ABSTRACT

The trees of Chironji (*Bachanania Lanzan*) nuts are found throughout the greater parts of India, Burma and Nepal. The chironji nuts have very high commercial value and have export opportunities because of its medicinal and cosmetic applications. In India, the trees are mostly found in tribal areas and the nuts are shelling manually adopting traditional methods only, which involves sun-drying, soaking in the water for overnight and rubbing with a stone–slab on a stationary rough stone surface. This process is very tedious, time consuming and also leads to the losses in the recovery of whole kernels (30-40 % only) and the rest remains as broken forms or powder that fetch much lower price. There are very few literatures available about the properties of chironji nuts but nothing is available on the shelling of chironji nuts using any types of mechanization. Thus , a study is conducted to design and develop a motor operated chironji nut decorticator to achieve the optimum shelling efficiency.

The study of the physico-chemical and engineering properties of chironji nuts and kernels are also carried out in line with the design and development of a shelling machine. The mean values of length, width, thickness and geometrical diameter of chironji nuts are found to be 10.2, 8.6, 8.0 and 8.89 mm, respectively. The mean values of sphericity, roundness, aspect ratio, porosity, bulk and true densities are 87.12, 79.45, 89.50, 33.82% 578.30 kg/m^3 and 884.30 kg/m^3 respectively. The chironji kernel is covered with a hard seed coat (hull) and the kernel length, width and thickness are found to be 6.80, 5.01 and 4.66 mm, respectively. The mean values of sphericity, roundness and aspect ratio of kernel are 77.08, 76.41 and 77.42%, respectively. The mean values of terminal velocities for nuts, kernels and hull are 20.4, 14.7 and 18.8 m/s, respectively. It is observed that all the physical properties of chironji nuts increase with the increase in moisture content at five different levels from 9.98 to 17.06% (db), whereas there is decrease in bulk density and true density with the increase in moisture content. Attempts have been made to decorticate the chironji nuts with different available mills and shellers and it is found that modified groundnut decorticator had high decortication efficiency with 68.98% as shelled nuts among the groups. The capacity of the developed chironji nut decorticator is 90–180 kg/h and is operated by a 3 HP electric motor. The grooved MS plates attached to the impeller are acts as the impacting device for decortication of nuts. The diameter of impeller shaft and the shaft pulley are chosen as 30 mm and 80 mm respectively. A decorticating chamber covering the bottom half (160°) portion of the impeller is provided with a replaceable concave made of MS flats at a spacing of 8 mm while the top half portion of the decorticating chamber is made of MS sheet with inlet to receive nuts from hopper. A trapezoidal hopper of 570 x 410 mm top dimension and 323 mm height is designed for a capacity of 22 kg. The discharge collecting hopper with 660 x 660 mm top dimensions and 285 mm height was provided at the bottom of the decorticator chamber. A feed rate controller was fixed inside the hopper for controlling the feed rate of the chironji nuts. A cleaning and grading device in the form of a set of two sieves were used for separation of kernels from hulls. The developed chironji nut decorticator gives decortication efficiency and kernel recovery of 74 and 91%, respectively at optimal levels of 11.25% db moisture content, 4.53 m/s impeller speed, 7 mm concave clearance and 131.4 kg/h feed rate. The shelling capacity of the machine (1314 kg/day) is very high as compared to manual shelling (8–10 kg/day) consisting 8 working hours per day during the trials at the producer's home. The cost of machine and manual decortication were found to be ₹ 3.00/kg and ₹ 24/kg, respectively.

Key words: Chironji (*Bachanania Lanzan*), decorticator, motor power, physical property, engineering property, cylinder speed, concave clearance, moisture content, decorticating efficiency, recovery whole kernel yield, CCRD, RSM and ANOVA