Storage Conditions to Improve the Shelf Life of *Jatropha curcas* Seeds in Terms of Quality of Oil

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**Abstract**

Problem statement: It is known that the chemical composition of oil varies according to the climate and locality. *Jatropha* seeds are the main feed stock available for biodiesel production. Since, *Jatropha* oil is hygroscopic - absorbs water. Also, it is high in acid, has high tendency to degrade quickly, particularly if not handled properly through the supply chain. In the presence of high moisture content, the poly chains of fatty acid (oil) gets oxidized and free fatty acid radicals are generated that deteriorates the oil quality in terms of increased viscosity, reduced trans-esterification; reduced energy efficiency and high corrosion to the IC engines.

Approach: Seeds need to be kept in proper storage conditions, not only to maintain moisture but also to prevent undue degradation and contamination / spoilage due to pest and microbial attack. Exposure to air and moisture must be minimized because that attracts microbes to attack seeds. Our efforts are in the direction to increase shelf life/stability of *Jatropha curcas* seeds in terms of seed contamination / infection caused by insects and pests as well as the quality of oil recovered.

Result: Among all storage parameters the seeds kept at cold temperature i.e. -20 °C showed the significant decrease in FFA percentage in comparison to fresh seed oil and at 10 °C.

Conclusion: Although cold storage proved to be effective to maintain or minimize the oil FFA content, the method was relatively expensive.

**Keywords:** *Jatropha curcas*; Storage conditions; Alternate fuel; Oil extraction

**Introduction**

*Jatropha* oil can be used as alternative fuel and for making biodiesel which overcome energy crisis problem. Various methods have been applied for the *jatropha* oil extraction such as solvent extraction [1], enzymatic extraction [2], mechanical extraction by screw press [3] etc. Studies have been done on the physico-chemical properties of *Jatropha* oil including the fatty acids and TAGs composition of *Jatropha* oil [4]. *Jatropha* seeds and seed oil quality may get deteriorated on storage due to bacteria, moles, enzymatic degradation, oxidation and hydrolysis [5,6]. Therefore, it is important to understand the effect of storage conditions on quality of oil in order to optimize the economically viable storage conditions for storage of oil/seeds. It has been observed that lesser the FFA in raw oil (>1%) the better is the bio-diesel recovery [3]. Higher FFA oil can also be used but the bio-diesel recovery will depend upon oil type and amount of sodium hydroxide used.

An experiment was taken up to determine the optimum storage parameters such as surrounding temperature, seed moisture, types and structure of storage containers and their impact on the *Jatropha* oil quality in terms of FFA content was studied.

**Materials and Methods**

**Seed material**

Local *Jatropha curcas* seeds were purchased from Dahod, Gujarat. Damaged seeds were discarded and seeds in good condition were cleaned and dried under the sun for about three days.

Seeds Sampling: 50 kg cleaned and dried *Jatropha* seeds were filled in plastic barrels, M S barrels, plastic bags, and jute bags. One set of storage barrels and bags were kept at an ambient temperatures and one set of storage seeds in plastic bags were kept at cold temperatures viz.

10°C and - 20°C. Seeds stored at ambient temperature were tested at every three months interval, whereas, seeds stored at cold temperatures were tested at every five months interval Table 1 to examine the effect of storage time on oil yield from *Jatropha* seeds and FFA content of *Jatropha* oil. Each time one batch of seeds was procured and oil was extracted.

**Oil extraction**

*Jatropha* oil was expelled using 6 bolt baby oil expeller of 50 kg/hr capacity. Electric motor (7.5 kW) powered to the expeller through a belt drive. *Jatropha* seeds were fed manually in the feeder. The blades of feeder gave constant feeding to the expeller shaft through the hopper. The expeller shaft is surrounded by metallic plates such that the solid waste comes from the left end of the expeller and oil comes out from the bottom. Oil which comes out contained a large amount of impurities which was allowed to settle for 24 hrs.

**Testing of oil**

Acid value (% FFA) of the seed oil was determined as per standard procedure. Approximately 20 g oil was taken into 100 ml glass beaker...
and 50 ml of 95 % alcohol was added to it and the solution was neutralized with 0.1 N alkali solution using phenolphthalein indicator. The content were heated to boiling point and shaken thoroughly, in order to dissolve the free acids as completely as possible. The solution was then cooled and titrated against 0.1N alcoholic caustic potash solution with constant shaking (using phenolphthalein as indicator) until the pink color persist after vigorous shaking. End point is supposed to be reached when the pink color persist for 30 seconds.

Calculations

From each oil sample, there were triplicates sets of oil samples were taken for FFA content analysis. Average FFA percentage value was the representative of actual acid value of that respective oil sample. Acid value of seed oil was determined according to AOAC Official Method Cd 3a- 63. Percentage Free Fatty Acids (FFAs) were calculated using oleic acid as a factor.

Statistical analysis

All the data obtained were subjected to Analysis of Variance (ANOVA) and where significant differences were observed, means were separated by the range test (HSD) for different storage parameters.

| S. No. Months Storage Period Seed samples for oil extraction | S. No. Storage Parameter Storage Period | Oil Storage Period |
|-----------------|--------------------------|-------------------|
| 1 29 Dec-09 0-Fresh At the time of purchase | 1 Plastic Bag | 7 Months Old 10 Months Old 13 Months Old 16 Months Old |
| 2 Mar-10 3-months old Ambient storage: plastic barrel; MS barrel; plastic bag; jute bag | 2 MS Barrel | Mean ± SD Mean ± SD Mean ± SD Mean ± SD Mean ± SD |
| 3 May-10 5-months old Cold storage: 10°C - 20°C | 3 Plastic Barrel | 1.14 ± 0.26 0.99 ± 0.04 1.89 ± 0.26 1.55 ± 0.10 1.47 ± 0.07 |
| 4 Jun-10 6-months old Ambient storage: plastic barrel; MS barrel; plastic bag; jute bag | 4 Jute Bag | 1.14 ± 0.26 1.32 ± 0.01 1.01 ± 0.05 1.56 ± 0.01 2.08 ± 0.23 |
| 5 Sep-10 9-months old Ambient storage: plastic barrel; MS barrel; plastic bag; jute bag | 5 Plastic Bag (10°C) | Mean ± SD Mean ± SD Mean ± SD Mean ± SD Mean ± SD |
| 6 Oct-10 10-months old Cold storage: 10°C - 20°C | 6 Plastic Bag (- 20°C) | 1.14 ± 0.26 0.82 ± 0.02 0.66 ± 0.50 1.32 ± 0.12 6.62 ± 0.39 |
| 7 Dec-10 12-months old Ambient storage: plastic barrel; MS barrel; plastic bag; jute bag | | 1.14 ± 0.26 1.41 ± 0.07 1.41 ± 0.11 1.36 ± 0.12 |
| 8 Apr-11 16-months old Ambient storage: plastic barrel; MS barrel; plastic bag; jute bag; cold storage: 10°C - 20°C | | 1.14 ± 0.26 1.56 ± 0.05 1.29 ± 0.24 0.58 ± 0.19 |

Table 1: Period of oil extraction from different Jatropha seed samples.

Table 2: Percent FFA in oil extracted from Jatropha seeds kept under different storage parameters.

| S. No Storage Parameter | Oil Storage Period |
|-------------------------|-------------------|
| 1 29 Dec-09 0-Fresh At the time of purchase | 7 Months Old 10 Months Old 13 Months Old 16 Months Old |
| 2 Mar-10 3-months old Ambient storage: plastic barrel; MS barrel; plastic bag; jute bag | Mean ± SD Mean ± SD Mean ± SD Mean ± SD |
| 3 May-10 5-months old Cold storage: 10°C - 20°C | 1.14 ± 0.26 1.32 ± 0.01 1.01 ± 0.05 1.56 ± 0.01 2.08 ± 0.23 |
| 4 Jun-10 6-months old Ambient storage: plastic barrel; MS barrel; plastic bag; jute bag | Mean ± SD Mean ± SD Mean ± SD Mean ± SD Mean ± SD |
| 5 Sep-10 9-months old Ambient storage: plastic barrel; MS barrel; plastic bag; jute bag | 1.14 ± 0.26 1.44 ± 0.24 1.10 ± 0.22 2.09 ± 0.05 3.13 ± 0.32 |
| 6 Oct-10 10-months old Cold storage: 10°C - 20°C | Mean ± SD Mean ± SD Mean ± SD Mean ± SD Mean ± SD |
| 7 Dec-10 12-months old Ambient storage: plastic barrel; MS barrel; plastic bag; jute bag | 1.14 ± 0.26 0.82 ± 0.02 0.66 ± 0.50 1.32 ± 0.12 6.62 ± 0.39 |
| 8 Apr-11 16-months old Ambient storage: plastic barrel; MS barrel; plastic bag; jute bag; cold storage: 10°C - 20°C | 1.14 ± 0.26 1.56 ± 0.05 1.29 ± 0.24 0.58 ± 0.19 |

Table 3: Percent FFA in Jatropha oil stored at different time period.
plastic barrels. In Indian conditions up to nine - ten months, we can keep the seeds in any type of container at ambient temperature and maintain the FFA percentage of its oil. It showed increase in FFA content after nine months in steeds stored in MS barrels.

(i) In jute bags, the FFA content was increased after 16 months due to the oxidation reaction, since pore in the jute bags allowed aeration. Also oil of the seeds in plastic bags had less FFA than plastic barrels due to the difference in thickness of container wall.

(ii) In Jatropha seeds stored at cold temperatures level of free fatty acids or acid values in the raw oil remained almost same in the initial period but after one year of storage it reduced significantly at – 20°C.

(iii) Although cold storage proved to be effective to maintain or reduce the oil FFA content, the method was relatively expensive.

Future Scope of Work

Further work can be done in the area of storage stability since no work has been done so far in this area. Storage stability of both Jatropha oil and bio-diesel in containers of copper, steel, plastic etc. need could be studied.

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