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Production of Alcohol Through Fermentation in Saccharum Officinarum (Sugarcane) and Jaggery (Gur)

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Abstract- **The anaerobic oxidation of compounds by enzyme action of microorganisms in which an organic molecule is oxidized without an exogenous electron acceptor. Usually pyruvate or pyruvate derivative serves as the electron acceptor is called fermentation. In the present paper alcohol has been produced through fermentation and the concentration of alcohol has been determined in the sugarcane and Gur sample with the help of the standard curve. Yeast has been used for the purpose of fermentation. The concentration of alcohol as compared with standard curve in Gur sample (1.1%) was greater than in sugarcane sample (0.8%).**

Keywords- **Saccharomyces Cerevisiae, Saccharum Officinarum, Jaggery**

I. INTRODUCTION

Fermentation in food processing typically is the microbial conversion of carbohydrates present in agricultural products [1] to alcohols and carbon dioxide or organic acids using yeasts, bacteria, or a combination thereof, under anaerobic conditions. Fermentation in simple terms is the chemical conversion of sugars into ethanol. Yeast has been used for fermentation. Yeasts are eukaryotic microorganisms classified in the kingdom Fungi, with 1,500 species currently described [2]. Yeasts are unicellular, although some species in yeast forms may become multicellular through the formation of a string of connected budding cells known as pseudohyphae, or false hyphae, as seen in most molds [3]. Various strains of indigenous yeasts capable of producing ethanol have been isolated from different local sources such as sugar mill effluents [4] and fermented pineapple juice [5]. In most of these studies, the preferred candidate for industrial production of ethanol has been *Saccharomyces cerevisiae.* This yeast also has the ability to produce ethanol which is not contaminated by other products from the substrate.

In the present study, alcohol has been produced in juice of sugarcane and Gur. A worldwide interest in the utilization of bio-ethanol as an energy source has stimulated studies on the cost and efficiency of industrial processes for ethanol production. Intense research has been carried out for obtaining efficient fermentative organisms, low-cost fermentation substrates and optimum environmental conditions for fermentation to occur. Sugarcane, or Sugar cane, is any of six to 37 species (depending on which taxonomic system is used) of tall perennial true grasses of the genus *Saccharum*, tribe Andropogoneae, native to the warm temperate to tropical regions of South Asia.

A sugarcane crop is sensitive to the climate, soil type, irrigation, fertilizers, insects, disease control, varieties, and the harvest period. The average yield of cane stalk is 60–70 tonnes per hectare per year. However, this figure can vary between 30 and 180 tonnes per hectare depending on knowledge and crop management approach used in sugarcane cultivation. Sugarcane is a cash crop, but it is also used as livestock fodder [6]. The production of ethanol from sugar cane is more energy efficient than from corn or sugar beets or palm/vegetable oils. Sugarcane juice is the juice extracted from pressed sugarcane. It is consumed as a beverage worldwide, and especially in regions where sugarcane is commercially grown such as Southeast Asia, South Asia, and Brazil.

Evaporated cane juice is a loosely defined term which can include combinations of sugars including glucose, and fructose. It is less processed than

bleached white sugar. Nutritional benefits are minimal; evaporated cane juice contains trace minerals and vitamins but has the same amount of calories as table sugar. Jaggery/Gur is a pure, traditional, unrefined form of sweetener. It is a good source of minerals like Calcium, Iron, Phosphorous and Protein.

II. MATERIAL AND METHOD

A. From Juice of Sugarcane

Juice is first diluted with saline. The solution is then made acidic with a small amount of sulphuric acid. Acidity is favorable to the growth of yeast but unfavorable to most other bacteria. Yeast is added to the resulting solution. The mixture is maintained at about 30°C for 2 or 3 days. During this period the enzyme invertase and zymase present in yeast bring about the conversion of sugars into ethyl alcohol. The fermented liquid is known as WASH. The wash contains 15-18% ethyl alcohol. It is subjected to fractional distillation in a special column. The fractional distillation of the wash yields three fractions:

1. Low boiling fraction drawn from the head of the column. It consists of acetaldehyde.
2. Main fraction drawn near the top of the column. It consists of 95% ethyl alcohol.
3. High boiling fraction drawn near the base of the column. It is called fusel oil.

B. From Gur (Jaggery)

Firstly 5 gm of Gur is dissolved in saline. Sterilize this solution at 120-140°C under pressure. The solution is then made acidic with a small amount of sulphuric acid. Acidity is favorable to the growth of yeast but unfavorable to most other bacteria. Yeast is added to the resulting solution. The mixture is maintained at about 30°C for 2 or 3 days. During this period the enzyme invertase and zymase present in yeast bring about the conversion of sugars into ethyl alcohol. The fermented liquid/ wash contains 15-18% ethyl alcohol. It is subjected to fractional distillation in a special column.

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3. High boiling fraction drawn near the base of the column. It is called fusel oil.

III. RESULT AND DISCUSSION

Qualitative test of alcohol:

(A) Ceric ammonium nitrate test: Added 3 to 4 drops of the substance in water to 0.5 cm of the reagent diluted to 3 cm, shake. Formation of red colour indicates the presence of hydroxyl group.

(B) Sodium test: Take the substance in a dry test tube; add a small piece of sodium metal. Effervescence due to the evolution of hydrogen gas indicates the presence of hydroxyl group.

(C) Ester test: Take the substance in a dry test tube, add anhydrous sodium acetate and 4-5 drops of conc. sulphuric acid. Warm gently, pleasant fruity smell is given out which indicates the presence of alcoholic group. Results are shown in Table I.

TABLE I

Sample	**Ceric ammonium nitrate test**	**Sodium test**	**Ester test**
Juice of sugar cane	+	+	+
Gur	+	+	+

Quantitative test:

Dilute the pure alcohol at different concentration as given in Table II. Then take the absorbance of diluted alcohol at 650 nm wavelength with the help of spectrophotometer. This leads to the standard curve of

the alcohol. After taking the reading of alcohol, the reading of fermented sugarcane and jaggery sample are taken at the same wavelength. A graph is drawn between absorbance and concentration of alcohols (Fig. 1). On the basis of the standard curve the absorbance obtained for the samples leads to the concentration of alcohol in the respective samples.

TABLE II

Concentration of alcohol	Alcohol (ml)	Distilled water (ml)	Absorbance
1%	0.1	9.9	0.082
2%	0.2	9.8	0.127
3%	0.3	9.7	0.208
4%	0.4	9.6	0.326
5%	0.5	9.5	0.305
6%	0.6	9.4	0.381
7%	0.7	9.3	0.46
8%	0.8	9.2	0.459
9%	0.9	9.1	0.554
10%	1.0	9.0	0.604
Gur (jaggery)			0.124
Sugarcane			0.075

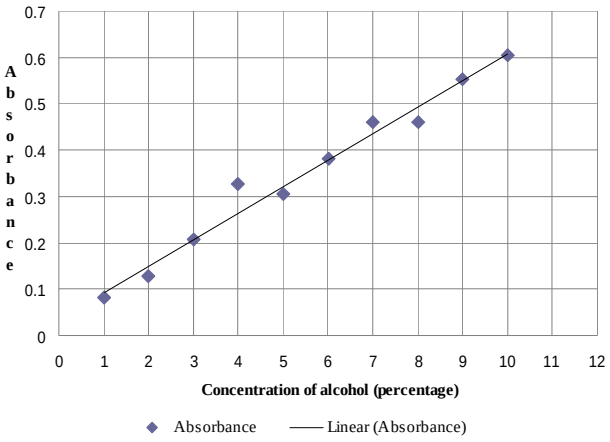

Fig.1: Absorbance v/s concentration of Alcohols

Due to the depleting petroleum reserves, there is global emphasis on ethanol production by fermentation process. Based on the above studies it is found that 0.8% alcohol was produced from sugarcane juice and 1.1% alcohol was produced from jaggery. Thus, bioconversion of carbohydrates present in sugarcane juice and jaggery can be used for generation of ethanol on a large scale by use of ideal microbial strain, appropriate fermentation substrate and suitable process technology.

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