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STUDIES ON MANUFACTURING PROCESSES OF TAMARIND OIL, BIODEGRADABLE PLASTIC AND RELATED PRODUCTS FROM TAMARIND- A REVIEW

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Abstract: Tamarind is one of the best vegetable products which are largely used by the domestic people as well as in the hotel industries, dhabas and restaurants for the food preparation as sour taste. After extraction of pulps from tamarind there is bye product of tamarind seed. Tamarind seed is largely used for the manufacturing of low cost tamarind seed flour. There is abundant amount of tamarind available in India, but there are very rare uses of tamarind as basic industrial raw material. Manufacturing of tamarind seed oil will be commercial exploitation of tamarind seed. It has very good scope in India as well as it can be exported for the pharmaceutical base products too. 7-10% oil is available in the tamarind seed. After the extraction of tamarind oil de-oiled cake is remains which are used in medicine and also used for the production of biodegradable plastic by extraction of starch. It can be extracted by using hexane, ether, toluene dichloromethane as solvent for extraction of tamarind seed oil. There is about 30% vegetable oil storage in our country which meat up by importing of vegetable oil. There is good market potentiality of the tamarind seed oil. As a whole this is good project along with other vegetable oil. Tamarind seed oil can be used directly in the paint industry. The oleoresin from Tamarind oil has very good pharmaceutical end use and it is high valued product. The seed oil can also be used as vegetable oil as food grade after refining of the oil and also can be used for manufacturing of high valued organic fatty acids. By using fermentation process starch can be converted into biodegradable plastic which are very much useful and best replacement for another plastic. This bio degradable plastic can be used in different purpose like making bottles, tea cups, packing paper and other. And by using shellac physical property of the biodegradable plastic can be increased.
Keywords: Tamarind oil, Solvent extraction, BioPlastic, Sbmarged Fermentation.

1. INTRODUCTION

1.1 Tamarind Fruit

Tamarind Fruit is brown pool-like legume and contains soft, acidic pulp and many hard coat seeds. Seeds can be scarified to enhance germination. Young fruit has hard, green pulp which is sour and acidic and used as component of salivary dishes. Ripened fruit is sweet and used in desserts, drinks and snacks.

1.2 Tamarind Kernel

Isolation of kernel without the thin tough and brown testa (shell) is difficult. The tamarind kernel powder is used as sizing material for textile and jute processing, and in the manufacture of industrial gums and adhesives. It is de-oiled to stabilize its deteriorating colour and odor on storage.

1.3 Composition of Tamarind seed kernel

Composition	Original	De-oiled
Oil	7.6%	0.6%
Protein	7.6%	19.0%
Polysaccharide	51.0%	55.0%
Crude Fibre	1.2%	1.1%
Total Ash	3.9%	3.4%
Acid Insoluble Ash	0.4%	0.3%
Moisture	7.1%	

Table 1: Composition of tamarind seed kernel

Isolation of kernel without shell is difficult and the solvent extracted oil from kernel is dark brown in colour. It is bleached after refining. The fatty oil from kernel resembles Peanut oil and useful in paints, varnishes and burning lamps. The fatty acid composition of oil is linoleic 46.5%, Oleic 27.2% and saturated fatty acids 26.4%.

1.4 Biodegradable green Plastic

The term green plastic applied to any polymeric material derived from a source of natural origin or purely synthetic, processable like conventional thermoplastics on existing equipments to finished product which are completely degradable either of the action of water or microbes.

The term green plastic therefore applies strictly to the wholly degradable resins i.e. material with the degradable polymer as the matrix and not to the product containing 6% starch. They are 100% biodegradable example starch lignin cellulose etc.

Green plastics are completely biodegradable by microorganisms or by water e.g. environmental polymers are not completely biodegradable, where the polymer may contain certain substituent which is biodegradable. For example in a polyethylene compound loading with 5% starch, only starch component is biodegradable while polyethylene is not, since the environmental polymers are mainly petroleum base which are not completely biodegradable. So there is a chance of pollution problem and also a chance of oil depletion. To avoid such a problem, the development of green plastics is important. Though the advancements, developments and modifications were done with environmental polymers, because they are the major cause of the environmental pollution even after disposal.

1.5 Need of Green Plastic

- To protect environment and human being. The accumulation of plastic waste from environment. It can be harmful to environmental and human being.
- To serve the natural resource. Generally the plastic can be derived from the hydrocarbons.
- Less release of toxic substances as compare to other polymer materials.
- To conserve the use of virgin polymers

Need for reduction in use of fossil fuel feedstock & increase in use of renewable feedstock, thus reducing the pollution. This can be achieved by biodegradable plastic. Biodegradable plastic are those plastic when disposed into biologically active environment are converted into smaller molecules that are not harmful to the environment. Starch based biodegradable plastics are those which are easily attacked by soil micro-organisms which breaks the polymer chain & becomes the part of plastic.

1.6 Properties of Green Plastics

- Biodegradability
- Water resistance
- Oxygen permeable
- Solid polymer of high molecular weight
- Low decomposition temperature
- Low melt strength
- Slow crystallization rate.

2. Materials and Methods

2.1 Extraction of oil

2.1.1 Cold Pressed or Cold Expeller Pressed: Cold pressed oils, also known as *cold expeller pressed oils*, have been mechanically pressed from the fatty portions of the botanical while ensuring that the maximum temperature (caused by friction) does not exceed 120 degrees.

2.1.2 Expeller Pressed: Expeller pressed oils are mechanically pressed from the botanical material at high pressure to obtain maximum yield. Not all expeller pressed oils are cold pressed as high pressure extraction can cause temperatures to rise above 120 degrees. Only if temperature is monitored and kept under 120 degrees, can the oil be called cold pressed. Otherwise it is simply called expeller pressed.

FromNatureWithLove.com always strives to supply cold pressed oils whenever possible, however, some oils cannot be cold pressed.

2.1.3 Solvent Extracted: Sometimes it is necessary to use a solvent in order to extract the oil from certain seeds, nuts or kernels in order to make the extraction cost effective. Once the oil has been obtained, the solvent is then removed from the oil, but a trace percentage of the solvent may still be present in the final oil. Coconut, Palm, Grapeseed and Rice Bran are typically solvent extracted.

2.1.4 CO2 Extracted: CO2 extracted oils are extracted using fluid carbon dioxide as the solvent. Carbon dioxide is converted to liquid using high pressure making it a safe and effective solvent that allows all the desirable active constituents of a plant to be collected without the risk of heat degradation. Once the extraction is complete, the pressure is released allowing the carbon dioxide to return to its natural gaseous state, leaving behind only the extracted essence of the plant. CO2 extracted oils are the closest representation of the natural plant ever achieved. CO2 total extracts include the volatile components as well as the heavier, waxy components that give plants their color, and are therefore thick and waxy in consistency.

2.1.5 Infusion/Macerate: Infused or macerated oil is a vegetable oil that has been "infused" with the fat soluble properties of other botanicals. Plant material is bruised and soaked in base oil for a set duration of time. The base oil is sometimes gently heated to encourage infusion. The material is then filtered. Additional material may be infused in the same oil a number of times. The final oil is then well filtered to remove any traces of plant particles. The benefit to using an infused vegetable oil is that the infused oil will contain the therapeutic properties of both the vegetable oil and the botanicals that were infused into the oil.

2.2 Refining

2.2.1 RBD: RBD is the abbreviation for "Refined, Bleached and Deodorized." Within the description / extraction method for each of our vegetable oils, we note those oils that are refined, bleached or deodorized.

2.2.2 Refined: Some oils undergo a refinement process in order to remove impurities, improve the color or texture, or stabilize the shelf life of the oil. The oil is reacted with a weak base solution to saponify the free fatty acids into soap. The oil is then centrifuged and washed with water until the pure oil remains. The oil may also be degummed to remove the sticky phospholipids, color pigments and odor lending portions.

2.2.3 Bleached: Some lipids are bleached in order to improve the color and clarity of the oil. Bleaching is generally done by passing the oil through fuller's earth or clay and then filtering the oil.

2.2.4 Deodorized: Some lipids undergo a deodorization process in order to remove compounds that lend an unappealing or overpowering aroma to the oil. This is generally done by blowing high temperature steam through the oil to vaporize the aromatic components. This process is made more effective by heating the oil to high temperatures and performing this process under a vacuum to help remove all of the volatile odorous substances. Due to the high temperatures used, deodorization is clearly the most damaging process of refinement.

2.2.5 Winterized: Oils that are winterized are cooled and filtered to remove the solid crystallized fractions. This process results in lighter, clearer oil.

2.3 Process for manufacturing Biodegradable plastic

In the processing of green plastics, the tamarind seeds must be de-oiled and dry flakes transported to processers where glucose is extracted and fermented into cell containing PHA. The cell are washed, spun in a centrifuge and broken apart to release the PHA, which is again washed and centrifuge. Then concentrated and dried to a powder.

2.3.1 Conversion of Tamarind de-oiled seeds flakes to Plastic

There are various steps involves in the conversion of waste corn to starch.

2.3.2 Cleaning

The raw material is delivered in Tamarind de-oiled seeds flakes cleaning machine. The waste Tamarind de-oiled seeds flakes are inspected and cob, dust, chaff and foreign material are removed. After cleaning the waste Tamarind de-oiled seeds flakes are transported to the steeps.

2.3.3 Steeping

A proper steeping is essential for high yields and high starch quality. The steeping is carried out in a continuous counter-current process. The cleaned waste Tamarind de-oiled seeds flakes is filled into a battery of large steeping tanks that is steeps, where the waste Tamarind de-oiled seeds flakes is soaked in hot water 30 to 48 hours to begin breaking the starch and protein bonds. The gluten bonds within the waste Tamarind de-oiled seeds flakes are begin to loosen and release the starch.

2.3.4 Steep water evaporation

The steep water containing approximately 10% dry substance is drained from the kernels and condensed on a multi-stage evaporator. The condensate from the first evaporator stage will therefore be discharged after the heat is recovered by preheating the entering steep water.

2.3.5 Grinding and Screening

After germ separation the material of waste Tamarind de-oiled seeds flakes (germ) is transported to the grinding mill to release starch & glucose bond in the form of fiber. Then this starch is transported to the first stage of fiber washing system where starch & gluten is screen out.

2.3.6 Starch Refining

Washing with fresh clean water refines the crude starch milk. With hydro cyclones it is feasible to reduce fiber and soluble including soluble protein to low levels with a minimum of fresh water.

2.3.7 Starch Fermentation

To convert Waste Tamarind de-oiled seeds flakes Starch into Lactic Acid, Fermentation process is used. In this process, the Waste Tamarind de-oiled seeds flakes Starch is fermented with the help of appropriate Enzymes to produce Lactic Acid.

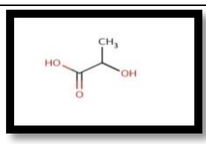
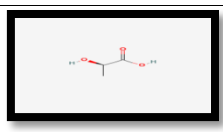
2.3.8 Enzymes Used for Fermentation:

The desirable characteristics of industrial microorganisms are their ability to rapidly and completely ferment cheap raw materials, requiring minimal amount of nitrogenous substances, providing high yields of preferred stereo specific lactic acid under conditions of low pH and high temperature. The choice of an organism primarily depends on the carbohydrate to be fermented. Lactobacillus amylophylus and lactobacillus amylovirus are able to ferment starch.

2.3.9 Polymerization

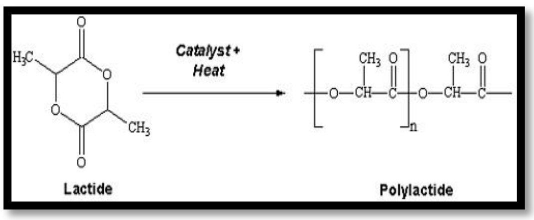
Then the polymerization is carried out using conventional polymerization techniques.

1) Bulk polymerization
2) Suspension polymerization
3) Emulsion polymerization
4) Solution polymerization

Sr. No.	**Lactic acid Structure**	
1	**L-lactic Acid**	**D-lactic Acid**
2		

Polymerization of Lactide

Polylactides (PLAs) :-



- ❖ PLA can be easily produced through ring-opening polymerization of lactide using a (stannous octoate) catalyst.

2.3.10 Degradation

Degradation is the process by which detoriation in the properties occur due to reduction in molecular weight. The above image shows the degradation of disposal glass made from green plastic and how it get decompose when it goes to the land filling.

2.3.11 Processing Parameters of Green Plastic

There are two main types to bear in mind when processing green plastics:-

- The limited thermal stability of the polymer, the polymer degrading rapidly above 195 degree Celsius.
- The need to optimize conditions to allow a maximum rate of crystallization and thus reduce cycle time.
- The maximum rate of crystallization is reported to be at about 55-60 degree Celsius.

Processing temperature should not exceed 180 degree Celsius. And duration of time the material is in the melt state should be kept to a minimum when blow molding the blow pin and mould should be at about 60 degree Celsius to optimize crystallization state. Similarly injection moulds are recommended to be held at 60 or 65 degree Celsius.

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