Production Of Bioethanol From Mango Peel

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ABSTRACT

Due to rapid increase in population size and exponential growth in industrialisation, load is increasing on the fossil fuel resources and thus these resources are being depleted very fast. To save the future generations from the acute shortage of fuel resources, which is being anticipated, it is important to find out some novel ways to produce renewable fuels. Some alternative fuels like Bio-fuel may reduce the load on conventional fossil fuel resources.

To produce bio-ethanol using substrates such as molasses, fruit pulps etc. are well known. In the present work bio-ethanol, from mango peel, was produced which in addition solves the problem of disposal of wastes from juice industries. Mango peels were dried and the then ground and finally powder obtained was dissolved in distilled water. Sugar concentration was adjusted to a level of 15 percent. Using baker's yeast, i.e. *Saccharomyces cerevisiae,* this substrate solution was fermented and the ethanol was produced after five days of incubation. The properties of bioethanol from mango peel were determined and found to be reasonably comparable with conventional gasoline.

INTRODUCTION

The excessive use of fossil fuels, particularly in large urban areas, has greatly contributed to generation of high levels of pollution. There is a need for

environmentally sustainable energy sources which will be viable and long-term substitutes for liquid petroleum. As a step to solve this problem, the use or addition of biofuels to gasoline, which reduces emission of carbon monoxide and unburned hydrocarbons that form smog, has widely been enforced in recent years.

Converting a renewable non-fossil carbon, such as organic wastes and biomass consisting of all growing organic matter (plants, grasses, fruit wastes and algae) to fuel would assure a continual energy supply.

The word biomass refers to all of the Earth's vegetation and many products and co-products that come from it. Biomass is the oldest known source of renewable energy. Human beings have been using it since they have discovered fire. Domestic biomass resources include agricultural and forestry residues, municipal solid wastes, industrial wastes, terrestrial and aquatic crops. Biomass is an attractive energy source for a number of reasons. First, it is renewable (as long as properly managed). Also, it is more evenly distributed over the earth's surface than finite energy sources and may be exploited using environment-friendly technologies. Biomass provides self sufficiency in the field of energy generation across the globe. The energy in biomass can be accessed by turning the raw materials, or feed stocks, into a usable form.

Several compelling issues have driven an international effort to develop and improve technology to make biofuels. The dependence on petroleum for fuelling the transportation sector threatens energy security, affects the environment and weakens the economy. Developing the technology to produce and use biofuels will establish safe, clean, sustainable alternatives to petroleum and will promote self-dependence in the field of energy production. According to Petroleum Planning & Analysis Cell, Ministry of Petroleum and Natural Gas, Government of India, the estimated demand of Motor Spirit i.e. Petrol for the year 2012-13 in India has increased by 5.8% from previous year and is 15862 TMT.

The Ministry of New and Renewable Energy, Government of India, through the National Policy on Biofuels, proposes to implement 20% blending of ethanol with gasoline by the year 2017 and 5% blending has already been made mandatory after October 2008. Therefore bioethanol production from waste can have a large impact and can substantially help the oil companies to reach the goal of 20% blending by 2017 set by the government.

The principle fuel used as a petrol substitute is bioethanol. Bioethanol fuel is mainly produced by the sugar fermentation process. Ethanol or ethyl alcohol (C_2H_5OH) is a clear, colourless biodegradable liquid and is less toxic and causes

less environmental pollution. It is a high octane fuel and has replaced lead as an octane enhancer in petrol.

The economics of ethanol production by fermentation is significantly influenced by the cost of the raw materials. It accounts for more than half of the production costs. To achieve a lower production cost, the supply of cheap raw material is thus a necessity. Production of value added products from agro-industrial and food processing wastes is now an area of focus because it reduces pollution in the environment in addition to the energy generation. The annual availability of these wastes amounts to 1.05 billion tons. The major part of this is mostly discarded and it becomes the main source for increasing the pollution in environment. Above all, the discarding process becomes a very expensive step due to high transportation costs. Majority of fruit and vegetable wastes available from their processing industries are seasonal and do not decompose rapidly.

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The mechanical drying of these wastes (mango peel, citrus peel, pineapple peel and tomato processing wastes) gives opportunity to store these substrates over long periods of time. The yeast, *Saccharomyces cerevisiae,* and facultative bacterium, *Zymomonas mobilis,* are best suited candidates for industrial alcohol production. However, ethanol is produced commercially by yeast because it ferments glucose to produce ethanol as a virtually sole product and it is known for its high ethanol tolerance, rapid fermentation rates and insensitivity to temperature and substrate concentration. Mango is processed to a maximum extent, thereby producing high quality of solid and liquid wastes.

Utilization of this mango waste is both a necessity and a challenge. If a factory is processing five tons of *Totapuri* mangoes per hour, about six tons of peel would be available as waste per day of 8h work. Approximately, 0.4 to 0.6 million tons of mango peel is generated annually in India. This waste is either used as cattle feed or dumped in open areas where it generates environmental pollution. The presence of high amount of reducing sugars in dried and fresh mango peel prompted us to make an attempt to utilize it as a raw material for ethanol production and development of a cheap medium. The present study was carried out to produce bioethanol using mango peel, an agro-industry waste. This would result in production of good quality, high octane Bioethanol and would take care of the problem of waste disposal of the growing agro industry.

OBJECTIVES

1. Production of bioethanol from mango peel using *Saccharomyces cervisiae.*
2. Characterization of bioethanol as fuel.

MATERIALS AND METHODS

Mango (*Mangifera indica*) peels were obtained from the local fruit shop. Peels were first sun dried and then oven dried at 50° C for 3 hours.After drying, mango peels were grinded to get the powdered form of mango peels.

Mango powder (100 g) was mixed with water (1:3) and left overnight. The liquid containing sugars was extracted with the help of cheese cloth by squeezing. This acted as control. The extraction medium pH was 5.0 and the temperature was 37°C. The extract was suitably diluted to obtain the desired concentration of sugars (7-9%, w/v).

To determine the reducing concentration of sugar in mango peels extract, DNS Method was performed. This method tests for the presence of free carbonyl group (C=O), the so-called reducing sugars. This involves the oxidation of the aldehyde functional group present, for example, glucose and the ketone functional group in fructose. Simultaneously, 3, 5-dinitrosalicylic acid (DNS) is reduced to 3-amino- 5-nitrosalicylic acid under alkaline conditions:

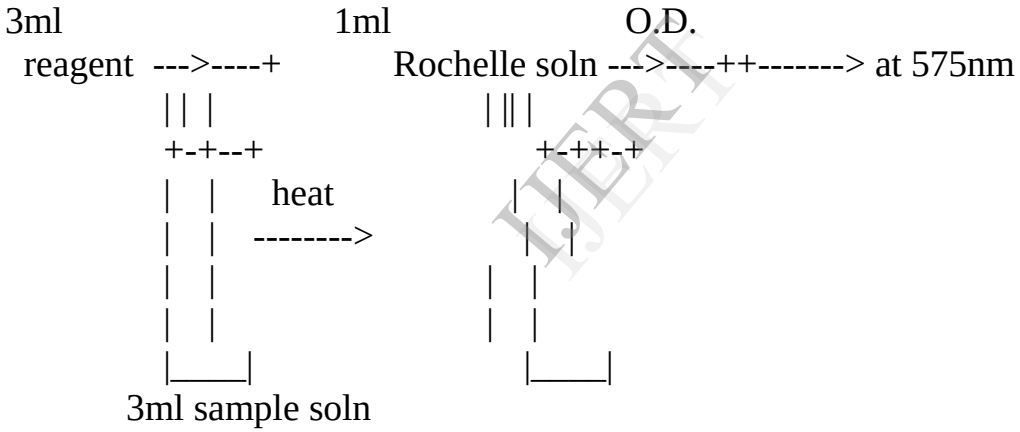
$$\text{aldehyde group} \xrightarrow{\text{oxidation}} \text{carboxyl group}$$

$$\text{3, 5-dinitrosalicylic acid} \xrightarrow{\text{reduction}} \text{3-amino-5-nitrosalicylic acid}$$

As dissolved oxygencan interfare with glucose oxidation, sulphite is added in the reagent to absorb dissolved oxygen.

The following procedure was adopted to produce bioethanol.

a) 3 ml of DNS reagent was added to 3 ml of glucose sample in a lightly capped test tube. (To avoid the loss of liquid due to evaporation, cover the test tube with a piece of paraffin film if a plain test tube is used).
b) The mixture was heated at 90º C for 5-15 minutes to develop the red-brown colour.
c) Thereafter 1 ml of a 40% potassium sodium tartrate (Rochelle salt) solution was added to stabilize the colour.
d) After cooling it to room temperature in a cold water bath absorbance was measured with a spectrophotometer at 575 nm.



The extract phase from extraction was used for a simple distillation. Then the obtained distillates and residual phase were analyzed by gas chromatography.

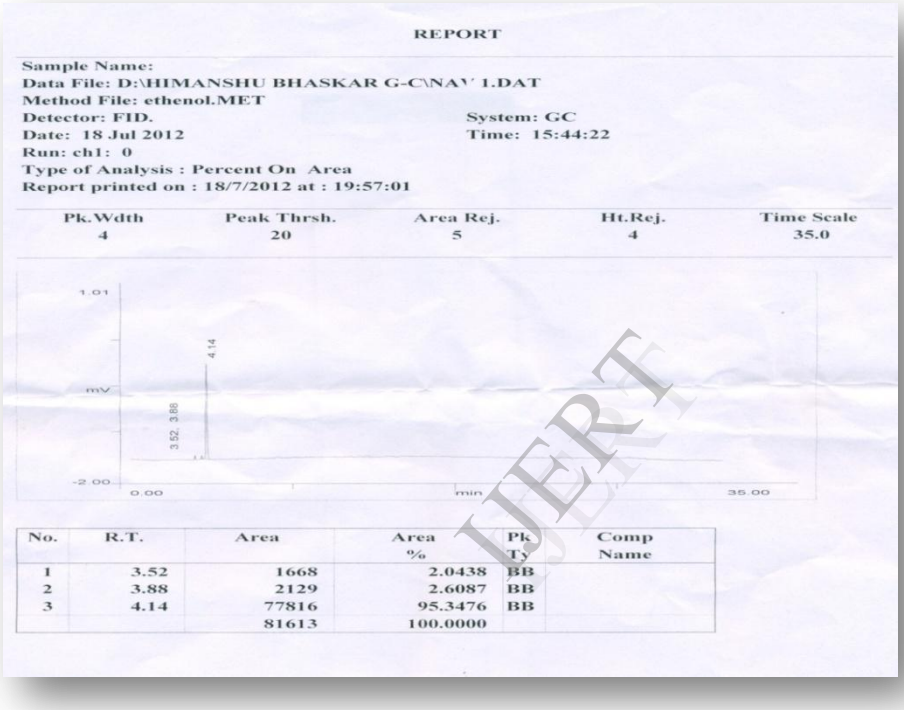
After distillation, gas chromatography was performed to check the concentration of Bio-ethanol.
The fuel properties of bioethanol were measured in accordance with the Institute of Petroleum, London.

Proprerty	Instrument	Value
Viscosity	Redwood Viscometer	2 cs
Calorific value	Digtal Bomb	27 MJ/ Kg

	Calorimeter	
Flash Point	Flash Fire point measurement apparatus	16.6 degree C
Ash content	Muffle furnace	0.2%

RESULT AND DISCUSSION

- It was detected with Gas Chromatography that solution produced from mango peel extract after fermentation contains 95% of Bio- ethanol.



REPORT

Sample Name:
Data File: D:\HIMANSHU BHASKAR G-C\NAV 1.DAT
Method File: ethenol.MET
Detector: FID. System: GC
Date: 18 Jul 2012 Time: 15:44:22
Run: ch1: 0
Type of Analysis : Percent On Area
Report printed on : 18/7/2012 at : 19:57:01

Pk.Wdth	Peak Thrsh.	Area Rej.	Ht.Rej.	Time Scale
4	20	5	4	35.0

No.	R.T.	Area	Area %	Pk Ty	Comp Name
1	3.52	1668	2.0438	BB	
2	3.88	2129	2.6087	BB	
3	4.14	77816	95.3476	BB	
		81613	100.0000		

CONCLUSION

As a very useful source of energy, Petrol, a finite fossil fuel is going to be depleted in some years (even if it is used very sustainably), a substitute is required to replace it. At the same time it should be kept in mind that the properties of the substitute should be almost same as petrol because the tools where this substitute is going to be used cannot be made suitable to it very soon.

Production of Bioethanol, a high octane fuel, therefore may be a good replacement. As bioethanol can be prepared with the help of fermentation, it does not need huge number of ingredients. Thus, it is very viable economically.

The present study was done with objectives to produce bioethanol from mango peel which solves the waste disposal problem. In a country like India, it is very hard to do proper disposal of wastes and thus generation of infectious diseases is rapid here. So, using these wastes not only provide a use of those wastes but also help to be beneficial economically.

The bioethanol was found to be equally comparable to petrol.

Finally, it can be concluded that the produced mango peel- Bioethanol is economically and environmentally viable. And can be a good substitute of Petrol. Although some more research works in different states and different environments should be done to find out any better result. Productivity and economical viability are also some fields to be taken care of to have a wonderful energy source.

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