Review on Dal Making Technologies

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Abstract: The dal mill industry is one of the major agro processing industries of our country. From an annual production of 14.5 million tonnes pulse in the country, 75% of these pulses are processed by dal mill. Due to various application of pulses in food industry the demand of dal is growing day by day, to meet this demand various changes are to be brought in their processing methods. The raw material i.e., whole pulses grown in the farmland and transported to processing mills and industrial units to make desired final product. Prior to industrialization, these raw grains used to conventionally process at house-hold levels or in cottage type units, mostly located in rural areas in the vicinity of farm lands. A low cost split pigeon pea making machine would help to reduce the product cost. In this project we have presented one such a low cost machine which can be useful to reduce process time, product cost and will improve product quality.

Keywords: Dal mill, milling technologies, pulse milling

1. Introduction

India is the largest producer of pulses around 14.5 million tons annually. Pulses commonly known as the dal in India are an important component of both the vegetarian as well as the non-vegetarian in India. Pulses consists one of the main source of protein in the Indian diet. It is an important component of food for diet in India. There are different varieties of pulses namely Chana, Mung. Masur, Urad and Tuvar dal the conversion of pulse grains into dal is done by the process of milling. Wherein dal is split into smaller sizes, rendering it convenient for cooking. This split pigeon pea making machine is simple in construction and easy to operate and maintain. It has been developed for dehusking and splitting of pigeon peas, is consist of horizontal tapered grinding stone is covered with emery coating surrounded by screen through which husk powder is discharged. The shelled dal pass through grinding stone on oscillating sieve unit where appropriate grinding of dal done. The vibratory sieves are provided with different size holes to match the requirements of the type of dal being processed. The removal of the outer layer of husk and splitting the grain into two equal halves is known as milling of pulses. Basic processes in dal milling are grading, de husking, splitting and separation. Major variation is involved with pre milling treatments. The various advantages of these split pigeon pea making machine are:

- Value addition of the product
- Cost of transportation saved
- Additional income through sale of seed coats as cattle feed
- Improved yield of ‘dal due to use of improved milling technology
- Easier operation & less maintenance cost construction

2. Literature Review

1. Yogesh Yugal, Kishore Biyani, “Technological Advancement In Pulseindustry” International Journal Of Pure And Applied Research In Engineering And Technology, 2016; Volume 5 (2): 90-102. The aim of this study is that it provides energy researcher’s insight into solar still design for clean water production and thus, it promotes commercialization of this product in rural development


3. This paper illustrate the optimization and use of new type of abrasive wheel hulling of Andhra toor Dal, which also would be used for the purpose of seed decorticating and pulse making. Presently Toor Dal mills are operating on very large scale and not able to fulfill the demand of Toor Dal for manufacturing Toor Dal (dal) needed for rural people. Conventional processes that are being previously practiced have a many factors which reduced the efficiency of the processes.

4. D. Ramasamy & Prasoon Verma, "Comparative Study On Abrasive Dehusking Of Pigeonpea At Elevated Moisture" International Journal of Agricultural Science and Research (IJASR) ISSN(P): 2250-0057; ISSN(E): 2321-0087 Vol. 5, Issue 3, Jun 2015, 133-138 TIPRC Pvt. Ltd. A study 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 pigeon pea. The

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milling of pre-treated pigeon pea 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 analysed 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 pigeon pea grain and milled by using abrasive dehuller.

5. Vijay K. Singh, “Testing and Evaluation Of Cftri Dal Mill For Pigeonpea” International Journal of Agricultural Engineering, Volume 10, Issue 2, October 2017, 239-245. This study covers the performance study of CFTRI dal mill using UPAS-120 variety of pigeonpea as untreated and treated grains. The machine performance was carried out in term of maximum grains input and output capacity, dehusking efficiency, milling efficiency, dal recovery, quality index. In dry milling method, it was found that the maximum grains input and output capacity were 83.77 kg/h and 54.86 kg/h, respectively. The machine dehusking efficiency, milling efficiency, dal recovery, quality index, were 98.97%, 89.31%, 75.21%, 89.34%, respectively while the pearled grains, broken, powder, husk and unhedhusked grains were 4.35%, 2.90%, 5.68% 16.20, and 0.03%, respectively.

6. Vishal R. Parate, Mohammed I. Talib, “Characterization Of Tur Dal (Cajanus Cajan) Husk Carbon And Its Kinetics And Isotherm Study For Removing Cu (II) Ions” IOSR Journal of Environmental Science, Toxicology and Food Technology (IOSR-JESTFT) e-ISSN: 2319-2402, p-ISSN: 2319-2399.Volume 9, Issue 4 Ver. III (Apr. 2015), PP 27-41. The present study was carried out with the aim to characterise the various physicochemical properties of Tur dal (Cajanus cajan) husk based metal adsorbent carbon and to model its metal adsorption behavior in removing copper ion (II) from aqueous solution using kinetics (pseudo-first and pseudo second order) and isotherm (Langmuir, Freundlich and Temkin) models for selecting appropriate operating conditions for the full scale batch process. The metal adsorbent carbon (Ad1) was obtained from Tur dal husk simply by their carbonization at 500°C in air tight container for 1 hr. The obtained adsorbent was characterized for various physicochemical parameters using standards methods of analysis and instruments (Surface Area Analyser, CHNS Elemental Analyzer, and Fourier Transformed Infra-red).

7. Audu, A. Oloso and B. Umar. “Development Of A Concentric Cylinder Locust Bean Dehuller”. Agricultural Engineering International: the CIGR Journal of Scientific Research and Development. Manuscript PM 04 003. Vol. VI. August, 2004. A locust bean dehuller was developed so as to reduce the amount of time and labour required in the traditional manual dehulling of African locust bean (Parkia biglobosa) seeds, which are processed into a food condiment and flavouring agent that is popular in many African countries. The dehuller principally consists of two concentric cylinders, a power transmission shaft and a prime mover. The space between the two cylinders constitutes the dehulling chamber. After design and construction, the dehuller was evaluated based on three parameters, namely moisture content of beans, length of the dehulling head and the speed of rotation of the inner cylinder.

8. Vishal.R.Parate, Mohammed.I.Talib “Study Of Metal Adsorbent Prepared From Tur Dal (Cajanus Cajan) Husk: A Value Addition To Agro-Waste” IOSR Journal of Environmental Science, Toxicology and Food Technology (IOSR-JESTFT) e-ISSN: 2319-2402, p-ISSN: 2319-2399.Volume 8, Issue 9 Ver. III (Sep. 2014), PP 43-54. The aim of the present investigation was to develop metal adsorbent from agro-waste (husk) of tur dal (Cajanus cajan) for their value addition and to improve the effectiveness of developed adsorbent by optimizing the conditions of adsorption for complete removal of Cu ions from its 50 ml, 50 ppm solution. The washed and dried tur dal husk was carbonized in air tight container at 500 0C for 1 hr. to get its carbon form possessing adsorption property. The physicochemical characterization of prepared adsorbent was done for yield, bulk density, conductivity, particle size, moisture, ash, water soluble content, pH, calorific value, trace elements, crystal nature and structural morphology.


10. Saniya N. Lalani, Harsh M. Hirani, Abhishek O. Gill, M.S. Altamash , “Study Of Price Trends Of Arhar (Tur) Dal With Special Reference To Akola District Markets” 2019 JETIR February 2019, Volume 6, Issue 2 (ISSN- 2349-5162). The Arhar (Tur) Dal is the staple food in India for different cuisines and India is considered one of top exporters in world. The commodity price defines the consumption of Arhar in India. In last five years the prices of Arhar had shown tremendous changes it soared to highest as well as fallen to lowest. This study had made an attempt to analyse these trends as we have considered last five years from 2014 to 2018. The year 2015 has shown highest price as compared to rest years.

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solar production and thus, it promotes commercialization of this product in rural development.

12. R. W. Patil 1 , A. B.Tupkar 2 & Dr. S. V. Deshmukh, "Optimization Of Abrasive Wheel Hulling For Andhra Toor Dal " International Journal of Latest Trends in Engineering and Technology Vol.(9)Issue(3), pp.1 701 7 5 DOI: http://dx.doi.org/10.21172/1.93.29 eISSN:2278621X". This paper illustrate the optimization and use of new type of abrasive wheel hulling of Andhra toor Dal, which also would be used for the purpose of seed dehulling and pulse making. Presently Toor Dal mills are operating on very large scale and not able to fulfill the demand of Toor Dal for manufacturing Toor Dal (dal) needed for rural people. Conventional processes that are being previously practiced have a many factors which reduced the efficiency of the processes.

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paper describes the detail information of design procedure of polisher machine. Pictorial views of fabricated machine is 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.

19. Saniya N. Lalani, Harsh M. Hirani, Abhishek O. Gill, M.S. Altamash. “Study Of Price Trends Of Arhar (Tur) Dal With Special Reference To Akola District Markets” 2019 JETIR February 2019, Volume 6, Issue 2 (ISSN-2349-5162). The Arhar (Tur) Dal is the staple food in India for different cuisines and India is considered one of top exporters in world. The commodity price defines the consumption of Arhar in India. In last five years the prices of Arhar had shown tremendous changes it soared to highest as well as fallen to lowest. This study had made an attempt to analyse these trends as we have considered last five years from 2014 to 2018. The year 2015 has shown highest price as compared to rest years.

3. Project Methodology
1. Review on the previously published work on pulse milling technology, Dal mills, pulse milling methods, dehusking.
2. Identification of critical factors by study of current scenario of research.
3. Define the problem on the basis of literature review & current scenario.
4. Modify current combinations according to data analysis.
5. Prepare the virtual model.
6. Implement modification.
7. Define process parameters for experimentation.
8. Design of experimentation of operations & selection of the factors and their levels.
9. Conduction of experiments.
11. Analysis of data which is measured in previous step conclusion from analyzed data
12. Result & Conclusion

4. Problem Statement
1. Labour shortage and high labour cost:- Labour is one of the most important components out of four factors of agriculture production (Land, labour, capital and knowledge). As a country moves from underdeveloped, to developing and to a developed country, labour starts moving from agriculture sector as opportunities increases in high productivity sectors. In India, a similar trend has been seen.
2. Narrow market available as farmers sell raw material: Selling of any agricultural produce depends on couple of factors like the demand of the product at that time, availability of storage etc. The products may be sold directly in the market or it may be stored locally for the time being. Moreover, it may be sold as it is gathered from the field or it may be cleaned, graded and processed by the farmer or the merchant of the village. Sometime processing is done because consumers want it, or sometimes to conserve the quality of that product.
3. Brokerage cost, Transformation cost, loading and unloading cost:- Brokers are villagers that live in the same area as the farmers and handle jobs in their immediate or nearest area. One broker will work under one or two service providers, depending on the service offered. The broker’s role in this system includes acting as coordinator, communicator, manager, supervisor and so on to the farming community. A brokerage fee is a fee charged by a broker to execute transactions or provide specialized services. Brokers charge brokerage fees for services such as purchases, sales, consultations, negotiations, and delivery.
4. Existing pod separation system are time consuming and expensive:- The demand of dal is growing day by day hence to meet this demand processing methods has been changed. Various conventional methods are adopted for milling and many machines are available but they are very huge and space consuming. For subsistence farmers cost of milling is unaffordable. A low cost pigeon pea making machine would help to reduce the cost.

5. Objectives
Objectives of the project are as follows:-
1. Identify the critical factors in tur dal making process.
2. Design and develop the low cost tur dal separation machine.
3. To develop system for easy dehusking and splitting of pigeon pea.
4. To avoid number of operation and time lap for dal making.
5. To improve farmers income by value addition to their crop at their place.

6. Dal Making Process

It has already been said that the milling process varies from mill to mill and region to region and no standard or common process is in practice. The sequence of operations like pre-
milling, conditioning, dehusking, and splitting is normally common. Large variation exists in the steps followed in milling but basic unit operations remain the same.

1) Milling process
   Essentially milling process involves cleaning, grading, pitting, treatment milling and polishing operations. Usually milling processes are described for the toughest to mill pulse grains i.e., pigeonpea. The major steps involved in pulse milling are discussed below:

2) Cleaning and grading
   It involves removing dust, dirt, foreign material, off sized, immature and damaged grains and grading in two or more fractions to process separately.

3) Pitting
   Use of emery-coated roller is a common practice in commercial dal mills. The emery coating is used for abrasive or refractory action. Whole pulses are passed through abrasive roller machine for scratching of seed to facilitate the entry of oil/water in the grain during pre-milling treatment.

4) Pre-milling treatments
   The treatment is given for loosening of husk from cotyledons, which is attached through a gum layer is called pre-milling treatment. Mostly premilling treatments are developed for pigeonpea. Water soaking, oil and water application, mixing of sodium bicarbonate solution and thermal applications are commonly recommended and adopted pre-milling treatments. For commercial milling in large capacity dal mills, oil and water treatment is commonly adopted, whereas for household milling, water treatment is popularly used. Different methods are employed in different regions depending upon type of grain. This also varies from mill to mill. Pre-treatments can be broadly classified into i) wet treatment and ii) dry treatment.

5) Wet treatment
   In this method of treatment, soaking and drying are considered as effective technique to loosen the husk. This method has the advantage of facilitating dehusking and splitting the cotyledons, giving less breakage. This can be attributed to lower dehusking percentage of grains in water treatment process. However, it has the disadvantage of being weather dependent and labour intensive. Dal produced by this method cooks better but takes longer time to cook. Commonly adopted red earth treatment is considered as wet method. In this method, grains are thoroughly mixed with a paste of red earth after soaking in water for about 12 hours and heaping for about 16 hours. The grains are spread in thin layer in drying yards for 2–4 days. When dried, the red earth is removed by sieving and the grains are then milled on power operated stone or emery coated vertical chakki to yield dal.

6) Dry treatment
   Dry milling treatment is reported to produce dal that cooks faster, however, losses due to broken and powdering are high. In dry method, oil/water application followed by drying are important steps in processing of pulses. In this process, after cleaning and grading, grains are pitted and then mixed with about 1% oil (linseed), thoroughly and spread for sun drying in thin layer, for 2–3 days. At the end of drying, 2-5% of water is sprayed, mixed thoroughly and tempered for overnight. Tempered grains are dehusked in roller machines to give dehusked grains and dal.

7) Tempering
   Once the pre-milling treatment is given, conditioning is done to have uniformity of treatment throughout the grain mass. This process gives time for better penetration of oil/water beneath the seed coat to dissolve gums.

8) Drying
   In most of the mills in India, sun drying method is commonly practiced. Grains are spread in thin layer on pucca floor under the sun and stirred frequently with rake/feet for even drying. This operation makes process of dal milling a very lengthy requiring (2-3 days). In this case, sun-dried grains require more passes and consumes more energy. The drying time with the use of dryers ranges between 2-3 hrs, which results in tremendous time saving. Dryers are used in few mills that too in rainy seasons for drying of treated grains.

9) Dehusking and splitting
   Dal mills by and large use emery rollers for dehusking and splitting. In case of pigeonpea, more than 3 passes are required for complete milling. Other pulses take one or two passes in emery mill in order to achieve maximum milling. The physical, chemical and structural strength of grain coupled with the functional and mechanical characteristics of processing units jointly play an important role. Grain properties such as hardness, load deformation behaviour, shape, size density and variety of grain etc. have considerable effect on dal yield. The machine parameters such as roller speed, clearance, emery size etc. have vital role to play on dal recovery. As a result of milling, unhusked and dehusked whole grains, split cotyledons, broken, husk and powder are obtained. Whole grains are passed again for further dehusking and/or splitting after water treatment. Husk and powder produced during milling is generally separated with the help of aspirator and are used as cattle feed.

10) Polishing
   Polishing is done to increase consumers appeal and is a form of value addition, though not desirable. Dal is polished in different ways, such as nylon polish, oil/water polish, leather and makhmal polish. Generally polishing is done using soap
stone, oil or water. Polishing gives uniform look and shine to each grain.

11) CFTRI process

The technology developed at CFTRI overcomes the major problems of weather dependent nature of pulse milling industry and gives high daily yield in lesser time. The process is independent of weather conditions and eliminates the use of oil. The loosening of husk is achieved by heating of grains in hot air current followed by tempering. Removal of husk and splitting of grains is achieved by improved processing machines. This conditioning technique through heat treatment and moisture adjustment of the cleaned, size-graded grains loosens the husk, while making it fragile and brittle besides hardening the kernels. The process involves two passes in a drier with 160 °C hot air, followed by tempering for 6 hours. The operation is continuous, replaces sun drying and carried out indoors. It is claimed that this method gives average yield of 80% dal. Many dal millers have not adopted this technique due to high electrical energy consumption, non-availability of sufficient and continuous supply of electricity, high cost of machinery, and non-utilization of traditional milling machinery. However this method has definite advantages like less requirement of manpower, no need of drying yard, no requirement of edible oil etc., which demands due considerations.

7. Production of Pulses at a Glance

Above statistics shows that the current statistics of Tur production in India 3.59 Million Tonne in 2019-20. 17.77 % average share of market last 3 years in pulses. Above statistics shows difference between Tur dal prices and Tur Prices [1]. The size of pulses economy of the world is 61.3 MMT. India is the largest pulse producing country with (22-25) % i.e. (13.50-15.32) MMT of the world production is concentrated in India. But as India has a large vegetarian population, which largely dependent upon pulses, wheat and milk as its major source of protein, the size of consumption of pulses in India is around (16-18) MMT, in order to meet such demand, India depends upon import of pulses to the extent of (3-4) MMT. Splitting of pulses is done in pulse processing. Dal mill industry is one of the major agro processing industries in India. Out of the total production of 13.50 MMT of pulse in the country, 75% is processed by these Dal mills. This has put India in an advantageous position, by developing its niche in its processing. As a result, Indian processors have been able to enhance their output efficiency, reduce wastage with good quality of output. [6] It is observed that traditional Tur Dal machines takes more floor space area for the splitting of grains also the rate is less. The power consumption in this process is more and the output as compared to the power and size is less and it also becomes unaffordable for various farmers. So to overcome these problems, we are designing a compact and affordable pulse milling machine. It provides a higher rate of outcome as compared to the traditional milling machines at low power consumption rate. It also provides an additional source of income for the farmers which will help them for their wellbeing.
8. Conclusion

This paper under look at a review based study on Dal Making Technologies in terms of its background, originality current status and research. This machine will help farmers in extraction of tur dal from pigeon pea at low cost and less time, which will eventually results in increase in their income by directly selling dal in the market in place of tur beans.

References