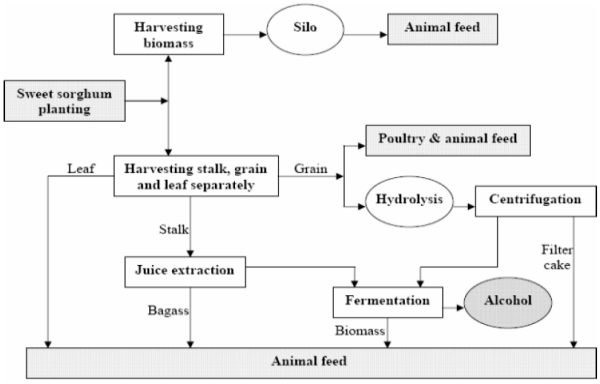
vii. It's produce much carbohydrates & sugar equal land area compare to sugarcane

1.3 Bio-ethanol produce from Sweet Sorghum

Bio-ethanol normally produce from sugarcane but in this research ethanol produce from sweet sorghum. There are four steps normally used to produce bio-ethanol from sweet sorghum.

1. Juice-extraction:

Juice is extracted by series of mills. The juice coming out of milling section is first screened, sterilized by heating up to 100 ^{0}C & then clarified. The muddy juice is then sent to rotary vacuum filter & the filtrate juice is sent to evaporation section for concentration & then fermentation.



[Figure 2.Ethanol production from Sweet Sorghum Layout [(2)]]

2. Fermentation:

Fermentation is a multidisciplinary process based on the chemistry, biochemistry and microbiology of the raw materials. Juice or syrup is converted into ethanol by the yeast Saccharomyces cerevisiae. Sugar is converted to ethanol, carbon dioxide and yeast biomass as well as much smaller quantities of minor end products such as glycerol, fuel oils, aldehydes and ketones.

3. Distillation & dehydration:

In the distillation section, alcohol from fermented mash is concentrated up to 95% v/v. This is further concentrated to produce ethanol with 99.6% v/v (minimum) concentration. The treatment of bagasse generated in the distillation section can be done using following option. Concentration of part of bagasse to 20 to 25% solids followed by composting using press mud available and concentration of rest of the bagasse to 55% solids and use as liquid fertilizer.

Since Iran has dry and hot climatic conditions therefore sweet sorghum has emerged as a leading candidate for liquid sugar and bio fuel production with minimum inputs.

2. LITERATURE SURVEY

P. Sakthivel et al [1] About 85% need of petroleum oil in India was imported. There's an increase of vehicular population and demand for transportation fuels as a result of steadily growing Indian economy. India has a greatest demand of petrol around 43 billion liters up to year 2020.This would be increase around 68 billion liters for year 2026(USDA, 2017).The demand of ethanol will also increases due to increase in gasoline as a demand for blending. "The global production of ethanol is continuously increase up to 98.6% in year 2015-16.India use 0.7 billion liters ethanol use as a blending in 2015-16.

Rouf Ahmad Dar et al [29] Sweet sorghum is a good alternative compare to sugar cane, corn, sugar beet .because sweet sorghum required less water & Harvesting in any season. Here for fermentation process , the yeast Saccharomyces cerevisiae converts juice or syrup into ethanol, for effictive production of ethanol require additives like nitrogen sources such as yeast extract, malt extract, peptone, urea and ammonium sulfate ((NH4)2SO4) have been utilized for efficient ethanol production. The S. cerevisiae has an optimum pH range of 4.0–5.0 for ethanol production. The ethanol concentration did not reduce significantly on decreasing the pH below 4.0 but it demands a longer incubation period.

J.N. Nigam et al [30] normally, in bio-ethanol fermentation process different type of additives use manage pH. Value & improve ethanol production. Here Agar gel (3% w/v) resistant to microbial degradation has been used for cell immobilization, resulting in higher yield and ethanol productivity & manage pH value add 0.5 g MgSO4 in sweet sorghum yeast syrup.

Prasad et al [6] they work ethanol production by sweet sorghum in an India, how different to sugarcane. Bio ethanol production by sweet sorghum about 1140-1640 L/acre direct from juice. Sorghum crop duration is 3 1/2 months, it's very short time comparison to sugarcane. Sweet sorghum and sugarcane water requirement 8000 m3 ha-1 & 36 000 m3 ha-1. Smith & Buxton reported that average ethanol yields above 3100 L ha-1 up to 5235 L ha-1 from different sorghum varieties. Result show that sweet sorghum best suggestion to produce because of its planting in any seasons & requirement of water is less compare to other.

Reji Mathai et al [7] Working on sweet sorghum is proposed to be one of the main alternative and renewable sources for prize effective attractive bio-ethanol production. Due to increase automotive vehicle, industrializations and population the demand of alternative fuel source increase day by day. However Production of bio-ethanol in world increase constantly. The Sugarcane and sugar beet are major Agricultural traditional crops used for producing bio-ethanol. For production of bio-ethanol from agricultural residues involves promising technology of Pre-treatment, enzymatic hydrolysis, fermentation and distillation.

Saida Lavudi et al [8] for optimization and statistically evaluation employed the surface methodology (RSM) on bases of central composite face centered design. Ethanol bagasse alkali pretreatment in condition, alkali concentration (1.5-4%), pretreatment temperature (125-140) and pretreatment time (10-30) min. optimized resulted glucose & xylose concentration 57.24 & 10.14 g/L. Alkali pretreatment better than acid pretreatment basis of result.

Balint sipos et al [9] Investigation that SO2 impregnated bagasse was steam-pretreated using various condition to pretreated slurry & separated fiber fraction. The optimization conditions 190 ^{0}C for 10 min, 180 ^{0}C for 10 min, 190 ^{0}C for 5 min ,200 ^{0}C for 5 min. Result from view show that when ,effect of liquid fraction the separation of hydrolysis 2% dry matter content of stem pretreatment & hydrolysis 48 h . In condition of 200 ^{0}C 5 min get 80-90% glucose to ethanol convert.

Nana baah Appiah-Nkansah et al [10] The objective of research was to production of ethanol from grains sorghum flour & sweet sorghum juice using free amino nitrogen at very high gravity fermentation various amount of flour were combine with different concentration of sweet sorghum juice from 33g/100mL mashes, 1st starch liqification occurs on mashes at temperature (86^{0}C) for 60 min & then cooling 20^{0}C, pH adjustment using HCL. SSF in present of (Glucoamylase + saccharomyces cerevisiae ethanol red) at temperature 30^{0}C for 72 hours Result showed that 20.25 % (v/v) of ethanol & 96 fermentation efficiency could be obtained from near equal to 33% (w/v) dissolved solid.

Niphaphat phukoetphim et al[11] work on ethanol production on basis of different gravity sweet sorghum juice .In different gravity conduction by nutrient supplementation & alternative feeding regimes like batch & fed batch system using highly ethanol-tolerant strain , saccharomyces cerevisiae NPO1. Result showed that highest ethanol concentration 90.00 g/L & ethanol productivity 1.25 g/L h without yeast & with yeast ethanol productivity increase. when fed batch fermentation using the ethanol concentration & ethanol productivity about 2.35 g/L h & 112.9 g/L, at a feeding time 9 hour & feeding rate 40 g sugar/h.

Crolina A. Barcelos et al [12] optimization ethanol production using sweet sorghum juice, gains, bagasse in different process.1st sweet sorghum juice fermentation in present of saccharomyces cerevisiae, get ethanol production about 87 g/L. The sweet sorghum bagasse pretreatment for the remove hemicelluloses & hydrolysis & its fermentibilty evaluate in present of strain saccharomyces cerevisiae. In result bio-ethanol yield 30 g/L. Pretreatment & alkaline extraction of solid underwent for the lignin remove. SSF (Simulation saccharification & fermentation) process on the removal lignin. Resulting 85 g/L bio-ethanol produce in 21h fermentation process.

3. MANUFACTUREING OF BIO-ETHANOL FROM SWEET SORGHUM

3.1 Raw material & additives used:

1) Sweet Sorghum Crop:

In bio-ethanol 1st harvest seedling of sweet sorghum in best harvest season September–November in every year .its harvest crop in surat India. The initial stage of sweet sorghum crop in first 15 days as shown in fig (3). Time duration of sweet sorghum about 4-5 months, its final stage of crop show in figure (4) & best juice yield from sweet sorghum get when crop duration about 3-4 months & before growing grains on it . Requirement of water less compare to sugarcane & other crops. Hand cut

[Figure 3. Intial Stage Of Sweet Sorghum]

[Figure 4. Final stage of Sweet Sorghum Crop]

2) Sorghum Juice:

Sweet sorghum crop duration about 3-4 months, best yield of sugar juice can be obtained it. It's cutting crop for juice extraction by hand. As show in fig (5) crop was cut & juice extracted using motoring drill machine

[Figure 5. Juice Extraction]

3) Saccharomyces Cerevisiae Yeast:

[Figure 6. Saccharomyces Cerevisiae Ncim 3594]

Saccharomy cescerevisiae is a species of yeast. It is perhaps the most useful yeast, having been instrumental to winemaking, baking, and brewing since ancient times. Saccharomy cescerevisiae using for fermentation process in ethanol production. Saccharomy cescerevisiae bought from Pune chemical shop.

4) Saccharomyces Cerevisiae MGYP Medium:

Saccharomyces Cerevisiae MGYP Medium made from using different additives at different concentration to maintain ph value of syrup. Additives used which shown in figure (7)

[Figure 7. Additives Used For Saccharomyces Cerevisiae Mgyp Medium]

Additives used in production process 1. Yeast Extracted Powder, 2.Peptone, 3. Malt Extract Powder, 4. Saccharomyces Cerevisiaeyeast 5. Agar to maintain pH value of syrup. Using additives concentration adjust by used of high precision balancer.

[Figure 8. Saccharomyces Cerevisiae MGYP Medium [14, 15, 16]]

Malt extract	**0.3 gram**
Glucose	**1.0 gram**
Yeast extract	**0.3 gram**
Peptone	**0.5 gram**
Distilled water	**100 ml**
Agar	**2.0 gram**
pH	**6.4 - 6.8**

3.2 INSTRUMENTS USED:

Bio-ethanol production from sweet sorghum which process need to instrument for the fermentation, distillation process shown in figure (9)

[Figure 9. Instruments Used]

1) A laminar flow cabinet:

2) Autoclave: -

3) Refrigerated Orbital shaking Incubulator: -

4) Distillery apparatus: -

3.3 WORKING PROCEDURE:-

1. Conical flask and test tube clean by water and put in auto clave sterilizer for free from bacteria.
2. MGYP medium prepare in conical flask for Saccharomyces Cerevisiaeyeast for grow.
3. Sweet sorghum molasses are dissolved in distilled water in conical flask in (1:4) quantity and H_2SO_4 and adjusting pH 4.2 to 4.5 and adding 1gm MgSO4 for 1 kg molasses, adding 1 vial streptomycin.
4. MGYP medium flask and sugar cane molasses taken in to fermentation flask and then put in auto clave sterilizer for sterilization.
5. Saccharomyces cerivisiae yeast adding in MGYP medium flask in Laminar flow cabinet with precaution and then this fermentation flask put in Refrigerated Orbital shaking Incubulator for 48 hours.
6. Sweet sorghum molasses adding in MGYP medium with yeast in Laminar flow cabinet and after this flask is put in Refrigerated Orbital shaking Incubulator for 72 hours at 35 Celsius temperature and 4 PH.
7. Distillation carried out in distillery apparatus at 78 degree Celsius bio-ethanol capture in airtight conical flask and after double distillation carried out for pure bio-ethanol was obtained.

3.4 TESTING & IDENTIFICATION OF BIOETHANOL:-

Bio-ethanol production from sweet sorghum using different additives. Finally about 5 to 10 ml fermented sample was taken and pinch of potassium dichromate and a few drop of H2SO4 were added [17]. The color of the sample turns from pink to green which indicates the presence of bio-ethanol.

4. RESULT AND CONCLUSION:-

This research archived the goal of Saccharomyces Cerevisiae Ncim 3594 & different additives used in bio-ethanol production from sweet sorghum crop. It was found that sweet sorghum can be harvested over at least 2-3 months period with high amount of sugars .Yeast extract and peptone promote ethanol fermentation maintain gravity of syrup. Hear mainly specific gravity of fermented medium maintained and

temperature is main optimize condition for absolute ethanol production .After this work of production concluded that 1 liters sweet sorghum with some additives, 400 ml absolute ethanol production .compare to sugar cane its good feedstock for bio-ethanol production.

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