ISSN: 2455 - 9938

EIJO: Journal of Science, Technology and Innovative Research (EIJO–JSTIR)

Einstein International Journal Organization (EIJO)

Available Online at: www.eijo.in

Volume – 1, Issue – 2, May - June 2016, Page No. : 01 - 05

Production of a Potential Fuel from Orange Peels by Extracting Essential Chemical Limonene

Aman Pandey[1], R. K. Yadav[2]

Department of Electronics & Communication Engineering

JRE Group of Institutions, Greater Noida, Uttar Pradesh, India

E-Mail: [1]e13ec.aman.pandey@jre.edu.in, [2]ravipusad@gmail.com

ABSTRACT

Limonene is essential oil that is present in the waste of orange peels and has the potential, to be used as a fuel which can be extracted from the peels using the steam distillation process the peels. In this work, experiments are carried out to remove limonene under suitable condition from the peels using the appropriate methods The experiments was carried out with grinded or chopped orange peel mixed with the water in the proportion of 3:1. The mixture was then processed to the steam distillation. The extracted oil that comes as distillate is limonene. The distillation waste is then processed with yeast in order to attain fermentation and obtain ethanol from it. Ethanol was obtained by steam distillation of the fermentable wort and the total volume of ethanol produced from 2kilo grams of the peel waste is 0.8 liters. Considering the percentage fermentable sugar yield from the biomasses in study, it is more economical to produce ethanol from peel waste. The left over residue from the fermentation can be dried and can be used as the fertilizer.

Keywords: Limonene, steam distillation, ethanol extraction.

1. Introduction

Orange oil is an essential oil produced by cells within the rind of an orange fruit (***Citrus sinensis*** fruit). It is composed of mostly greater than 90% d-limonene, and is often used in place of pure d-limonene. D-limonene can be extracted from the oil by distillation. And has the potential to be used as a fuel [1]. Limonene gives orange fruit their aroma, for which they are known for and is therefore used in perfume and anti-microbial agent. It is also an effective, environmentally friendly, and relatively safe solvent, and stain removers, cleaners of various sorts, and strippers. Limonene is also highly useful in agriculture [2]. Orange juice is one of the most widely-consumed beverages in today's world. And hence, the cultivation of oranges has become a major industry and an important economic sector in the India, United States and most Mediterranean countries [3]. A high percentage of orange production (80%) is used to manufacture derivative products and approximately 40– 70% of the processed fruit is transformed into citrus peel waste .In order to prevent problems related to the disposal of this product and environmental concerns, this waste must be properly processed.

Presence of limonene makes orange peel an effective source of making fuel.

Since the beginning of the industrial age, mercury pollution has increased steadily in our environment, particularly in rivers and oceans. As a result, high-level predators in our waterways often contain very high levels of mercury, and eating fish containing this neurotoxin can lead to serious health issues. This can be resolved using orange peels. A number of investigations have been carried out to tackle the inhibition challenges by limonene. These methods can be classified into three categories of limonene removal, limonene recovery and conversion of limonene into less toxic compound so that it can be used as fuel. Among these methods, limonene recovery seems to be the best alternative since this chemical can be used as a valuable compound used in several industries such as perfumery, chemicals, cosmetics, medical, and food flavor. There are several methods that have been reported for limonene recovery including steam explosion, steam distillation microwave treatment and acid hydrolysis. However, these methods are performed under harsh conditions, which require high energy consumption. But there is only few method that can be used to take out the limonene efficiently one of the limonene extraction using the steam distillation [4]. Citrus waste for different types of citrus based industries such as Real Orange Juice, Tropicana Orange Juice, Minute Maid Pulpy Orange and DelMonte are However, still producing a large amount ofwaste that is still being dumped every year, which causes both economic and environmental problems such as high transportation cost, lack of dumping site, and accumulation of high organic content material. Therefore, more effective and sustainable alternatives for using orange peel wastes such as fuel are highly desirable [5].

2. Proposed Methodology

a. Apparatus required:-

(a) Extraction of orange oil (limonene) from peels

1. Orange peels (blended)
2. Water
3. Flask
4. Tripod stand
5. Bunsen Burner
6. Water jacket
7. Wire gauze
8. Flask to collect distillate
9. Thermometer.

Step 1

Peel the oranges. Keep as much of the white membranous part of the peel as possible, since this is particularly high in pectin and limonene.

Step 2

Blend the orange peel and mix in 100ml water.

Step 3

Pour the mixture in the flask and put it on the Bunsen burner.

Step 4

Maintain the temperature of 176 degree Celsius as limonene has flash point of 176.

Step 5

Turn on the water supply in water jacket.

Step 6

Collect the distillate; thick white layer on water will be of limonene.

Step 7

Separate the limonene using separating funnel.

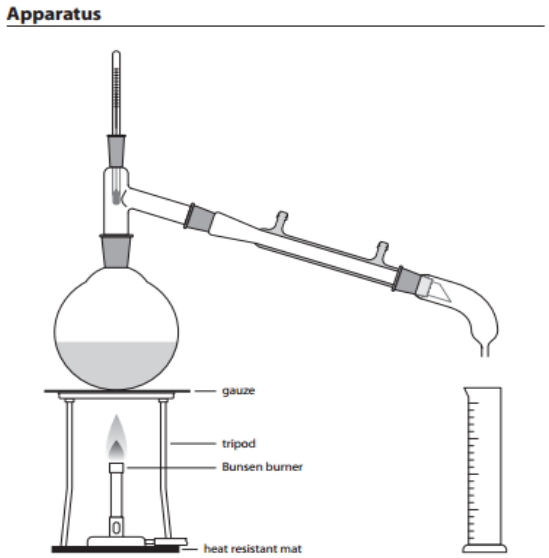

Figure: 1: Apparatus set up.

Figure 2: laboratory set up for steam distillation of citrus peel.

b. How limonene can be used as a fuel

In accordance with this research we hope to use a chemical found in lemons and other citrus fruits to make clean, renewable jet fuel.m“Limonene is a volatile chemical that is best known for providing the aroma to citrus fruits,” “It was first identified in turpentine oil in the late 1800s and is now used as a flavour and fragrance in foods, household cleaning products, and perfumes. It also holds promise as an anti-cancer agent.” Some researchers have said that environmental benefits of using limonene as a fuel were particularly exciting. “It may sound weird, but limonene one day could be a renewable, clean source of aviation fuel,”

Limonene is a colourless liquid hydrocarbon classified as a cyclic terpene. The more common d-isomer possesses a strong smell of oranges [6]. It is used in chemical synthesis as a precursor to carvone and as a renewable-based solvent in cleaning products. Limonene takes its name from the lemon, as the rind of the lemon, like other citrus fruits, contains considerable amounts of this compound, which contributes to their odour. Limonene is a chiral molecule, and biological sources produce one enantiomer: the principal industrial source, citrus fruit, contains d-limonene ((+)-limonene), which is the (*R*)-enantiomer. Racemic limonene is known as dependence. D-Limonene is obtained commercially from citrus fruits through two primary methods: centrifugal separation or steam distillation. Long before there was the petroleum-based plastic fruit cup, nature perfected its own biodegradable wrapper for keeping oranges fresh: the peel. But aside from adding a bit of zest to food or being used in the orange-smile gag, peels have largely escaped any greater purpose. That is, until now. By these experiments we could use this fuel to power cars or to produce a fuel that can be used as a jet fuel, In our studies we came to know that orange peels contain certain molecules which, if properly extracted and converted to

liquid, could be used effectively as an energy source.. Not only we can use the orange peels as a fuel but the distillation waste can also be used extract ethanol from the orange peel.

So we can say the orange peel that was threat earlier as it's talking 6 months to get decomposed but now it can be used as very effective in all terms and gives us a very effective result not only this , Since the beginning of the industrial age, mercury pollution has increased steadily in our environment, particularly in rivers and oceans. As a result, high-level predators in our waterways often contain very high levels of mercury, and eating fish containing this neurotoxin can lead to serious health issues. This can be resolved using orange peels, so I conclude that limonene and orange have phenomenon benefits if used properly.

c. Procedure to convert the waste of distillation to ethanol

Step 1

Take all the waste left after the steam distillation and then add Saccharomyces ceverisiae. (Brewer's yeast) to it.

Step 2

The process of fermentation will begin, now wait for 48 hrs.

Step 3

Now after 48 hrs. separate the liquid part from solid part.

Step 4

Mix the liquid part with the ethyl acetate it creates an immiscible liquid and ethanol can be separated using separating funnel.

Step 5

Keep the solid part and dry it to make an effective manure or fertilizer.

d. Distillation waste to ethanol

After the distillation is done the remaining boiled peels under goes the Production of ethanol fuel from orange peels waste has been carried out with the singular aim of converting the waste to useful material. To achieve this, the conversion of peel waste and orange juice waste were respectively carried out via acid and microbial hydrolysis, which yielded 40% and 60% fermentable sugar wort. This was then converted into ethanol by fermentation process using *Saccharomyces ceverisiae (*Brewer's yeast). 90% ethanol was obtained by fractional distillation of the fermentable wort and the total volume of ethanol produced from 2 kilograms of the peel waste is 0.8 liters [5]. Considering the percentage fermentable sugar yield from the biomasses in study, it is more economical to produce ethanol from peel waste. The left over residue from the fermentation can be dried and can be used as the fertilizer.

3. What Is the Need?

If you consider all the planes fly around in the world and all vehicles on the roads, that's a lot of fuel – and non-sustainable fossil resource carbon – being emitted in the atmosphere. Limonene extracted from citrus peel had been used successfully as a jet fuel component in demonstration flights in the past. However large-scale limonene production from citrus peel is impractical, producing it in yeast should provide a route to much greater yields of limonene which are easier to extract.

Limonene yields from the modified yeast are not yet high enough to be commercially viable, but we have plans to further modifications to be done in this regard .What if we design an engine according to our needs?

There are many questions yet to be answered, this work entitles what we can do with our limited resources to work sustainably so that we can save our limited and precious stocks of fossil fuels.

4. Conclusion and Future Work

The orange peel that was a waste and was producing the harmful gases that contributes in global warming ,the effect of the same is neutralized by extracting all the possible useful components from it that are in the form of D-limonene, ethanol and remaining waste as a fertilizer. It has got all the potential to be used as a fuel if extracted properly. However large-scale limonene production from citrus peel is impractical. But if we are seeking for a fuel that is area or domain specific fuel then can use this, if our citrus based industries uses the limonene as a fuel large amount of fossils will be saved by this and can used as our future stock. Going sustainably is the need of the time so that we can save it for generations to come.

5. References

[1]. https://en.wikipedia.org/wiki/Orange_oil
[2]. http://phys.org/
[3]. Periyasamy Elaiyaraju and Nagarajan Partha, **"**Biogas production from co-digestion of orange peel waste and jatropha de-oiled cake in an anaerobic batch reactor," African Journal of Biotechnology Vol. 11(14), pp. 3339-3345, 16 February, 2012.
[4]. Rachma Wikandari *et al.*, "Improvement of Biogas Production from Orange Peel Waste by Leaching of Limonene," BioMed Research International, Volume 2015,pp. 1-6.
[5]. http://www.science.gov/topicpages/w/waste+orange+peel.html
[6]. Amin Ganjali, " Antimicrobial Effect of Essential Oil of *Ziziphora tenuior* on Water by Heterotrophic Plate Counts Method in Kerman (Southeast of Iran)," International Journal of Chemical Engineering and Applications, Vol. 7, No. 2,pp.120-124, 2016.
[7]. http://www.perkinelmer.co.uk/PDFs/downloads/APP_Limonene_In_Citrus_Rinds_By_GCMS.pdf
[8]. https://www.reading.ac.uk/web/FILES/chemistry/Limonene.pdf
[9]. M. A. Martın, J. A.Siles, A. F. Chica, and A. Martin "Biomethanization" of orange peel waste," Bio resource, vol. 101,no. 23, pp. 8993–8999, 2010.