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Effect of abrasive emery rollers using various speeds on dehulling of black gram (*Vigna mungo*)

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Abstract
The study was done to assess the effect of abrasive roller on the dehulling of the black gram to minimise the losses and increase the dal recovery the two different emery roller prepare by the using the emery no. 40 and 60. was used in PKV mini dal mill which was used for milling experiment on black gram grain. The maximum dal recovery 75.69% found in case of roller made from emery no.40. The dehulling efficiency, dehulling index and degree of dehulling 87.05%, 0.87 and 95.03 and for emery roller no. 60 dal recovery, dehulling efficiency, dehulling index and degree of dehulling 72.71%, 80.08%, 0.84 and 80.8 at the speed of 1200 rpm.

Keywords: Abrasive emery rollers, various speeds, dehulling, black gram, (*Vigna mungo*)

Introduction

The word "Pulse" is derived from the Latin word "Puls" meaning pottage i.e. seeds boiled to make porridge or thick soup (Singh *et al*. 2018) [16]. Pulses play a vital role in daily diet, without the presence of pulse, common man meal will not complete. A vast majority of the Indian population, pulse provide a perfect mix of vegetarian protein component with cereals. Pulses can be described as potentially, the most valuable of the naturally occurring source of protein. Pulses are the cheapest source of dietary proteins. The high content of protein in pulses makes the diet more nutritive. It is supplementary protein in daily diets based on cereals and food for predominantly vegetarian population and for those who cannot afford expensive animal protein, It often regarded as poor men's meat (Mangaraj *et al.*, 2013) [11]. Pulses contain the same amount of calories as cereals but the protein content varies. The protein content of pulses are twice that of cereals (20-25%) and almost equal to that of meat and poultry (Singh *et al*. 2018) [16]. In the country pulses are consumed mostly in the form of dal, dehusked and split kernel. Nearly 75% of the total legumes production is converted into the dal. Milling of edible pulses for production of dal is an age old process. Milling procedures vary widely from place to place. Thus, recovery of dal varies from 60-75% depending upon the type of pulses, techniques and mills adopted by the millers (Singh 2018) [16]. Black gram is one of the important pulse crops in India. It has been reported that these crops were cultivated in India since ancient times. It is believed that black gram is a native of India and Central Asia and grown in these regions since prehistoric times. India is the leading pulse producing country in the world based on 04th Advance Estimates India produce 25230.00 thousand tonnes pulse in the year 2017-18, in 2017-18 production of black gram was 3560 thousand tones that are 14.11 percent of share in total production in India (Anonymous, 2018) [1]. Pulses containing 24% protein, 59.6% carbohydrate and 1.4% fat (Gopalan *et al.*, 1989). India is the largest producer and consumer of black gram Pulses are reported to contain anti nutrients in seed coat. Also, the seed coat is hard and imparts a bitter taste, reducing the palatability of the pulses. In order to remove the anti-nutrients and improve the palatability, it is common practice to dehull the pulses before using. Dehulling is a process of removal of hull from the cotyledon of pulses. It reduces the fibre content and improves appearance, texture, cooking quality, palatability and digestibility of grain legume (Tiwari *et al.*, 2007) [22]. Dehulling of black gram has been a difficult operation due to the presence of vitreous layer of gums and mucilages, which makes bond between hull and cotyledon stronger. Pulse dehulling constitutes two major steps, *viz.*, loosening of the hull followed by its removal in suitable milling machine (Narasimha *et al.*, 2003). On an average black gram contain 12 percent seed coat, 2 percent embryo and 86 percent cotyledons (Anonymous 2015) [3].

The increased trend of consuming black gram and green gram amongst vegetarian Indians necessitates introducing suitable dal milling technologies for higher percent of dal recovery of black gram.

Material and method:

The pulse sector is undergoing dynamic changes at global, regional and country levels, to meet the growing demand for protein. Projections indicate that demand for pulses will continue to increase in developing counties due to growing population and rising per capita incomes. Globally, the average share of pulses is only 5 percent of the total protein consumption, but in several developing countries their contribution ranges between 10 and 40 percent (Sherasi *et al*. 2017) [18].

Black gram is traditionally pre-treated by the dry method which involves pitting and oiling the pulses followed by conditioning by sun drying for 2 to 3 days and heaping overnight before dehulling. The process is labour intensive, time consuming and needs a fair amount of edible oil for processing. In addition, losses in the form of powder and broken seeds lead to less milling yields, which varies from 65% to 70% in Indian pulse mills depending upon the variety, climatic conditions and milling machinery used (Tiwari *et al.*, 2010) [25].

The AICRP on Post Harvest Technology of (Indian Council of Agricultural Research) operating under Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola has developed a dal milling unit (popularly known as PKV mini dal mill), which has good potential for adoption at small scale (Phirke *et al.*, 1995) [15]. The machine was used for the experimental trial.

Among the different variety of black gram cultivated in Maharashtra, the TAU-1 of black gram is most commonly grown through the state. Moreover, "TAU-1" is milled in many pulse mills of Maharashtra on large scale for getting dal. Therefore variety of black gram was selected for the present investigation. The black gram was procured from the local market of "Akola" in the month of August. The pulse grain was sundried for two days to reduce the moisture content up to 10 percent (w b) and 11 percent on (d b) for conducting various trials on dehulling. After procurement, black gram and green gram grains were cleaned and graded. The experiments were conducted by using 40 emery number rollers and 60 emery number rollers rotate about various speed of 8000,900,1000,1100,1200 and 1300 respectively at the feed rate of 200kg/h The grains were cleaned and graded and dried up to 10% moisture content (w b). The sample size of grain used was 7 kg. The first pass was common i. e. done for scarification (pitting) of grains at a feed rate of 200 kg/h and speed of 1000 rpm followed by oil treatment @ 0.25% (of the weight of grain) (Dhoke 2014) [5]. The oil treated sample was heaped for overnight, dried under the sun for about 3 hours or more to reach the moisture content near about 10 percent (w b) and then it was passed through milling mechanism. During the second pass, the milling was carried out at various speeds. There are five outlets to PKV mini dal mill *viz.* i) mixture of dehulled and undehulled intact/whole grains, ii) mixture of dehulled and undehulled split, iii) broken iv) husk with some broken and powder and v) powder with some fine husk. Each outlet of dehulled fraction, different codes were given for ease of sample analysis. sample of each outlet was used for analysis of broken, husk, mixture of fine husk and powder, intact dehulled, intact undehulled, split dehulled and split undehulled for further analysis of using the folling formula dal recovery (DR), dehulling efficiency (DE), dehulling index (DI) and degree of dehulling (DD) was calculated (Sreeram 2009) [26].

Dal Recovery (D.R.)

$$\mathrm{DR}\ (\%) = \frac{\mathrm{W1}-(\mathrm{W3}+\mathrm{Wh}+\mathrm{Wb})}{\mathrm{W1}} \times 100$$

Dehulling Index (D.I.)

$$\mathrm{DI} = \frac{(\mathrm{w2}+\mathrm{Wh})-(\mathrm{W3}-\mathrm{Wb})}{\mathrm{W1}}$$

Degree of Dehulling (D.D.)

$$\mathrm{DD}(\%) = \frac{\mathrm{W1}-\mathrm{W3}}{\mathrm{W1}} \times 100$$

Dehulling Efficiency (D.E.)

$$\mathrm{DE}(\%) = \left(1-\frac{\mathrm{Wu}}{\mathrm{W1}}\right) \times \frac{\mathrm{W2}}{(\mathrm{Wh}+\mathrm{W2}+\mathrm{Wb})} \times 100$$

Where,

W_1	= Initial weight of sample taken for dehulling, g
W_2	= Weight of dehulled grains, g (wt. of dehulled split + dehulled intact whole grain)
W_3	= Weight of undehulled grains, g (wt. of undehulled split + undehulled intact whole grain)
W_h	= Weight of hulls, g
W_b	= Weight of broken and powder, g
W_u	= Weight of undehulled intact grain, g

Result and Discussion

The result obtained with respect to dal recovery, dehulling efficiency, dehulling index and degree of dehulling on dehulling of black gram by the effectiveness of the emery roller of emery no 40. Show in table no. 1 at the speed of 1200 rpm gives the higher dal recovery and it was followed by the 1100 and 1000 rpm and less effect was found at the of 900 and 800 rpm it shows that as the speed of emery roller increase initially from 800 to 1200 rpm and after that it was decrease at 1300 rpm it was due to the low speed of emery roller was providing less friction between the revolving roller and the grain, which being not sufficient resulted in increased undehulled grains and the dal recovery was low. At higher roller speed, friction between revolving emery roller and grain was higher than required hence percent of broken and powder increased which resulted in less dal recovery. Similar trend was found in the emery no. 60 roller also. Show in table no.1

Table 1: Effect of abrasive emery rollers on the dehulling of black gram with the various outputs

Speed of emery roller, rpm	Emery no. 40 roller				Emery no.60 roller			
	Dal recovery, %	Dehulling efficiency, %	Dehulling index	Degree of dehulling, %	Dal recovery, %	Dehulling efficiency, %	Dehulling index	Degree of dehulling, %
800	73.58	83.74	0.85	93.29	64.65	63.47	0.64	63.47
900	73.17	81.61	0.83	92.78	70.94	71.9	0.75	71.9
1000	74.71	75.63	0.86	95.04	67.63	74.09	0.75	74.09
1100	74.76	87.09	0.88	95.35	71.26	74.48	0.76	74.48
1200	75.69	87.05	0.87	95.03	72.71	80.8	0.84	80.8
1300	67.22	81.99	0.83	92.88	69.04	76.73	0.8	76.73

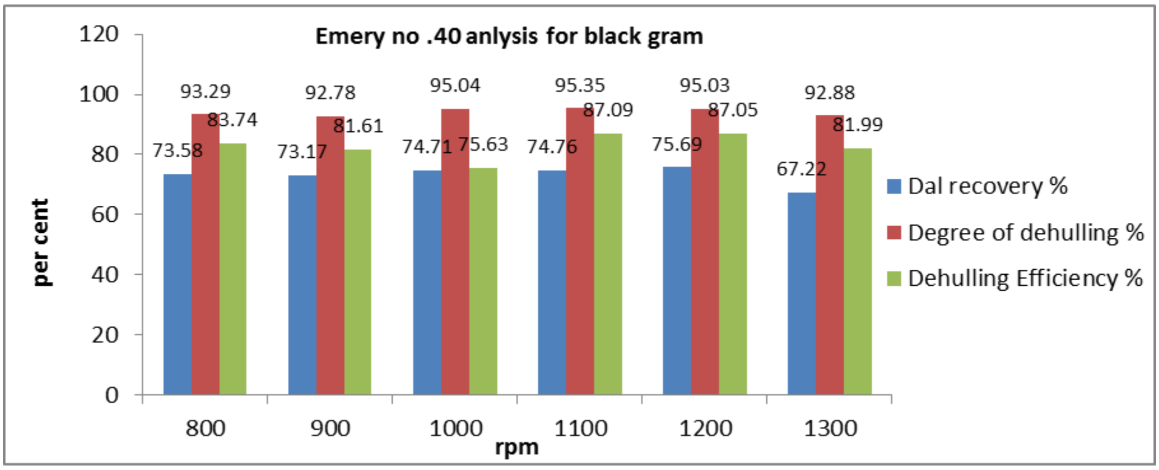

Fig 1: Effect abrasive (40 no. emery roller) roller using various speeds on dehulling of black gram

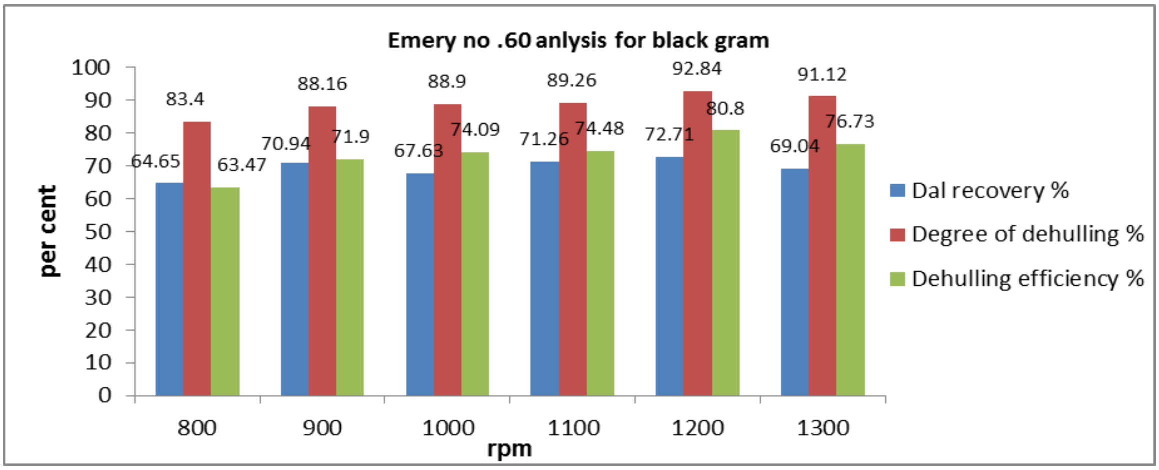

Fig 2: Effect abrasive (60 no. emery roller) roller using various speeds on dehulling of black gram

The graphical representation of the emery roller no. 40 and 60 in fig 1 and fig. 2 shows that the effect of emery roller on the dehulling of black gram. The figures shows that the emery roller 40 was found superior and gives the higher dal recovery was 75.69 percent at the speed of 1200 rpm and for the emery no.60 roller it was found to be 72.71 percent, this was found due to the impact and shearing force produce by the emery roller at the dehulling of black gram.

Dehulling efficiency, dehulling index and degree of dehulling for emery roller no. 40 and emery roller no.60 was found to be 87.05, 0.87 and 95.03 and 80.08, 0.84 and 80.8 respectively.

Conclusion: On the basis of the experimental result it show that the abrasive emery roller gives the maximum dal recovery, dehulling efficiency, dehulling index and degree of dehulling at 1200 rpm was found to be 75.67%, 87%, 0.87 and 95.03% respectively.

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