An approach on development of abrasive wheel hulling for Andhra pigeon pea

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Abstract- *This paper illustrate the optimization and use of new type of abrasive wheel hulling of Andhra pigeon pea, which also would be used for the purpose of seed decorticating and pulse making. Presently Pigeon pea mills are operating on very large scale and not able to fulfill the demand of Pigeon pea for manufacturing Pigeon pea (dal) needed for rural people. Conventional processes that are being previously practiced have a many factors which reduced the efficiency of the processes. The horizontal wheel arrangement gives maximum contact area for dehulling. Farmers currently sell their product in raw form, which produce is passed through a network of intermediaries that includes several layers of traders, processing mills, and wholesalers/retailers. Farmers are systematically exploited in this process due to asymmetries in information and inefficiencies in this chain. Ultimately, the farmer receives less than 1/3 of the retail price for processed dals. It is widely agreed that "poor market linkages", "weak infrastructure", and "many layers of intermediaries" hinder the growth of India's countryside, wherein over 2/3rd of the population lives. Abject poverty is unfortunately the norm, not the exception, for the majority of Rural Indians. The creation of a small-scale dal mill and surrounding procurement & marketing capabilities would allow farmers to engage in value addition and thereby receive more equitable returns for their hard work. Beneficiaries could participate in the venture and stand to see a 15-50% improvement in incomes. All above objectives will help us to increase the efficiency of the machine. We are going to optimize this machine considering these objectives & design this mechanism with introduction of motor as prime mover. This will make it simple in construction & use for agriculture purpose with minimum cost.*

Keywords- hulling, decorticating, roughness.

I. INTRODUCTION

Now a day, it is a need of an hour to improve the farm machinery, so the government is also now interested in the research and development of agriculture equipments. Our proposed machine is simple in construction and easy to operate and maintain. it consists of horizontal grinding wheel which is covered with emery coating, surrounded by a drum through which the husk is discharged. The shelled pulses will pass through a conical hopper at bottom, below which they are collected. It will run on electric motor. Arrangement will be made for collection of de husked and split pulses, undehusked and split pulses, undehusked pulses and broken pulses. This proposed machine will offer dust free operation, does not cause pollution, retains proteins, natural shine etc. considering the above importance the optimization of abrasive wheel hulling of Andhra Pigeon pea mill is our aim. As far as proposed machine is concerned the machine must have the ability to decorticate Pigeon pea and make its pulses. Pigeon pea is one of the major factors in vidarbha's economical aspect. As Pigeon pea is principle source of proteins and is integral part of Indian diet. At the same time, pulses occupying a premier position next only to cereals as the daily food item in India. Conservation of pulses can be done mainly through the development of superior milling procedure and equipment. Dry whole seeds of pulses possess a fibrous seed coat. The seed coat is often indigestible; therefore pulses are mainly consumed after dehulling to improve their palatability and taste. The Andhra Tur as named by the merchants has two fold impact, on the farmers side they had given lesser prices (nearly Rs. 1000 less per quintal) and the reason behind this is said to be the hulling potential as said in local language 'Utara' (i,e, the percentage of whole grain dal in hulled dal) is less ac compared to the other variety of Pigeon pea. Therefore overall productivity is less. Our aim in this proposed research is to find out the optimum conditions so as to increases the productivity of this variety of Pigeon pea. So ultimately the benefit would the higher productivity and higher remuneration to the local farmers for their crop.

II. LITERATURE REVIEW

O. ODUMA, P.O. FEMI, M.E IGBOKE [1] in his research paper "Assessment of Mechanical Properties of Pigeon Pea under compressive loading " studied the Mechanical properties of pigeon pea such as rupture forces, deformation, bio-yield forces, toughness, stiffness and modulus of deformability along side with some physical properties such as size, volume and surface area relevant to the development of processing and handling devices for pigeon pea were determined at three moisture content levels of

13.3%, 35.5% and 45.5% (w.b). The four varieties of pigeon pea studied include: flavus, bicolor, amarino and hunt. The compressive force to initiate rupture was greatest for flavus with the largest size followed by bicolor, hunt and least with amarino at all moisture content levels. The compressive breaking force decreases with an increase in moisture content and the corresponding deformation increase with an increase in moisture content. The same trend also applies for rupture forces, toughness, stiffness modulus, bio-yield forces and modulus of deformability. It follows therefore that the mechanical properties of the peas depend much on their moisture content levels. This research work will aid the engineers in designing the machine which can be used for harvesting and post-harvesting operations of pigeon pea.

SAGAR H. BAGADE1, PROF. S. R. IKHAR, DR. A. V. VANALKAR [2] in his research paper "Design, fabrication and Performance Evaluation of Polisher Machine of Mini Dal Mill" studied the paper describes the detail information of design procedure of polisher machine. Pictorial views of fabricated machine are given. The processed dal sample is tested for reflectivity. Schematic of test apparatus is given. Apparatus consist of LDR, which detects incoming light in the form of resistance. Three Dal samples are tested. Surface of Polished Dal samples found more reflective than unpolished Dal sample. Decrease in resistance indicates increase in intensity of light striking LDR (LIGHT DEPENDENT RESISTOR i.e. Photo-Conductive cell). it indicates that grains samples of Pigeon pea processed through Polisher Machine have better shine. From above study, results shown that there is improvement in the textur of Pigeon pea.

D. RAMASAMY & PRASOON VERMA [3] in his research paper "Comparative Study on Abrasive Dehusking of Pigeonpea at Elevated Moisture" studied was conducted to investigate the effect of moisture content, i.e., 10, 15, 20 and 25 (%, d.b.) on dehulling efficiency and dal recovery of pigeonpea. The milling of pretreated pigeonpea was done on abrasive dehuller and CIAE dal mill. The milling products were fractionated into unhusked whole grain, dehusked whole grain, unhusked dal, dehusked dal, broken and powder. The results were analyzed to find out the best level of moisture content for obtaining maximum percentage of finished product, dal recovery and highest hulling efficiency. The maximum dal recovery and hulling efficiency were obtained at 10% moisture content of pigeonpea grain and milled by using abrasive dehuller.

TANNIN SORGHUM, M. A. MWASARU, R. D. REICHERT, S. Z. MUKURU[4] in his research paper "factors affecting the abrasive dehulling efficiency of high" studied the High-tannin sorghum gives low yields when the grain is abrasively dehulled. Consequently, the factors affecting dehulling performance of this grain were investigated with a small-sample dehuller, the Tangential Abrasive Dehulling Device. Ten grinding wheels, which varied in grit size, grade, structure, and surface finish, were specially manufactured and tested on three soft-endosperm, high-tannin sorghum cultivars. Flourextraction (tannin), defined as 100 minus the required percent kernel removed to reduce the tannin content to 0.5%, ranged from 19 to 91%. All cultivars could be dehulled at low throughputs with flour extraction (tannin) greater than 70% by using a grinding wheel with a low disk abrasive index; a low index was achieved by decreasing the grit size, by increasing the grade or the structure, or by using grinding wheels with a smooth surface finish. The independent effects of grain tannin content, hardness, and shape on dehulling performance were investigated by testing lines that varied widely in one variable but were similar in the other two. Flour extraction (tannin) was significantly correlated with tannin content ($r = -0.98$, $P < 0.01$), hardness ($r = 0.84$, $P<0.01$), and seed shape ($r = 0.74$, $P<0.05$). Development of harder, rounder grain with the minimum tannin content required to confer bird-resistance or other desirable agronomic characteristics is required before high throughput, commercial processing of high-tannin sorghum would be viable.

S PARASURAMAN, T RAJARETNAM [5] in his research paper "Agriculture, food security and nutrition in vidarbha: a household level analysis" studied the paper is based on an assessment of agricultural practices and livelihoods of people in Vidarbha, one of the most distressed regions in India. Using the data generated from a baseline survey on a sample of 6,990 households covering six districts, this paper attempts to assess the relationships between agriculture, food security and nutrition for children, adolescents and married women of reproductive age. The study indicates that (i) overall under-nutrition amongst children, adolescents and married women in the study area is substantial and it does not differ significantly between different socio-economic groups, (ii) higher the food crops production, lower are under-nutrition levels, and (iii) the public distribution system contributes significantly to the food security of poor families and it must be extended to include families above the poverty line as well.

P. G. CHENGAPPA [6] in his research paper "Emerging Trends in Agro-Processing in India" studied the Agricultural transformation through creation of forward and backward linkages with industry are a recently emerging phenomenon. Our farmers' efforts in using the Green revolution technologies are strengthening our food and income security, in addition to generating surplus production. While a part of the surplus production is stored in our buffer stocks,

the remaining portion is yet to attract the value addition chain, the key for agricultural growth in the context of liberalisation. Thus, the predicament of market glut leading to price depressing effect can be slightly overcome by creating value addition opportunities in the domestic and international markets. This reduces pressure on the Government through market intervention schemes to some extent. India is the world's second largest food producer and the growth potential of food industry is enormous considering the vast consumer population. In this note, the current status, emerging trends and the key issues related to agro processing are analyzed.

III. NEED FOR DEHULLING

Semi-arid regions in developing countries such as India, Africa, etc. For example, can only support the cultivation of cereals such as pigeon peas, sorghum, millet and maize. As a result, a significant percentage of the population in many parts in Maharashtra depend on pigeon pea for their daily meal. Other crops such as wheat and bajri contribute to the daily diets of population. Rural women have traditionally improved the organoleptic quality of foods prepared from cereals by processing the grains to remove the outer layers (the pcricarp and testa). The pericarp (bran) contains mainly fibre, whereas the testa contains anti-nutritional substances, such as polyphenols, which give a bitter taste to the grain and inhibit the digestion of protein from the grain . Phytic acid, which is present in the bran and germ of pigeon pea combines with mineral elements such as calcium, iron, sodium, zinc, and magnesium, to form insoluble compounds (phytates) thus making them unavailable for human nutrition . The presence of high concentration of c-glycosyl flaveres in undehulled pigeon pea changes test of food. Many of these various anti-nutritional factors can be substantially reduced by dehulling. Most producers and consumers of pigeon pea face a daily task of dehulling and pulverizing the grains manually before being able to prepare the daily meal. Traditionally, pigeon pea are dehulled (a) To remove the outer layers, which contain primarily fibre, the presence of which affects cooking quality and taste and texture of the product, and adds bulk to the daily meal. (b)and To remove sources of bitter taste (polyphenols or tannins) that are often found in the outer hull or in the testa layer immediately under it.(c)The average rural homemaker and her children will save substantial energy and time if they have access to machinery that can provide a convenient and inexpensive dehulling and grinding service.

IV. FEATURE OF DEHULLER'S PERFORMANCE

Laboratory and field studies indicate that the performance of abrasive disk dehullers depend on:

- Speed of rotation of the disks.
- Physical characteristics of the disk surface such as roughness and hardness.
- Number and diameter of disks in the barrel, reflecting the total surface area available for dehulling.
- Spacing between disks and their angle of inclination to the shaft.
- Distance between the end disks and the end plates of the barrel.
- Clearance between the periphery and the barrel.
- Presence or absence of aspiration during dehulling.
- Roughness of the inner surface of the barrel.
- The rate at which grains are fed into the dehuller in the continuous mode, and the quantity of grain in the dehuller in the batch mode.
- Residence or retention time of the grain in the dehuller.
- Physical characteristics of the grain being dehulled.

V. COST-EFFECTIVE ASPECTS

Tur is one of the major agricultural products in Vidharbha region. The selling price of tur is about Rs.3500/- per quintal from farmers to the traders. And the market price of pigeon pea increases due to cost incurred in its processing of converting from tur to dal . The selling price of pigeon pea after all processes is about Rs 7000/- per quintal. The traditional process which are used for hulling the tur are

- Use of traditional dal mill
- Floor mill
- Dal mill

The hand mill used for hulling dal is outdated now .Generally the floor mill are most popular means of decorticating and milling. The cost of milling on the floor mill is about Rs 250/- per quintal. But main thing is the efficiency of the floor mill is not more than 60%. It means nearly 40% of the product goes waste. Also a gap between the grinding wheel should be adjusted frequently for milling the dal . If the adjusted gap is more than the output will be not proper and if it's too narrow, seeds will be crushed. Another way of dal processing is the mini dal mill. They give the efficiency higher than the floor mill nearly 75%. But the cost of milling is about RS. 300/- per quintal. The efficiency about 75%. Even if the efficiency is larger but the initial investment for dal mill is RS.150000/- and it is not available in remote rural area so the people have to come to the town .This adds extra transportation cost in the price of pigeon pea .

VI. PROMOTION CHANNELS OF PIGEON PEA

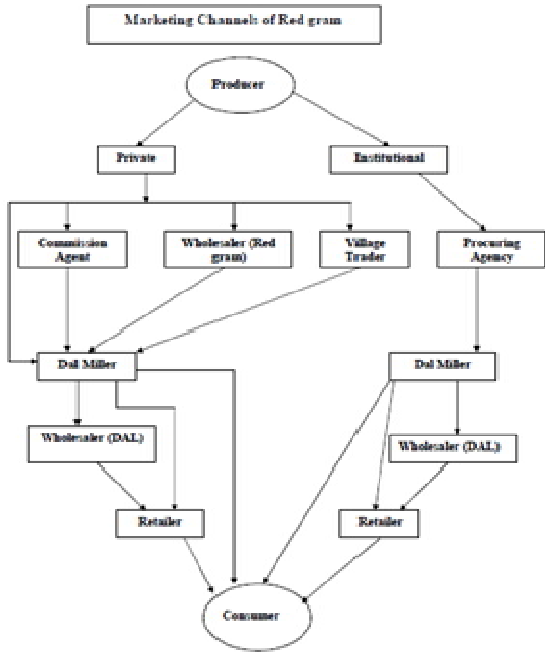

Figure 1. Marketing channels of Pigeon pea

VII. METHODOLOGY

From the review of traditional processes and machineries available in market for decorticating pigeon pea, we have a clear view of the plan of working that will lead the way towards the efficient working model.

Following are the point which covered in the plan of work:
1. Use of emery powder of different numbers.
2. Speed adjustment mechanism.
3. Gap adjustment mechanism.

(a) Use of emery:

The actual process of decorticating and hulling will be done mainly with the help of roughness of emery. After taking interview of several people who have actually worked on same project, we come to conclusion that the emery having grades 24 and 30 may give optimum result. So taking idea into consideration, we decided to produce two different wheels of grade 24 and 30 emery pasted on it and taking output of each wheel on varying speed and gap. An abrasive which is too hard or too coarse can remove too much material or leave undesired scratch marks. Excessive abrasion or the presence of scratches may:

VIII. CONCLUSIONS

Our paper is based on the overview on optimizing the dehulling process of Andhra pigeon pea. The reason behind selecting the Andhra pigeon pea for project is that, tur is one of the major agricultural products in our Vidarbha region. Our project will help farmers to relive from the problem of low efficiency dehulling from the traditional processes. Firstly we have studied about various traditional and existing methods for dehulling, we collected all relevant data about pigeon pea and dehulling processes. After studying various aspects of optimizing the dehulling process, we selected the few parameters such as: emery grade, gap between the wheels and speed of rotation of wheels. Experiments to be done on these parameters to find out the optimum settings to get desired output.

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