International Journal of Agricultural Engineering, Vol. 2 No. 2 (October 2009 to March 2010) : 329-332

Research Paper :

Design and development of power operated wet type dehuller for green gram and black gram

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Accepted : *September, 2009*

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ABSTRACT

A small unit of power operated wet type dehuller was developed incorporating rough dehulling surface for removal of hulls of soaked green gram and black gram. The soaked green gram and black gram for 1st, 2nd, 3rd, 4th and 5th hour was dehulled at three different revolutions as 40, 60 and 80 of dehuller. The power-operated dehuller achieves higher dehulling efficiency for five-hour soaking period with minimum losses. The study shows 94 per cent dehulling efficiency for black gram while 97 per cent dehulling efficiency for green gram during five hour of soaking period at 40, 60 and 80 rpm, while the dehulling capacity of wet type dehuller was found to be 8 kg/hr.

Key words : Green gram, Black gram, Dehuller, RPM, Dehulling efficiency, Dehulling capacity

Green gram (*Vigna radiata*) and black gram (*Vigna mungo*) are the pulses commonly called as mungbean and urdbean, respectively. These are one of the major food legumes grown and consumed extensively in India. The annual production of green gram and black gram is 1.29 million tonnes and 1.31 million tonnes, respectively, which is about 17 per cent against the total world production. The area under green gram and black gram against world in country is 3.13 million hectares and 3.18 million hectares, respectively (Anon, 2000). Pulses being nutritionally vital and are an important constitute of diet for a very large number of peoples in the world especially in India where majority of peoples are vegetarian. Apart from being relatively cheaper source of dietary protein, it is also an important source of calories, certain essential aminoacids, minerals and vitamins. The per capita availability of pulses in India is currently estimated as 24 g/day as moderately recommended intake 42 g/day (Anon, 2000)

Post harvest scenario of pulse shows that 75 per cent of production was milled as dehusked split *i.e. dal*. Majority of pulses was consumed in India as splits. Milling of pulse reduces fiber content, palatability improves appearance, texture and cooking quality of pulse. Traditionally green gram and black gram dal is dehulled manually after soaking in water (Kurlein, 1987). Water soaking for varying period, imparts adequate loosening of hulls. It was considered as most difficult to dehulled gram due to fine seed coat attached to gummy layer between hull and cotyledon. Several methods are adopted for dehulling of gram, which may be classified as wet type and dry type (Patil, 1991). In wet type method, loosing of hull is done in first step and then removal of hull with suitable dehuller. So study is planned to develop a power operated wet type dehuller and to evaluate the effect of RPM and soaking period on dehulling efficiency and broken percentage.

METHODOLOGY

Design considerations:

Apart from tedious dehulling operation, an introduction of power operated dehuller in rural areas. The dehuller should dehulled soaked gram easily without clogging. To achieve this requirement dehuller with different type (*i.e.* rough surface of coconut rope wounded on roller and hair roller nylon brush) were developed. The nylon hairbrush as dehulling surface was taken for study.

The dehuller should be simple in design and construction, easy in operation and maintain easily without any highly trained person. It should also be reasonably cheap, durable and fabricated with locally available materials and affordable price. It should be possible to modify dehuller in future.

Construction detail of power operated wet type dehuller:

Construction detail of power operated wet type dehuller shown in Fig. 1. The main part of dehuller consist of a drum (casing) made from PVC pipe of diameter 50 mm and length of 345 mm fixed to wooden shaft of dehulling surface. A dehulling surface made from nylon

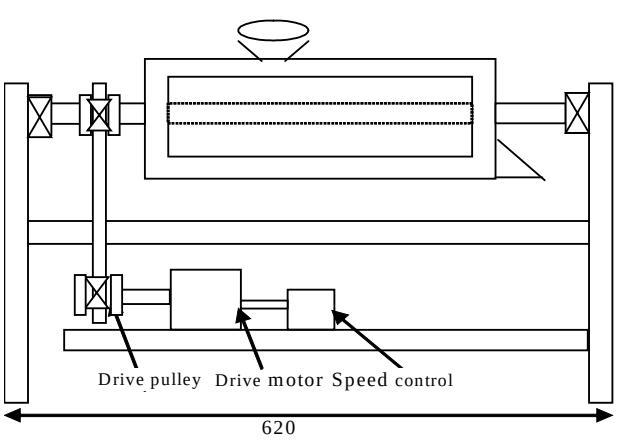

Fig. 1 (a) Front view of wet type

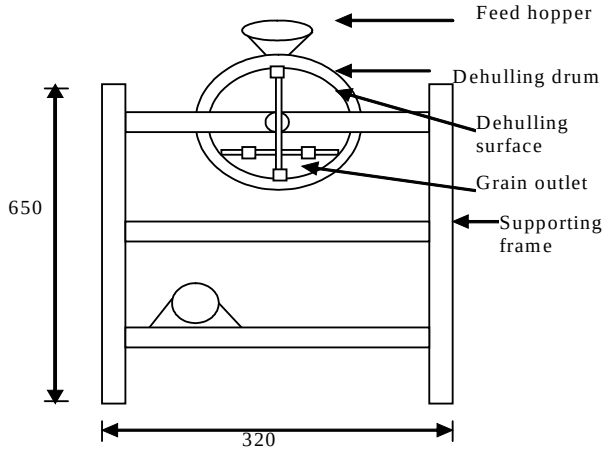

Fig. 1 (b) Side view of wet type

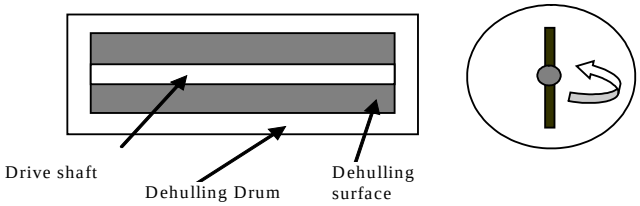

Fig. 1 (c) Cross section view of dehulling drum

Fig.1 (d) Dehulling assembly

Fig. 1 : Construction details of wet type dehuller

spikes fixed on wooden shaft of diameter 30 mm (nylon roller diameter was 25 mm) and length of 395 mm. The clearance between inner surface of a drum and outer of dehulling surface was 3 to 5 mm sufficient to cause dehulling by abrasion. The slope was also given to the dehulling drum for movement of dehulled gram with continuous flowing water supplied from overhead tank.

The dehulling drum is fixed to the supporting frame with help of metal clamp at both ends. A pulley is fixed to drive shaft to transfer revolutions of motor to drive shaft through V- belt and coupled with variable speed drive. The main function of dehulling surface is to move gram around inside the dehulling drum thus creating the relative movement of gram against gram and against dehulling surface leading to cause abrasion which is main dehulling force in this unit.

For loading and unloading of gram, a feeder hopper is provided at top on one end and outlet at the rear end of dehulling drum with tray for separation of hulls.

Performance test of wet type dehuller:

The sample (500 g each) of green gram and black were soaked in water at ambient temperature for soaking period of 5 hours. At an interval of 1hour sample of black gram and green gram was dehulled with wet type dehuller at three different rpm as 40, 60 and 80, respectively to evaluate dehulling performance of wet type dehuller. The dehulling efficiency was evaluated by following formula.

$$\eta_{dehulling} \; Z \frac{x_1}{x_1 \, H \, x_2} x100 \qquad (1)$$

where $n_{dehulling}$ = Dehulling efficiency, per cent

x_1 = Weights of hulls obtained, grams

x_2 = Hulls separated from unhulled dal, grams

Grain soaking:

The 50 g each of sample was soaked in water for 5 hours at ambient temperature. At an interval of 1st, 2nd, 3rd, 4th and 5th hour, 50 g each of soaked sample was fed to dehuller.

Dehulling test:

A 50 g of soaked sample was fed to dehuller, at an interval of 1 hour and dehulled at 40, 60 and 80 revolution

of drive shaft for five minute with continuous stream of water. After dehulling the gram was removed from dehuller through outlet and hulls, splits, unhulled splits and broken were separated from dehulled gram. The fractions were weighted to determine dehulling efficiency and broken percentage.

RESULTS AND DISCUSSION

The results obtained from the present investigation are discussed below :

Dehulling performance:

A sample of black gram and green gram (500g each) were soaked in water for 5 hours and dehulled with help of power operated wet type dehuller at 40, 60 and 80 rpm. Output obtained was analyzed for splits, hulls, unhulled splits and broken. Weight of fractions and dehulling efficiency and broken percentage were found out.

Dehulling of black gram:

It was observed that the dehulling efficiency was increasing with the increase in soaking period. It varied from 88.08 per cent to 93.3 per cent at 40 rpm for soaking period of 5 hour. Higher dehulling efficiency was due to higher absorption of water, which reduces the bonding force between hulls and cotyledons, causing to increase dehulling efficiency. Similar trends were observed for 60 and 80 rpm. The dehulling efficiency for 60 and 80 rpm varyied from 90.46 per cent to 94.38 and 90.82 per cent to 94.99 per cent, respectively. While broken percentage ranges from 6.61 to 11.32 per cent for 40 rpm, 9.16 to 12.63 per cent for 80 rpm and 9.59 to 15.61 rpm, respectively during 5 hours of soaking period.

Dehulling of green gram:

It has been observed that the dehulling efficiency was increased with soaking period. It varied from 94.32 per cent to 97.50 per cent at 40 rpm for 5 hour of soaking. Higher dehulling efficiency with soaking period was due to higher absorption of water higher water absorption reduces the bonding force between the hulls and cotyledons. Similar trend was observed for 60 and 80 rpm. The dehulling efficiency was varying from 95.48 per cent to 97.52 per cent and 96.48 per cent to 97.56 per cent, respectively for 60 and 80 rpm. While broken were found to 3.86 to 11.15 per cent, 8.19 to 11.31 per cent and 9.96 to 12.25 per cent for 40, 60 and 80 rpm, respectively during 5 hours of soaking period. These observations reveal that the soaking period of 1 hour gives dehulling efficiency of 93 per cent to 94 per cent with minimum broken of 3.86 per cent at 40 rpm. The dehulling efficiency and broken percentage for varying soaking period was plotted in a Fig. 2, 3, 4, 5, 6 and 7.

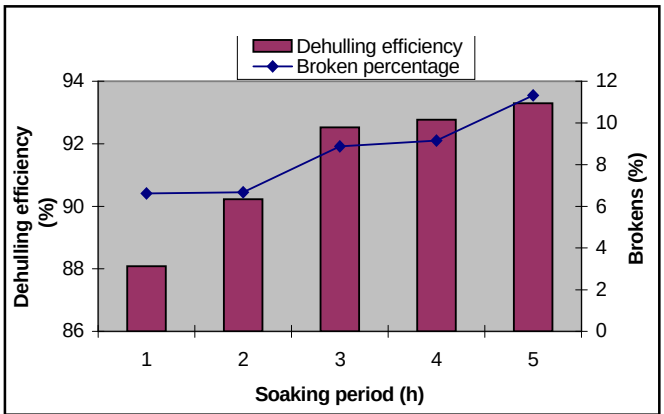

Fig. 2 : Effect of soaking period on dehulling efficiency and broken percentagee of black gram at 40 rpm of dehuller

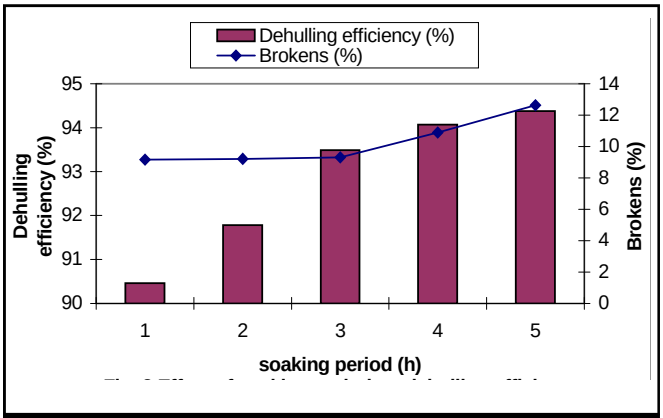

Fig. 3 : Effect of soaking period on dehulling efficiency and broken percentagee in black gram at 60 rpm of dehuller

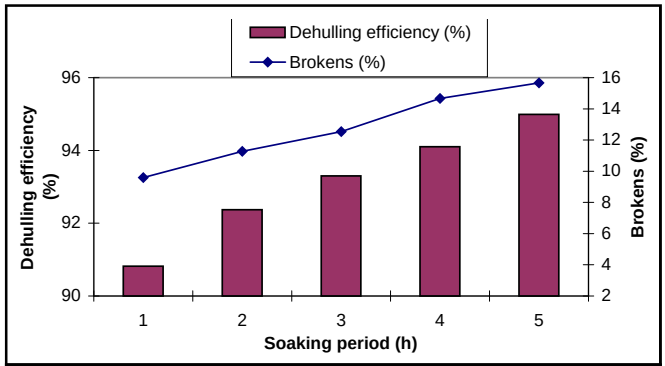

Fig. 4 : Effect of soaking period on dehulling efficiency and broken percentagee in black gram at 80 rpm of dehuller

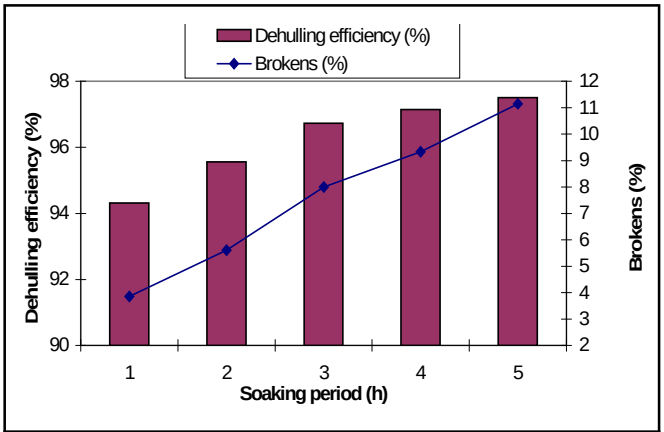

Fig. 5 : Effect of soaking period on dehulling efficiency and broken percentagee in green gram at 40 rpm of dehuller

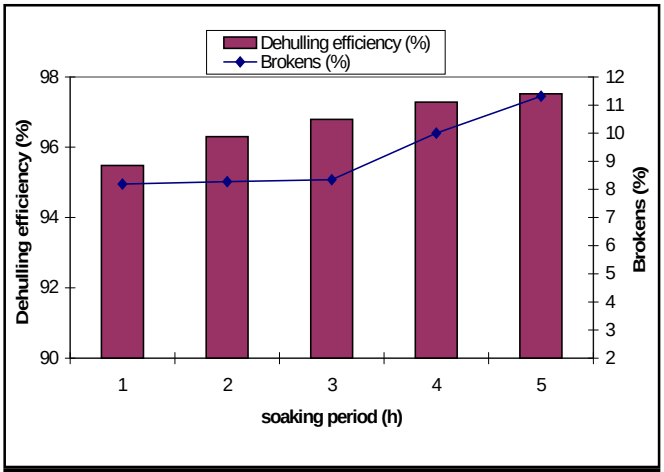

Fig. 6 : Effect of soaking period on dehulling efficiency and broken percentagee in green gram at 60 rpm of dehuller

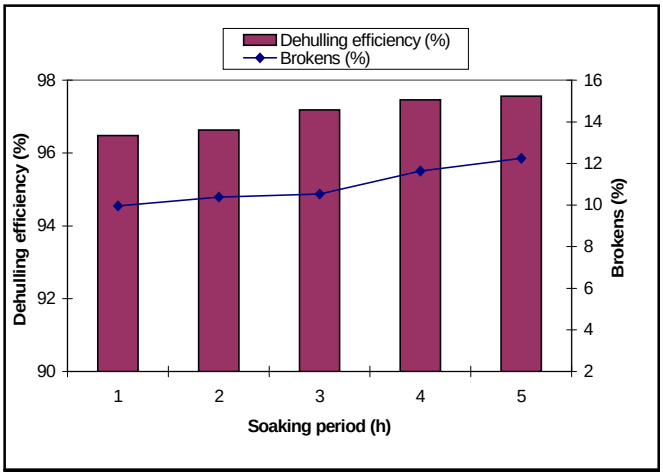

Fig. 7 : Effect of soaking period on dehulling efficiency and broken percentagee in green gram at 80 rpm of dehuller

Conclusion:

The following conclusions are drawn from the study.

– Minimum brokens (6.62 per cent) with higher dehulling efficiency (90.23 per cent) was observed for black gram during 2 hour soaking at 40 rpm.

– While minimum brokens (3.86 per cent) with high efficiency (94.30 per cent) were observed for green gram during 1 hour soaking at 40 rpm.

– Higher RPM of wet type dehuller increases dehulling efficiency of machine but also increases the broken percentage.

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