Production of Ethanol from Sugarcane Molasses

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ABSTRACT

Ethanol is a potential energy source and its production from renewable biomass has gained a lot of popularity. There has been worldwide research to produce ethanol from regional inexpensive substrates. The present study deals with the optimization of process parameters (viz Ph, Substrate conc, Urea conc) for ethanol production from sugar cane molasses. Sugar cane molasses are the cheapest source of ethanol production. It can also produce from wheat, sugar beet and corn etc. The study was carried out by process of parameter optimization. The process parameters optimized were substrate conc, pH and urea conc. The values of the process parameters are 30% substrate conc, pH 4.5 and urea conc 0.5%. Fermentation period was 7 to 8 days at 28°C.

Keywords: Ethanol, Wheat, Sugar beet and cornet, pH 4.5 and urea conc 0.5%.

I. INTRODUCTION

Mainly there are four kind of alcohol as ethyl, denatured, isopropyl and rubbing. Where Ethyl alcohol is more widely being used for its various fruitful application. They are highly demanded in industrial (Mc Cambridge et al., (2019)) as well as in domestic (Adrian, M., & Ferguson, B. S. (1987)) market. As they play an essential role in production of many daily use product (Cochran, S., & Anthonavage, M. (2015)) or they are used as a simple raw material or in carry out certain chemical reaction (Goswami et al., (2013)) or for other industrial services (Larsen et al (1994)). Moreover, they are now famous in various domestic application after the invasion of pandemic (Rabenau et al., (2005)).

Ethanol (C\(2\)H\(6\)O) is a simple chemical compound, commonly known as simple alcohol. It is widely famous for its use in intoxicating alcoholic beverages like beer, wine, rum etc. Besides being a good intoxicating agent ethanol (Wu et al., (2014)) has many other merits. Such as, it is common choice in most of the pharma and chemical synthesis industries for the production of chemicals and medicines. Moreover, it is also use as an active ingredient in preparation of high calorific value fuels like gasoline (Hansen et al., (2005)). Furthermore, presently it has been used widely for making sanitizer and disinfectants in order to battle harmful microbes and pathogens(Assefa et al., (2020))( Thomason et al., (2020)).

If we talk about the motive of selecting sugarcane molasses, it’s very simple. Firstly, sugarcane molasses is the waste product of sugar (food sweeteners) making company. Hence, they are very cheap if we compare its cost from other sources. Secondly, it is available throughout the year therefore, there is no chance of shortening of fresh supplies. Moreover, as it’s come from sugar making process so, it contains a very large amount of sugar in the residues. As the sugar making industries juice extractor in not fully efficient. Hence, may this be not good for sugar industries but it boon for alcohol manufactures. As, its contain pure sugar which act as vital nutrient for the fermentations machineries, which are microbes (Ikegami et al., (2020)). Furthermore, it’s found that if the source of carbohydrate is not simple it takes longer duration for the fermentation causing microbes to produce alcohol from it. To reduce the time, the manufacture, need to apply enzyme or need to carry out extra procedure to bring the source carbohydrate in simple form. Such simple that it become a good feed for microbe to consume. These additions may rise up the cost of production and hence reduce the profit. Therefore, selecting Sugarcane molasses as the raw material may act as a good alternative(Wu et al., (2020))(Khoja et al., (2015)). As, the vital content of molasses are sucrose that can easily be converted into simple for by simple rise of temperature. Hence, choosing sugarcane molasses could be a great option for alcohol manufacturing company.

In today’s automotive world where transportation is the basic need of living. Fuel play an important role in the transportation industries. But as per increase in demand of automobile fuel the natural sources of fuel are depleting day by day. Therefore, it is necessary to create an alternative for petroleum fuel before it’s too late. Ethanol, is found to be very much efficient in running automobile after successful adjustment in its content (Zhang et al., (2020))(Anderson et al., (2020))(Li et al., (2020)). But in order to compete with the demand of rising transportation business. It is very much necessary to discover such ways that can be a suitable alternative for automobile fuels.

Presently, ethanol is produced from many sources. Sources that contribute cheap carbohydrate content. Although there are number of sources available
for the production of ethanol still there is number of experiment running worldwide to discover more alternative sources for the production of ethanol. Mostly the motive of this efforts are to reduce the cost of mass productions as low as possible. But, the reduce in cost should not create any extra burden and them should not be any compromise in the quality and quantity of the product. As these are the important aspect for mass level production. So, here in this task report we have tried to add another alternative source for the production of ethanol. We have chosen sugarcane molasses as a test sample.

II. RESEARCH METHODOLOGY

Material

**Chemical Required**
- Sodium hydroxide
- HCL
- Urea
- Glucose

**Media Required**
- YEPD Broth.

**Substrate Required**
- Molasses.

**Equipment Required**
- Shaking Orbital Incubator
- Electronic Balance
- pH meter
- Spectrophotometer
- Heating mantle
- Autoclave
- Alcohol meter (gay lussac temp 20°C and Range 0-100° by volume)

**Miscellaneous Required**
- Conical flasks
- Distilled water
- Syringe
- Beakers
- Micropipettes

**Methods**

**Maintenance of yeast**

The Baker’s yeast maintained on (YEPD) broth containing yeast extract (1g/100ml), peptone (2g/100ml), glucose (2g/100ml) was obtained from the available stock culture available in lab. The flask was incubated at 28 °C for 2 days for maximum growth.

**Development of Inoculum**

100 milliliter of YEPD (containing yeast extract (1g/100ml), Peptone (2g/100ml), glucose (2g/100ml) was added in 500ml Erlenmeyer flasks. The flask was properly covered and autoclaved for 15 min at 121°C then allow to cool at room temperature, after cooling 2gm of yeast granules was added aseptically. Then the flask was kept in shaking orbital incubator for 2 days at 28°C.

**Optimization of pH**

- The five setups of pH (3.5,4,4.5,5.,5.5) was taken in 500ml flask.
- 10 ml inoculum was added and final volume was adjusted 200ml with distilled water.
- First 30/5of sugar was taken as it was optimized earlier then pH was set by pH meter.
- All the flask was kept in shaking orbital incubator at 28°C for 7 to 8 days for fermentation.
- Distillation was done with distillation column.
- Alcohol percentage was measured with alcohol meter.

**Optimization of urea Concentration**

- The four setup of urea concentration (0.25%,0.5%,0.75%,0.1%) was taken in 500ml flask.
- In each flask sugar conc was kept 30% and pH adjusted to 4.5 in each sample as it is earlier,
- 10 ml inoculum was added and final volume was adjusted 200ml with distilled water.
- Kept all the flask in shaking orbital incubator for fermentation about 7 to8 days at 28°C.
- Distillation was done by distillation column.
- Final alcohol percentage was measured by alcohol meter.

**Final Ethanol Production**

- The final ethanol was produced with the optimized process parameters (substrate conc. pH, urea conc).
- Then flask was kept in shaking orbital incubator for 7 to8 days at 28°C temp for fermentation.
- After fermentation flask was carried out for distillation.
- Final alcohol was measured with alcohol meter.

III. RESULTS AND DISCUSSION

**Results**

Ethanol produce from different parameter optimization by substrate conc,ureaconc, pH range are as follows.

**Optimization of first process parameter: Substrate conc.**

As discussed in material and methods six setup was considered of sugar concentration for optimization. The values was (10,15,20,25,30,35%) out of all these six samples one was showing high amount of ethanol that is 30% means 30% sugar conc was optimum cone of substrate for ethanol production.
Table 1: Final ethanol production after substrate conc optimization

| Serial | Substrate conc (w/v) (%) | Inoculum (ml) | Final volume made with distilled water (ml) | Alcohol (%) (v/v) |
|--------|--------------------------|---------------|-------------------------------------------|------------------|
| 1      | 10                       | 10            | 200                                       | 1                |
| 2      | 15                       | 10            | 200                                       | 3                |
| 3      | 20                       | 10            | 200                                       | 4                |
| 4      | 25                       | 10            | 200                                       | 5                |
| 5      | 30                       | 10            | 200                                       | 7                |
| 6      | 35                       | 10            | 200                                       | 5                |

The given graph indicate two line one is showing substrate conc while other one was showing amount of alcohol produced from particular substrate concentration. As shown in graph at 30% substrate conc ethanol produced was 7%.

3.1 Optimization of second process parameter: pH

As we discussed in earilier in material and methods five set up of pH was considered the values taken are (3.5,4,4.5,5,5.5) out of these five values one was producing high amount of ethanol that is 4.5pH range.the amount produced from 4.5 range was 8%.

Ethanol production after optimization of pH range

Table 2: Final ethanol production after pH optimization

| Serial no | Substrate conc(w/v)(%) | pH    | Inoculum (ml) | Final volume(ml) | Alcohol (%)(v/v) |
|-----------|------------------------|-------|---------------|------------------|------------------|
| 1         | 30                     | 3.5   | 10            | 200              | 3                |
| 2         | 30                     | 4     | 10            | 200              | 6                |
| 3         | 30                     | 4.5   | 10            | 200              | 8                |
| 4         | 30                     | 5     | 10            | 200              | 5                |
| 5         | 30                     | 5.5   | 10            | 200              | 2                |

The given graph showing different pH range producing particular amount of ethanol during pH optimization we take substrate conc constant that is 30% optimized conc.the optimum pH range is 4.5 for high ethanol production.
3.2 Optimization of third process parameter: Urea conc.

As mentioned in the material and method, four different urea conc was taken that were (0.25%, 0.5%, 0.75%, 1%) out of these values one was showing the best for ethanol production that was 0.5% produce more ethanol than others that was 10%. During urea conc optimization pH and sugar conc was constant that was 4.5 and 30% as already optimized.

Table 3: Final ethanol production after urea conc optimization

| Serial no | Substrate conc (w/v)(%) | pH range | Urea conc (%) | Final volume (ml) | Alcohol (%) (v/v) |
|-----------|-------------------------|----------|---------------|-------------------|-------------------|
| 1         | 30                      | 4.5      | .25           | 200               | 5                 |
| 2         | 30                      | 4.5      | .5            | 200               | 10                |
| 3         | 30                      | 4.5      | .75           | 200               | 8                 |
| 4         | 30                      | 4.5      | 1             | 200               | 5                 |

The given graph indicating the alcohol amount produced from urea conc optimization the best optimized urea conc was .5 that produced 10% alcohol.

**Final ethanol production after all parameter optimization**

After all parameter was optimized the final ethanol was produced. The optimized parameter was sugar conc, pH and urea conc. The optimized values were Sugar conc-30% (w/v) pH-4.5 urea conc-0.5 (w/v) the given graph indicating ethanol produced after all the parameter was optimized final ethanol produced. amount of ethanol produced was 10%.
Table 4: Final ethanol production all process parameter optimization

| Serial no | Substrate conc (w/v) (%) | pH range | Urea (gm) | Inoculums (ml) | Final volume (ml) | Alcohol (%) |
|-----------|--------------------------|----------|-----------|---------------|------------------|-------------|
| 1         | 30                       | 4.5      | .5        | 10            | 200              | 10          |

IV. CONCLUSION

The optimized parameter was substrate conc, pH and urea conc. For fermentation (YEPD) broth was taken having peptone, dextrose, yeast extract and yeast granules. Incubation period was 2 days. All the parameter was optimized by taking different values and ferment for 7 to 8 days at 28°C after fermentation distillation process was done and alcohol produced from different conc was measured by alcohol meter. The Optimized parameter values was 30% substrate conc, 4.5pH and .5% urea conc. After parameter optimization final ethanol produced.

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