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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
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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, broaken, powder, husk and undehusked grains were 4.35%, 2.90%, 5.68% 16.20, and 0.03%, respectively.
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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.
10. Measurement of response parameters by using respective measuring devices.
11. Analysis of data which is measured in previous step conclusion from analyzed data
12. Result & Conclusion

4. Problem Statement

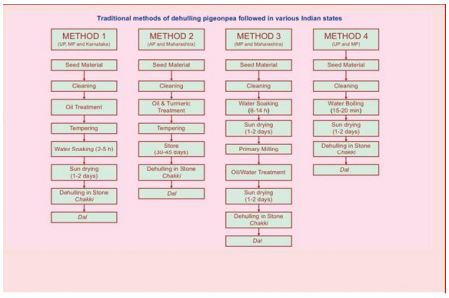
1. Labour shortage and high labour cost:- Labour is one of the most important components out of four factors of agriculture production (Land, labour, capital and knowledge). As a country moves from underdeveloped, to developing and to a developed country, labour starts moving from agriculture sector 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 treatment, 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 involve in pulse milling are discussed below:

2) Cleaning and grading

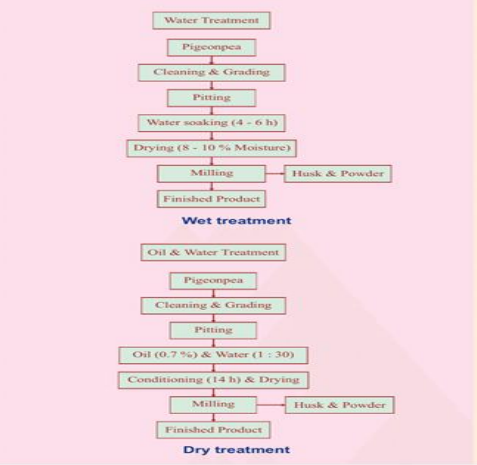
It involves removing dust, dirt, foreign material, off sized, immature and damaged grains and grading in two or more fractions to process separately.

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 bi-carbonate 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 deshusking 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

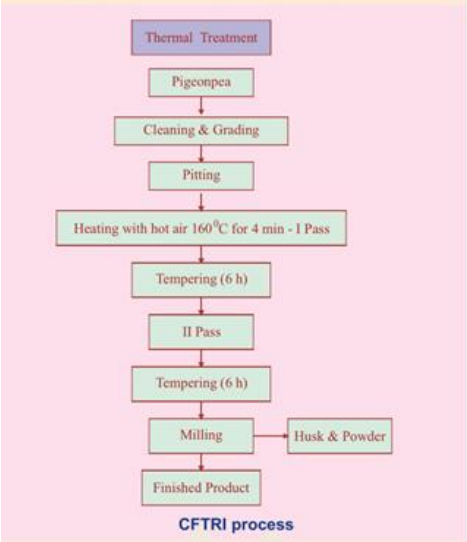
Dal mills by and large use emery rollers for dehusking and splitting. In case of pigeonpea, more than 3 passes are required for complete milling. Other pulses take one or two passes in emery mill in order to achieve maximum milling. The physical, chemical and structural strength of grain coupled with 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 dalyield 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.

Flat pulse

	Consumption (lakh tonnes)	CPI Inflation (per cent)*
2013-14	185.91	4.57
2014-15	199.02	7.91
2015-16	195.64	31.67
2016-17	186.90	10.93
2017-18	224.95	-20.83
2018-19	220.99	-8.20
2019-20	207.43**	8.70***

*Average year-on-year; **Projected; ***Apr-Jan.
Source: IPGA, NSO.

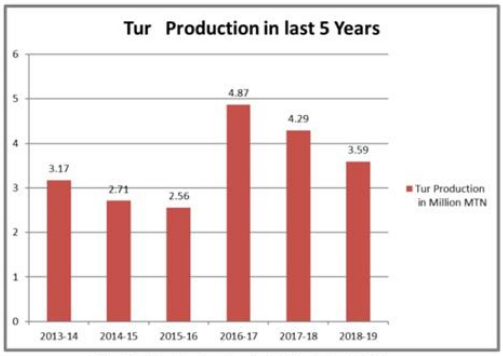


Fig. 2. Tur Production in India in last 5 Years (Source: www.agricoop.gov.in)

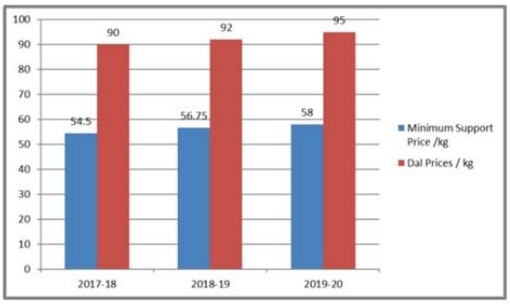


Fig. 3. Comparison between Minimum support price and Average Dal Prices in India (Source: www.agricoop.gov.in)

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.

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