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Biofuel from jamun seed (*Syzygium Cumini (L.)*)

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Abstract: Petroleum based fuels play a vital role in rapid depletion of conventional energy sources along with increasing demand and also major contributors of air pollutants. Major portion of today's energy demand in India is being met with fossil fuels. Hence it is high time that alternate fuels for engines should be derived from indigenous sources. In the present energy scenario of fuels, bio- diesels has already been given great importance. It is understandable that the non-renewable fuel resources like crude oil are meeting their ends. However, the transformation of the automobiles and other machineries for using renewable resources is a tedious task and almost impossible. So, there is a need for prolonging the period of the availability of non-renewable fuel resources by opting for alternate fuels like Bio-Diesels. This can be done by increasing fuel efficiency and reducing the level of pollutants in the emissions. Oxide formation has been a major concern in normal fuels as well as in bio-fuels. So there is a need for the presence of anti-oxidant in the fuel we use. After clearly examining the antioxidant properties of various natural products we predicted Syzygium cumin which is also called as jamun fruit, to have better anti-oxidant properties, as we highly interested in utilizing natural waste we used jamun seed powder instead of jamun fruit.
Keywords: Jamun Seed, Syzygium cumini, Oxide Formation, Bio-Diesels, Pollutants.

Introduction:

The American Society for Testing and Materials (ASTM) defines biodiesel fuel as monoalkyl esters of long chain fatty acids derived from a renewable lipid feedstock, such as vegetable oil or animal fat. ''Bio'' represents its renewable and biological source in contrast to traditional petroleum-based diesel fuel; ''diesel'' refers to its use in diesel engines [13]. A number of researchers have shown that biodiesel has fuel properties and provides engine performance that is very similar to diesel fuel [1]. For producing any kind of bio-diesel there are various factors that has to be considered. Factors such as specific fuel consumption, mechanical efficiency, thermal efficiency, emission gases are to be considered, to determine the overall efficiency and effectiveness of the bio-diesel. In particular, considering the emission gases Carbon monoxide (CO), Carbon dioxide (CO_2), Hexane, Nitrogen oxide (NO), Oxygen (O_2). As clearly oxide formation is predominant in emission gases there is a need to add anti-oxidants to reduce the formation of oxides. Many researchers have worked on alternate fuels such as CNG, H_2, etc. and biodiesels using Jatropa oil, Rice bran oil [3-5], Honge oil [6], Neem oil [6-8], Thumba oil [9], ethanol blends [10], etc. Most of the above biodiesels result in an increase in NO emissions, however some studies report varying or opposite results. So, clearly we can see the increase of formation of oxides in the Bio-diesels emission, which clearly shows the need for adding anti-oxidant to the bio-diesel. By observing the anti-oxidant properties of the jamun fruit [11-12], we decided to use jamun seed powder as anti-oxidant in our work. Jamun fruit can be generally found in India, Bangladesh, Indonesia, Sri

lanka, Nepal, Pakistan. It consists of elements such as Calcium (ca), Magnesium (mg), Iron (Fe), Phosphorous (P), Potassium (K) and Sodium (Na).

Experimental:

Method 1:

Jamun seed was collected and crushed into powder. The powder was filtered with the mesh to remove the unwanted impurities. The filtered powder was segregated with diesel in the following blend ratio.

a) Sample A: 20% jamun seed powder and 80% diesel
b) Sample A: 30% jamun seed powder and 70% diesel

The segregated mixture was added to the corresponding volume of diesel at room temperature and the blend was left idle for fifteen days and then filtered. The performance test is carried out in a twin cylinder diesel engine and the parameters like Fuel consumption, Brake power, Fuel power, Brake thermal efficiency were calculated.

Method 2:

Jamun seed was collected and crushed into powder. The powder was filtered with the mesh to remove the unwanted impurities. Orange peel was take and dried. The dried peel was crushed into powder. The filtered Jamun seed powder and the orange peel powder was segregated with diesel in the following blend ratio.

a) Sample A: 20% jamun seed, 0% Orange peel powder and 80% diesel.
b) Sample B: 20% jamun seed, 20% orange peel powder and 60% diesel.

The performance test is carried out in a twin cylinder diesel engine and the parameters like Fuel consumption, Brake power, Fuel power, Brake thermal efficiency was calculated.

Method 3:

Oil from Jamun seed was extracted and conversion of biofuel into biodiesel was done through transesterification process. In this process the triglycerides (Jamun seed oil) are heated to a temperature of 80-85°c by placing it in water bath. Similarly, alcohol (methanol) is heated to 65°c in the presence of potassium hydroxide. Both Jamun seed oil and alcohol are combined together and heated at a temperature of 60-65°c. The effect of fuel properties after Transesterification was studied. The engine was tested with various parameters and various blends ratios (B10, B20, B30, B40, B100) and the result for each blend ratio was compared with pure diesel.

Result & Discussion:

According to Method 1, The anti-oxidant properties of the jamun seed which is assumed to reduce the levels of oxide formation was proved to be ineffective. And there by giving unyielding results. There has been an enormous increase in the oxide formation levels however the unexpected reduced emissions of HC Hexane have captured the importance of jamun seed. While coming to the performance analysis the blends proved to have high fuel power and brake thermal efficiency in parallel with the reduction of Fuel consumption there by compensating the fuel economy by the above two factors.

According to Method 2, The anti-oxidant properties of both the orange peel and jamun seed are ineffective to control the oxide formation of the emission gases. The oxide formation in the emission gases had increased tremendously particularly for Carbon dioxide and Nitric oxide proving that it cannot reduce the oxide formation in a small fraction also. The performance analysis is up to the mark by giving a different result. Though the fuel consumption is very high, proportionately the brake thermal efficiency. It can be concluded that the anti-oxidant properties of Orange peel and Jamun seed or fruit when mixed together cannot reduce the oxide formation of the emissions.

According to Method 3, The outcome of the project shows that JOME yields better results than diesel at full load condition. Among the various blends of JOME (B10, B20, B30, B40, B100) B30 shows better performance and emission characteristics than diesel. The B30 blend yields 3.5% more brake thermal efficiency than diesel and the specific fuel consumption decreases by 8.8%. In emission characteristics B30 blend shows considerable reduction in CO, CO_2, HC, Smoke density particularly NO_x emission of B30 decreases by 32% when compared to diesel.

Raw Material	Method	Process Parameter		Journal
Jamun Seed powder	Addition of Jamun seed powder to Diesel in various blend ratio.	Blend Ratio: Sample A: 20% jamun seed powder and 80% diesel Sample A: 30% jamun seed powder and 70% diesel	The anti-oxidant properties of the jamun seed which was proved to be ineffective. There has been an enormous increase in the oxide formation. The blends proved to have high fuel power and brake thermal efficiency in parallel with the reduction of fuel consumption.	International journal of environmental research and development. Volume: 4
Jamun seed and Orange peel powder	Addition of Jamun seed powder and orange peel powder to Diesel in various blend ratio.	Blend Ratio: Sample A: 20% jamun seed, 80% diesel Sample B: 20% jamun seed, 20% orange peel powder and 60% diesel	The anti-oxidant properties are ineffective to control the oxide formation of the emission gases. The fuel consumption is very high.	International journal of engineering and technical research (IJETR) Volume-2
Jamun seed oil	Conversion of Jamun seed oil to biodiesel through transesterification process and it was blended with diesel.	Blend Ratio: Sample A: 10% Biodiesel & 90% Diesel (B10). Sample B: 20% Biodiesel & 80% Diesel (B20). Sample C: 30% Biodiesel & 70% Diesel (B30) Sample D: 40% Biodiesel & 60% Diesel (B40). Sample E: 100% Biodiesel & 0% Diesel (B100). Sample F: 0% Biodiesel & 100% Diesel (D010)	B30 shows better performance and emission characteristics than diesel. It yields 3.5% more brake thermal efficiency and the specific fuel consumption decreases by 8.8%. NO_x emission of B30 decreases by 32% when compared to diesel.	International journal of science, engineering and technology research Volume 3

Conclusion:

The best result obtained was by using Jamun seed oil which gave 3.5% more brake thermal efficiency and the specific fuel consumption decreases by 8.8%. In emission characteristics it shows considerable reduction in CO, CO_2, HC, smoke density particularly NO_x emission decreases by 32% when compared to diesel.

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