

**DEVELOPMENT OF DEPULPER AND DECORTICATOR
FOR PROCESSING OF
NEEM (*Azadirachta indica*) FRUITS AND SEEDS**

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**CENTRE FOR RURAL DEVELOPMENT AND TECHNOLOGY
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NEEM (*Azadirachta indica*) FRUITS AND SEEDS**

by

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CENTRE FOR RURAL DEVELOPMENT AND TECHNOLOGY**

Submitted

In fulfillment of the requirement of the degree of

DOCTOR OF PHILOSOPHY

to the



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AUGUST 2011

DEDICATED TO....

MY BELOVED PARENTS

CERTIFICATE

This is to certify that the thesis entitled, “DEVELOPMENT OF DEPULPER AND DECORTICATOR FOR PROCESSING OF NEEM (*Azadirachta indica* A Juss) FRUITS AND SEEDS” being submitted by **Mr. Ramesh Chander Solanki** to the Indian Institute of Technology, Delhi for the award of Doctor of Philosophy is a record of bonafide research work carried out by him under our guidance and supervision in conformity with the rules and regulations of Indian Institute of Technology, Delhi. The research report and results in this thesis have not been submitted, in part or in full, to any other university or institute for the award of any degree or diploma.

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Abstract

Neem is recognized for its products as a substitute of synthetic fertilizers and different types of chemicals world wide. It is seen as an environmentally safe alternative to synthetic pesticides. India has a huge potential of promoting Neem (*Azadirachta indica A. Juss*) and its by-products. Traditionally Neem fruits are manually collected by the rural community and sold to the industries where these are processed. It results in considerable loss of time which adversely affects the production of quality products. It is estimated that about 30-35 % of Neem fruits goes waste during collection and another 30 % is wasted due to inadequate post harvest operations at farm/site level before it reaches the industries. Depulping and decortication of Neem fruits at farm level are two crucial operations that can lead to reduced losses and increased production. It is also envisaged that oil recovery is higher if primary processing of Neem fruits can be done at decentralized level (farm/site). Hence, the main focus of the present study was to develop efficient method of fruit collection, development of low cost depulper and decorticator for reducing losses and improved oil recovery as well as quality for enhancing the income of the farmers.

Three different methods viz traditional collection of fruits fallen on the ground, spreading a plastic sheet under the tree and directly picking fruits from the tree were evaluated for their economic viability. Fruit collection by spreading sheet was observed to be best with a clean fruit collection of 136.5 kg/day at profit of Rs 1.16 per kg (Rs 158 per day). The physical and mechanical properties of fruit and seed, required for the design and development of depulper and decorticator were determined. The mean length, diameter, bulk density, true density, porosity, angle of repose, coefficient of friction of Neem fruit (30.41 % m. c.) were 17.66 mm, 13.18 mm, 633 kg m⁻³, 98 kg m⁻³, 35.4 %, 40.32° and 0.42 %, respectively. For dry Neem seed (11.73 % m.c.) these values were as: 13.56 mm, 7.63 mm, 278 kg m⁻³, 67 kg m⁻³, 59.1 %, 32.42° and 0.44 % respectively. The terminal velocity of Neem seed (8.77 m/s) indicates the easy separation of kernel from broken shells. These properties are found to vary with change in moisture content of fruits and seeds. The mean shear force of Neem fruit and seed was observed to be 2.58 N and 8.4 N whereas the mean crushing force was 14.7 N and 20.5 N respectively.

Considering the above mentioned physical and mechanical characteristics of Neem fruits and seeds, a depulper was designed and developed. Final design values were calculated and one unit got fabricated. It consisted of rubbing system, cylindrical sieve handle, base frame with an arrangement for adjustment of slope and water flow rate. The depulper was evaluated for two levels each of rubbing system, sieve design, water flow rate, slope and 5 levels of soaking of fruits. The optimized design and operational variables of depulper consisted of spiral flat belt rubbing system, a continuous water supply @ 20 l/h inside the sieve cylinder of 200 mm diameter having oblong holes of 18 x 4 mm and kept at horizontal level. The performance evaluation of the machine was done in terms of its efficiency, capacity, reduced losses, oil recovery and its quality. Neem fruits soaked in water for three days gave best results. At optimum level of variables, the depulping efficiency and capacity was 98.2 % and 25.2 kg/h respectively.

A manually operated Neem seed decorticator was also developed on the basic principle of groundnut decorticator. It was evaluated for three levels of moisture content of seed, two levels each of sieve type, beaters and clearance between sieve and beater. The final design values were 11.6 % moisture content, sieve with 20 x5 mm oblong holes, flat belt beater and 4 mm concave clearance. At optimum level of variables the decortication efficiency and capacity was 78.0 % and 20 kg/h respectively.

The oil was extracted from kernels obtained after processing, using newly developed depulper and decorticator and compared with quality of commercially available oil by HPLC technique. The oil extracted from the kernel by employing prototype equipment was observed to be of better quality in terms of azadirachtin content, acid value, saponification value and viscosity. The oil recovery was also more on kernel weight basis (37 %) as compared to seeds obtained by other methods (33 % and 20 %) but less than manual method (44%). The economic analysis indicated that by adopting the above technological system, a net profit of 69.87%, 87.95% and 140.96% could be obtained in terms of collection, depulping and decortications respectively. The research findings clearly reveal multiple benefits to rural entrepreneur through newly

designed cost effective Neem seed/fruits processing equipments including better yield and good quality Neem oil for commercial applications.

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