SUMMARY AND FUTURE SCOPE.

The thesis discusses on development and evaluation of lubricating greases as well as lubricating oils derived from vegetable oils. Non-traditional vegetable oils used in research were Karanja oil, Neem oil and Tobacco seed oil. These oils were chemically modified by means of various unit processes like trans-esterification, epoxidation, hydrolysis, estolide ester formation. The formulated products were compared with petroleum based products to get an idea regarding lubricating characteristic of vegetable oil based lubricants.

In chapter 2, vegetable oils were evaluated for its physico-chemical properties and then vegetable oils were transesterified using hexanol, octanol and neo-pentyl glycol. These transesterified oils were characterized by GC-MS to confirm the formation of esters. Transesterified oils were further used as base oil to formulate bio-based grease. Lithium-12-hydroxy stearate was used as thickener and it was thermos-mechanically dispersed in the chemically modified vegetable oil. Tribological properties of grease like cone penetration, roll stability, weld load, wear preventative properties were studied and results were compared againsts petroleum based grease. From the comparison it was found that bio-based grease have excellent extreme pressure properties than mineral oil based grease.

Chapter 3 discusses on series of chemical modifications of vegetable oils like epoxidation followed by hydroxylation and esterification.

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Epoxidation of vegetable oil can be a good route to remove unsaturation present in the oil, which proves to be a draw back for the use of lubricant at elevated temperature. In this chapter vegetable oils were epoxidised using per-acetic acid. These epoxidised oil was further esterified using acetic anhydride. The final product was evaluated for its pour point, carbon residue, co-efficient of friction, flash and fire point. The results were compared with mineral oil based lubricant as it was found that chemically modified vegetable oil has higher flash and fire point values, it offers much less co-efficient of friction which shows that it has good lubricity and metal adherence than mineral oil based lubricants.

In the last chapter, chapter 4, vegetable oils were blended with castor oil in various proportion and then estolide esters were synthesized using oleic acid as capping acid. Castor oil has hydroxyl functionalized recinoleic acid which can be used to form estolide linkages with oleic acid. These estolide esters have good comparable pour point, viscosity index, fire point, co-efficient of friction as compared to the mineral based lubricating. Also the pour points of vegetable oil based lubricating oil were decreased noticeably by formation of estolide esters.

In a nut shell, vegetable oils can be chemically modified and a value added product like lubricants can be developed from them. Lubricants
derived from vegetable oils are eco-friendly and have good satisfactory properties as compared to petroleum based lubricants.

**Future scope**

- A study of enhanced properties can be carried out by incorporating various additives in bio-based lubricants.
- A good formulation of bio-lubricant can be made by incorporating optimum amount of additives.
- Exploration of other vegetable oils and chemically modifying them could lead to a variety of bio-based lubricants.