

A Culinary Mahua (*Madhuca indica*) flower from Bihar, India– A potential in Production of Jam, Alcohol for Pharmacological benefits with Fertilizer value

Sonika Jha , Vineet Vaibhav and Suneetha V*

Instrumental and Food Analysis Laboratory, School of Bio Sciences and Technology, VIT University,
Vellore-632 014, India.

Abstract

Mahua flower is generally used by local people for preparation of alcohol and stored by many local people to use in winter as a food source. This paper deals with fermentation of mahua flower for ethanol production and its estimation. As flower is having high sugar and important mineral content we prepared jam from flower which can be used as food source at house hold purpose for poor people. The remains of fermentation used as fertilizer and its effect are demonstrated by growing seeds. The characterisation of fermentation remains by XRD and FT-IR shows the presence of several important minerals which are responsible for the plant growth.

*Corresponding author, Mailing address:
Suneetha V*
vsuneetha@vit.ac.in; vntvaibhav@gmail.com;
sonikajha.27@gmail.com,

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INTRODUCTION

Mahua (*Madhuca indica*) belongs to Sapotaceae family. It is found throughout the subtropical region of Indian subcontinent and it is propagated mainly by seeds. It is a large and evergreen tree [1-4]. Mahua is also famous for its seed oil which has an estimated annual production potential of 181 thousand metric tonnes in India[5]. According to previous studies, it has also been stated that the seed of Mahua (*Madhuca indica*) has 30 to 45% of oil content and each tree yields about 20 to 40 kg of seed per year and by this the total oil yield per ha is 2.7t[6].

In our work we have used Mahua (*Madhuca indica*) flower to explore its potential. Mahua (*Madhuca indica*) flowers are pale yellow in colour with rusty, pubescent calyx and fleshy corolla. Mahua (*Madhuca indica*) flower has the potential to be used as coolant, expectorant, carminative, aphrodisiac, galactagogue. It can be beneficial to cure the burning sensation, biliousness and ear complaints. We can also make sugar syrup from it after decolourizing it with activated charcoal^[7,8]. It can be used for the preparation of liquor as seen in the previous studies^[10-14] and it can also be used for the preparation of bakery and confectionary goods^[9].

We have used Mahua (*Madhuca indica*) flower in our work because it's cheap and easily available. We have emphasised on the production of ethanol from this flower by fermentation and we also have explored the potential of its fermentation waste as a cheap and useful bio fertiliser. It's edibility was also tested by preparing jam from its dried flower.

Methodology

The dry Mahua (*Madhuca indica*) flower was bought at the rate of 18rs per kg from the local people of Chandwa, a place in Arrah i.e. a city in Bihar (25°.34'N, 84°.4E). All the experimental works were carried out in Instrumental and Food Analysis Laboratory in school of bio sciences and technology (SBST).

Materials required for jam preparation

100 g of Mahua (*Madhuca indica*) flower was taken, soaked in water and then crushed using Philips mixer grinder, sugar (according to taste), lemon juice, 2-3 g pectin (to give the jam jelly like appearance) and butter were used for the jam preparation.

Preparation of fermentation media

500 g of dry Mahua (*Madhuca indica*) flower was taken and soaked overnight in distilled water for endosmosis to occur. It was then grinded till it converted into fine slurry using mixer grinder

(Philips). After that, it was transferred to the black round bottle and then by adding water, the solution was made up to 1.5 L. The prepared culture of yeast *Saccharomyces cerevisiae* was then transferred to the Mahua (*Madhuca indica*) flower slurry and was mixed well. After that, the bottle was covered with black card paper and was left undisturbed for incubation (duration was 8 weeks).

Bio fertilizer property study

After the ethanol extraction the left over semi-solid material (fermentation waste) was collected and kept for drying in the oven at 100°C. After complete drying, it was mixed with sand and on this prepared media; the plant was grown for the study of bio-fertilizer property. This method is demonstrated by a simple experiment. The presence of macronutrient like Potassium, Nitrogen, Phosphorus and Calcium was confirmed by XRD (Advance X-Ray Diffractometer at the step size of 0.02 degree/minute) and FT-IR (Fourier infrared spectroscopy using SHIMADZU instrument at 400 to 4000 cm⁻¹) result.

RESULT AND DISCUSSION

Jam preparation

100g of dry Mahua flower was washed properly and soaked in water. When the flowers got swelled up (endosmosis), they were taken out in a steel bowl and after that the bowl was kept on gas stove. After that, the flowers were crushed with the help of potato masher and the following steps in which it was heated and crushed using spoon simultaneously, after that 2-3g of pectin (either commercial or obtained from the fruit peels powder) was sprinkled on the mixture. The mixture was stirred continuously till the jelly like appearance was seen. Sugar was poured into the mixture according to taste and was stirred till it got dissolved properly. Some butter and lemon was mixed well in the jam for taste. Jam was transferred to a sterilised jar and was packed after the removal of vapours (fig 7)

Ethanol estimation

After 2 months of fermentation alcohol was extracted from fermentation culture with the help of centrifugation. OD at 660nm was taken and standard graph was plotted, it is shown in the graph below. 0.8 ml of the extracted alcohol was taken and mixed with 4.2 ml of water according to method. According to the standard graph, concentration of alcohol obtained was around 8.5 mg per ml.

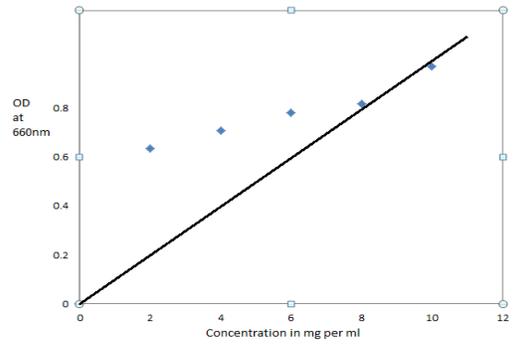


Fig. 1

Demonstration of experiment

Two plastic cups were taken. The first one was filled with sand (this sand was washed several times in order to nullify its mineral content) and the second cup was filled with the sample (fermentation waste)

mixed with cleaned sand. In both of the cups three gram seeds were sowed. This was done in order to increase the mineral competition between the plants. These two cups were maintained under proper illuminated condition and were watered regularly for 10 days.

Plants in second cup showed almost twice the growth of plants which were in the first cup, this proved the presence of vital minerals which helped in the plant growth (fig 3, 4). The presence of these minerals was further confirmed by XRD and FTIR results.

XRD result

The graph obtained from X-ray diffraction of the sample shows the presence of following- Major picks in the XRD graph showed either the presence of potassium silicate, potassium aluminium silicate or silica. At 21.7204, this graph is showing the presence of potassium with silica and crowded peaks around 27.65 gives the presence of potassium silicate and silica.

So XRD result gave the presence of very vital macro mineral that is potassium (K) in the sample (the fermentation waste). Other importance was studied with the help of FTIR.

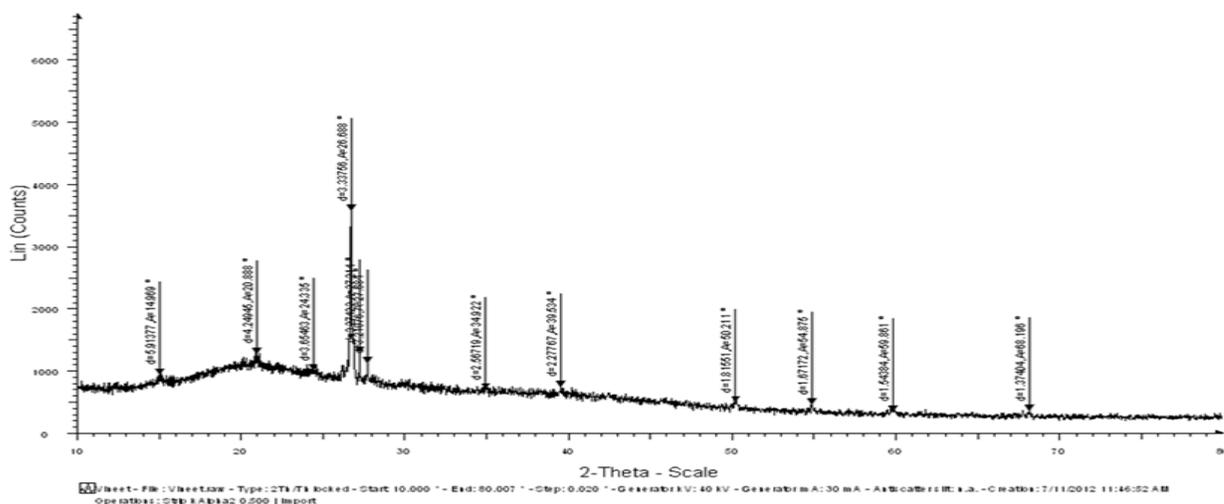


Fig 2

FT-IR result

FT-IR graph showed the following bond stretching; at 1640 it shows N-H bond bending, peak ranging from 100 -1200 shows the C-N bond stretching. 2852 and 2924 shows the symmetrical stretching of C-H in CH₂ and CH₂ chain symmetrical stretching respectively, 1402 shows the presence of carbonate, 1045 confirms the presence of phosphate, peak at 3406 indicates the presence of adsorbed water molecule, 1074 represent peak for Si-O-Si stretching,

and peak range from 2923-2857 represents the peak for amine.

XRD graph confirms the presence of potassium and FT-IR result confirms the presence of nitrogen, phosphorus, calcium (in form of carbonate). These minerals are main macro nutrients of soil and promote the plant growth in efficiently. So the result justifies that fermentation waste of Mahua (*Madhuca indica*) flower is a good bio fertilize.

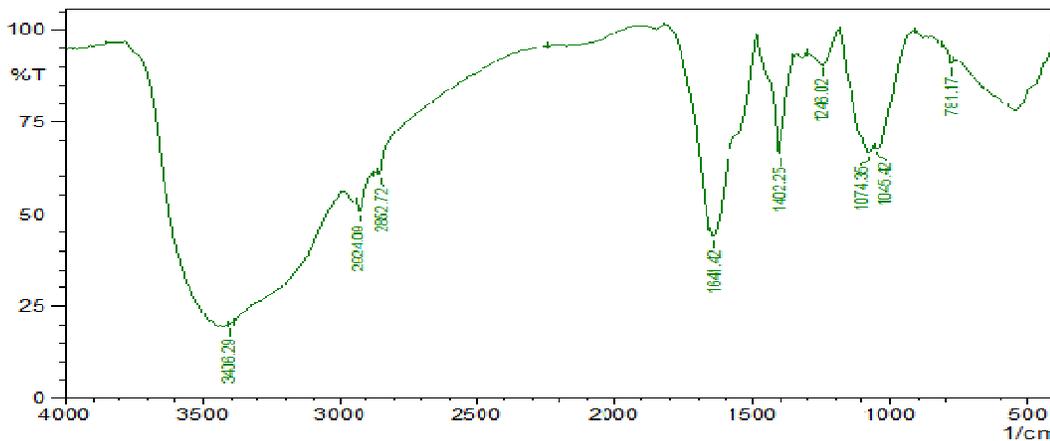


Fig 3:





Fig. 1 Dry mahua flower collected from Arrah, Bihar; **Fig. 2** Process of transferring Mahua(*Madhuca indica*) flower 's prepared slurry to the fermentation bottle; **Fig. 3** Comparison of plant growth in both cups; **Fig. 4** Plant growth with sand mixed with sample(fermentation waste) ; **Fig. 5** A step for alcohol estimation; **Fig. 6** Mahua tree; **Fig. 7** Prepared jam from Mahua flower.

Conclusion

People in small villages don't have sufficient money for various resources to earn their living that is why they are fully or partially dependent on the natural resources which are easily available, cheap and renewable. We can conclude from our experiments that Mahua (*Madhuca indica*) flower is having potential to satisfy few needs of rural people. High sugar content of Mahua(*Madhuca indica*) flower allows it to be consumed as jam, jelly or raw. The dried Mahua flower can be sold to the local distillery and hence they can make good money from it. The fermentation waste can also be used as bio fertilizer which is eco-friendly and cheap in comparison to the expensive fertilisers.

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