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Research Article

MULTI-ELEMENTAL ANALYSIS OF EXTRACT FROM *PONGAMIA PINNATA*

ADITHYA G[1], DEEPANRAJ A[1], UTHAM G[1], RANJITHA J[2], VIJAYALAKSHMI S[2]*

[1]Energy Division, School of Mechanical & Building Sciences, VIT University, Vellore, Tamil Nadu, India. [2]CO_2 Research and Green Technologies Centre, VIT University, Vellore, Tamil Nadu, India. Email: vijimicro21@gmail.com

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ABSTRACT

Heavy metals are found to be an important micronutrient for plants, humans, and animals provided the level is within the limit hence it is necessary to determine its concentration. The extract from the seeds of *Pongamia pinnata* was derived by acid digestion using H_2SO_4. The extract was further clarified and filtered using standard filter papers. The clarified extract was diluted and the diluted extract was analyzed for the presence of heavy metals such as Zn, Mn, Mg, Fe, and K using atomic absorption spectrometry. The analysis revealed that the concentrations of certain metals were in acceptable levels and concentrations of certain other metals were in unacceptable levels which will have considerable impact on the engine's life and the environment when the extract from it is used for biodiesel production.

Keywords: *Pongamia pinnata*, Heavy metals, Atomic absorption spectrometry, Impacts, Engine, Environment.

INTRODUCTION

In the present world scenario, with increasing demand for power and fuel and fast depleting conventional fuel sources, the world nations now shifts their focus to alternate fuel sources that are mostly non-polluting and eco-friendly. This feature of the alternate fuels acts as a redemption for the wounded environment by the use of conventional fuels. There are many renewable energy source and the bio fuels are important among them as they can directly substitute the conventional fuels with minor processing. Biofuels are also of economic importance as they can reduce the fuel imports considerably. Crop plants that yield oil are important for the growth of energy and agricultural sectors.

The oil extract from oil seeds containing polyunsaturated fatty acids are important for biodiesel production. The plant species *Pongamia pinnata* is one such plant that is extensively used for biodiesel production. The seeds are reported to contain oil on an average about 28-34% with high percentage of polyunsaturated fatty acids [1]. History reveals that the parts of the plant were used for treatment of tumor, piles, skin disease, itches, abscess, painful rheumatic joints wounds, ulcer, diarrhea, etc. [2]. Recently with growing interest on bio-fuels, its application is mostly focused on biodiesel production. For healthy, uninterrupted and efficient performance of the engine it is necessary that the biodiesel must be free from impurities. The biodiesel is derived as fatty acid methyl esters (FAME) by transesterification of triglycerides in oil seeds. The process includes purification, neutralization, transesterification, and separation [3].

The major impurities in biodiesel are glycerol, residual catalyst, excess alcohol, heavy metals, unconverted/partly converted fat, and soap [4]. Impurities except heavy metals exist in biodiesel due to the steps involved in the production process. These impurities can be easily removed by various physical and chemical processes, but heavy metal impurities in biodiesel are due to the physicochemical characteristics of the oil sources. These impurities have considerable impact on the engine and the environment. Hence, it is necessary to estimate and analyze the heavy metal in the oil source before it is used for biodiesel production.

In the current study, the heavy metal that are present in the *P. pinnata* seeds extract is identified, analyzed, and estimated and the impacts of these metals in the engine are reviewed.

METHODS

Plant material

The plant material used for the study were fully developed healthy seeds from *P. pinnata*, collected from VIT University, Vellore (12.9202°N, 79.1333°E) during the month (Fig. 1).

Extract preparation

The acid digestion method is adopted for the extract preparation. 1 g of the crushed seeds of *P. pinnata* were taken in the conical flask and 10 ml of diluted sulfuric acid was added. Heated in the mantle heater for 20 minutes then allowed to cool for 30 minutes. The seed extract are extracted by filter paper and seed extract are makeup by distilled water (Fig. 2).

Standard preparation

Metals salts of the following salts were collected from Environmental Quality Management Laboratory at VIT University, Vellore. The fraction of the molecular weight of the salt to the atomic weight of the metal gives the amount of salt required to prepare the 1000 ml of stock solution (Fig. 3). The standard solutions of 10 ppm, 20 ppm, 30 ppm, 40 ppm, 50 ppm were prepared from the stock solutions for each salt (Table 1).

Atomic absorption spectrometry (AAS) analysis

The standards of different concentrations for the metal to be analyzed is fed in to the AAS to obtain standard curve for individual metals to be analyzed. After obtaining the standard curves the sample is fed in the AAS and using the standard curve the individual metal in the sample is estimated (Fig. 4).

Fig. 1: Plant and seeds of *Pongamia pinnata*

RESULTS AND DISCUSSION

Results

The AAS analysis of the standards of the various metals as well as the sample gave their absorbance values, based on these absorbance values the standard calibration chart for the individual metals were plotted and from the chart and the absorbance value of the sample the concentration of the individual metals under analysis were calculated and tabulated in Table 2. The standard calibration charts for the metal standards are shown in Figs. 5-9.

The acceptable concentration of heavy metals in the plant is restricted to 5 ppm; a value beyond 5 ppm indicates that the soil, where it is grown has heavy metal contamination.

Discussion

The heavy metal concentration in oil extract from the *P. pinnata* depends on the contamination level of the soil medium it grows. Usually, it is used for the following purposes.

Services on P. pinnata

- Soil quality enhancers: Plant material such as leaves, flowers, etc., which falls on soil decomposes and adds to the nutrient value of the soil. Press cakes that are the by-product after oil extraction is used a nutrient supplement for some special plants.
- Nitrogen fixers: Nodulation is reported in pongam. In nurseries and fields in the presence of nodules on uninoculated pongam seedlings are common. Therefore, this species may not be specific in its *Rhizobium* strain requirement. It nodulates and fixes atmospheric nitrogen with *Rhizobium* of the cowpea group [5].
- Reclamation *P. pinnata* is a tolerant plant to salinity; this feature makes it an ideal candidate for reclamation of a variety of waste land. *Pongamia* can tolerate a wide range of soil types including saline, alkaline, sandy, heavy clay and rocky soils, and waterlogged soils. In the 2 months experiment, the plants of *P. pinnata* were grown in control and waste soil. Heavy metal analysis of initial waste soil contains Cu (8.83 mg/0.1 g), Zn (14.490 mg/0.1 g), Cr (4.97 mg/0.1 g), Ni (1.12 mg/0.1 g), Fe (21.07 mg/0.1 g), Mn (14.464 mg/0.1 g), and Co (−0.120 mg/0.1 g). The present study revealed that all these metal concentrations were lower down Cu (6.06 mg/0.1 g), Zn (5.372 mg/0.1 g), Cr (0.564 mg/0.1 g), Ni (0.251 mg/0.1 g), Fe (22.175 mg/0.1 g), Mn (5.372 mg/0.1 g), Co (−0.143 mg/0.1 g) except Fe after 2 months experiment [6]. This reference shows the reclamation service of *P. pinnata.*

Neutralization, washing, and water separation can prevent the alkaline metal in B100. If metal contamination occurs, metal deactivators can be used to chelate transition metals, and inhibit catalytic oxidation and polymerization effects.

- Oil production:The seeds of *P. pinnata* contain 30-40% oil. The seeds are largely used to extract oil known as “Karanja oil.” The fuel property of *Pongamia* is compared with petroleum diesel [7]. The other uses of the oil includes, lubricant, water-paint binder, pesticide, and in soap making and tanning industries [8].

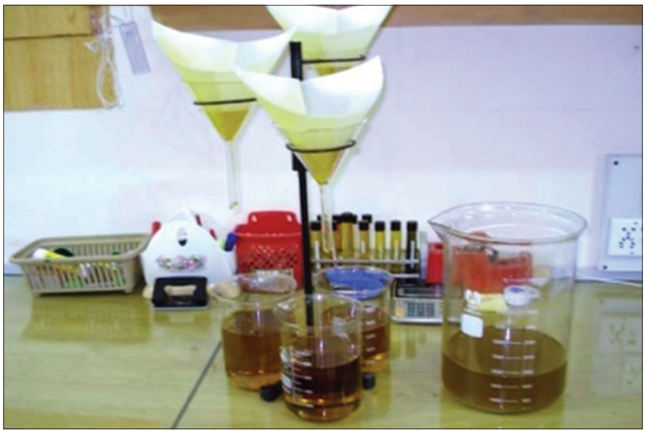

Fig. 2: Extract preparation

Fig. 3: Standard preparation

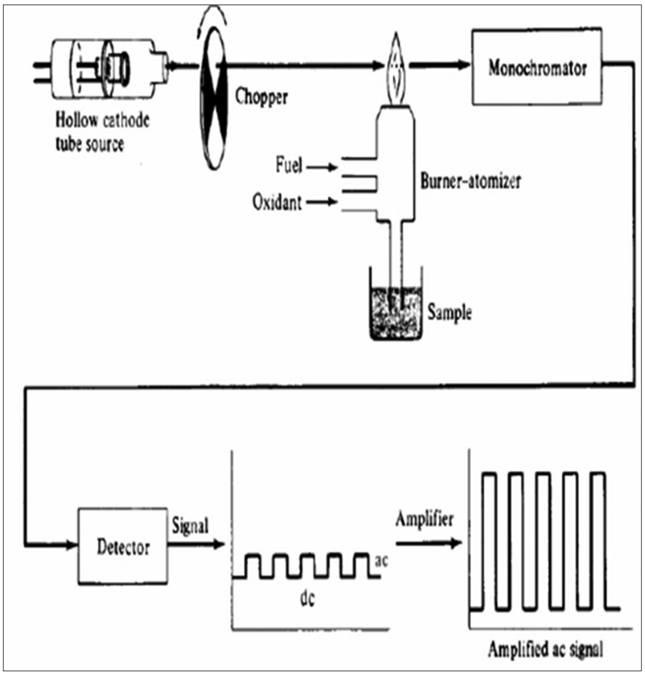

Fig. 4: Atomic absorption spectrometry analysis

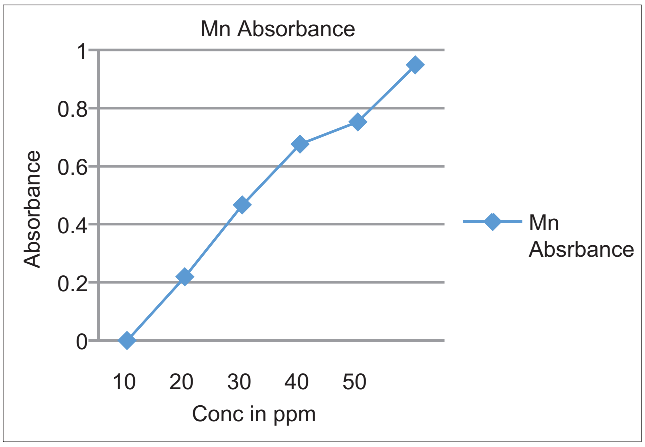

Fig. 5: Mn absorbance

Table 1: Standard preparation

S.No	Salt	Metal	M.W of salt	M.W of metal	Grams
1	Chromium nitrate (Cr $(No_3)_3.9H_2O$)	Chromium	400.15	52.00	7.6951
2	Ferrous sulfate ($FeSo_4.7H_2O$)	Iron	278.01	55.84	4.9780
3	Zinc sulfate ($ZnSo_4.7H_2O$)	Zinc	161.47	65.38	2.4697
4	Potassium chromate (K_2CrO_4)	Potassium	194.2	39.09	4.9680
5	Manganous sulfate ($MnSo_4$)	Manganese	169.01	55.00	3.0727
6	Magnesium Sulfate ($MgSo_4.7H_2O$)	Magnesium	246.47	24.3	10.1420

M.W: Molecular-weight

Table 2: Heavy metal concentration in extract

S.No	Elements	Wavelength (nm)	Concentration (ppm)
1.	Mn	279.5	6.107±0.001
2.	Fe	248.3	4.285±0.0013
3.	Zn	285.2	4.615±0.0022
4.	Pb	228.8	3.120±0.0020
5.	Cd	324.8	4.822±0.0012

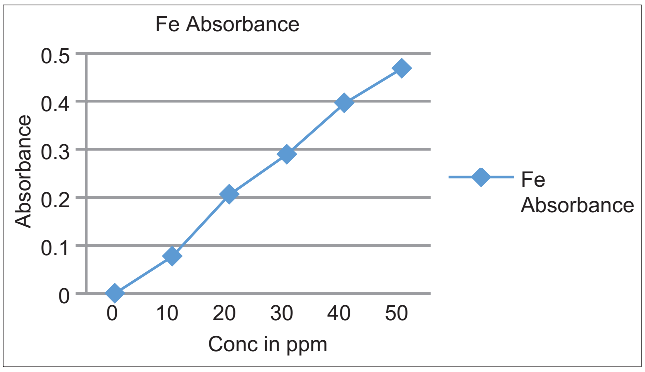

Fig. 6: Fe absorbance

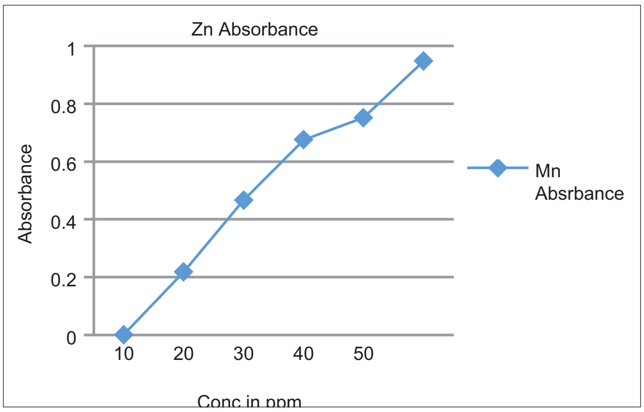

Fig. 7: Zn absorbance

The oil is known to have value in folk medicine for the treatment of rheumatism, as well as human and animal skin diseases. It is effective in enhancing the pigmentation of skin affected by leukoderma or scabies.

Impact of metals in oil on engines

The property of the plant to absorb heavy metals in the soil in which it is grown results in the heavy metal contamination of the oil which is extracted from it. The presence of heavy metal in the oil has the following effects on the engine. The oxidation and polymerization reaction of HC are catalyzed by the pressure of heavy metals. Heavy metals induce auto oxidation [9]. Metals such as Cu or Fe cause corrosion in the manufacturing process. Alkaline metals (K, Na, Ca, and Mg) Ca form sediments and cause injection failures. Alkaline metals

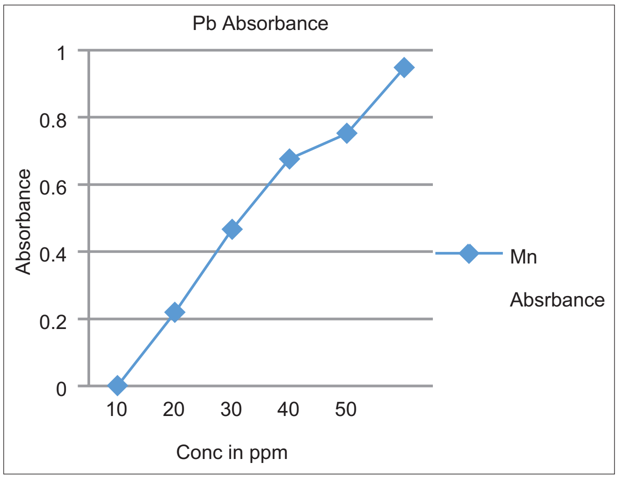

Fig. 9: Pb absorbance

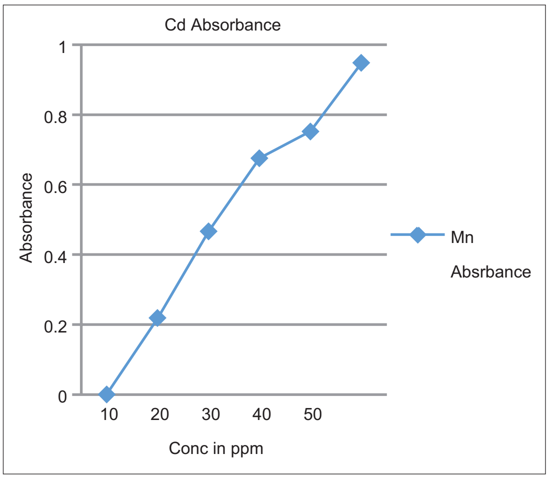

Fig. 10: Cd absorbance

could form soaps and contribute to insoluble or water haze in diesel fluids [4]. There is a limit of five parts per million for the amount of sodium plus potassium in FAME used as biodiesel [10].

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Author Queries???

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