THE ENZYMATIC DEHUSKING OF GRAINS

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ABSTRACT

Dehusking is basically the removal of husk from the grain using mechanical force, here; we used enzyme treatments. In the present study we carried out the effect of enzymes on Chickpea grain to increase the percentage of yield. Moisture content of the seed plays a very vital role in dehusking. Generally, the initial moisture of seeds ranges from 8-10%L, Moisture of the grains were determined by using Indosaw MM and Sartorius MM equiptments. The percentage of pitting varies from 30 to 90%. The amount of water to be added to the grains was calculated based on the initial moisture content and final moisture required in the gain after resting. The scale up trials were done using mini dall mill with replicates to reduce the % of errors.

Keyword: *Enzymes, Moisture, Dehusking, Indosaw MM, protein analyser, Sartorius MM*

1. Introduction

The nutritional importance of food legumes as an economic source of proteins, carbohydrates, minerals and vitamins has been recognized throughout the world. It is more economical to consume grain legumes directly instead of converting them into animal proteins [1]. Legumes have been considered as leading candidates in protein supply to the malnourished areas of the world. The seeds contain 2 to 3 times more proteins than cereals. The combination of cereals and legumes provides a good balance of amino acids. Considerable resources and efforts have been diverted to improve grain yield, nutritional quality, storage and processing technology of grain legumes [3]. In this study the technique employed is Dehusking. For the lab scale trials, a small mechanical device was used to do the dehusking. The sample is then sorted into dehulled, unhulled and husk. Every month, the protein/ amino acid concentration of seeds is done using the LECO protein analyser. RVA test is done to determine the effect of enzyme on the pasting properties of seeds. Dehusking is a simple process for removal of husk from the grain by

mechanical process, which in this case is being assisted by various catalytic enzymes depending upon the chemical composition of the target grain. It is a processing technique usually used for preparation of dehulled splits of seeds. During this process, the seed is passed through milling machine so as to remove its husk.

1.1 Methods of Dehusking:

- Conventional method of mechanical dehulling
- Enzymatic dehulling in combination with mechanical process [7].

2. METHODS AND MATERIALS

2.1. COLLECTION OF SIX DIFFERENT TARGET GRAIN SAMPLES

The grains from different localities like Akola, Hubli, Chindwara, Yashwanthpur etc., were collected for this study.

2.2. MOISTURE CALCULATION OF SAMPLE

The moisture content of the seeds is measured using moisture meter, which is a device used to calculate moisture of solid grains/seeds and other substances. Generally, the moisture of seeds varies from one region to the other region due to enviornmental conditions. If the seeds come from a very hot, draught affected area their initial moisture might be low. The moisture of the seeds if low below moisture meter range, the seeds were crushed into fine powder in mortar pestle and put in the Sartorius moisture meter to measure the moisture of the sample on the initial *v/s* dry weight basis. The fine powder should be kept in a beaker and covered with paraffin immediately to minimise the erros.

2.3. PITTING RATE CALCULATION

Pitting is an abrasion/scar caused on the surface of the seeds using the large-scale dehuller. The pitting rate is directly proportional to the amount of water-enzyme stock absorbed by the seeds, so is a very important variable for dehusking. The pitted samples are only used for further sample preparation [5]. The pitting percentage varies from 30 to 90% in the mill. Higher pitting also generate high amount of dust and broken samples. Based on raw material each miller optimizes the pitting percentage.

2.4. PREPARATION OF ENZYME STOCK FOR SAMPLE TREATMENT

The enzyme stocks were prepared by using either liquid or granular enzymes by mixing the enzyme with required amount of water for conditioning of the grain was done using the constant magnetic stirrer [11]. The water is added slowly and the stocks are mixed thoroughly and covered with aluminium foil to avoid any further alterations in the stock.

The amount of water to be added to the grains was calculated based on the initial moisture content final moisture required in the gain after resting. Enzyme mixing with the grain was done either manually or mechanically [14].

2.5. INCUBATION OF SAMPLES

The samples were incubated at 30°C, over night for 15 hours in an incubator or hot air oven.

The samples were arranged on the trays in the incubator according to the order of mixing [8].

2.6. DRYING OF SAMPLES

Drying is one of the critical steps for dehusking which takes place a hot air oven/ incubator at 45°C. This step follows conditioning/ tempering of the samples.

The samples are dried in a series of sequence, control followed by enzyme treatments in increasing concentration. The trays are covered by white sheet, and named as per sample poured on them.

The drying time, taken by the sample ranges from a minimum of, 20- 40 mins. The drying time depends upon the initial moisture content of the sample, after tempering and over night incubation, and the area from where the seed were obtained. The moisture content of samples is measured after conditioning and incubation using the mechanical moisture meter and later the intermediate moistures are also taken until the final/ required moisture %L is attained.

The moisture content in the seeds were max 12% and minimum 10% [6]. The time taken by the seeds to dry up to this %L will depend upon the seeds type and its moisture content. After the required moisture is achieved, the samples are poured back taken for milling.

2.7. DEHUSKING FOR LAB SCALE TRIALS

Dehusking is basically the removal of husk from the grain using mechanical force, here; we used enzyme treatments as a plus in order to facilitate the dehusking process, make it less time consuming, more efficient and less laborious.
For the lab scale trials, a small mechanical device was used to do the dehusking. The dehusking device was placed on a plate with a ring attached to it [10]. The seeds were dehusked between two abrasive surfaces. The sample is then sorted into dehulled, unhulled and husk. The amount of sample taken is 10 gm; the weight of all three is recorded and checked for mass balance as well. A usual 10 runs per sample are sufficient to determine the dehusking yield per sample and comparisons can be done on the basis of standard deviation equation.

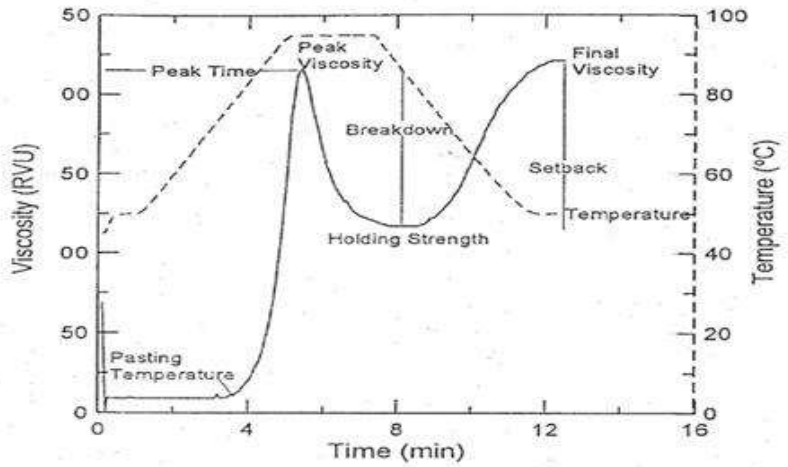
2.8. DEHUSKING FOR LARGE-SCALE TRIALS
Scale up trials done using mini mill with replicates to reduce the errors [12].

2.9. COOKING QUALITY
The samples are cooked in a pressure cooker, for about 30 mins. After cooking, the identity of samples is concealed, and the samples are placed in small Petri plates for their cooking analysis [13]. The objective of this test is to determine the effect of enzyme on cooking quality of the samples and the data for the sample is recorded and results are drawn.

2.10. RAPID VISCO ANALYZER (RVA)
This test is done to determine the effect of enzyme on the pasting properties of seeds. So, the seeds are grinded in a mixer and filtered through a 100-mesh size sieve, to obtain the fine powder. The moisture content of this powder is measured using the Sartorius moisture meter. The raid visco analyzer is attached to a computer which has a suitable program fed in it depending upon the type of seed and the moisture content of the powder. Once the moisture is entered, the amount of powder to be taken and water to be added to that powder is displayed on the computer screen. The RVA does the processing of the mixture and displays a graph of hold, peak and final viscosity of sample.

The same tests are conducted for various types of enzyme treatments and different concentrations. The best suitable enzyme and its best concentration will be chosen for the final process. And the same tests are carried for all the enzymes with respect to the market variety and control seeds.
Optimization of the mechanical device using control, i.e., water treated sample- Generally 2-3% of *p*H 8 RO water is added to the sample in order to simulate the industry condition[2]. The final moisture content of the sample should range between 10-12%. Hence, the water added may also depend upon the initial moisture content of the sample.
Screening of enzymes- once the mechanical device is optimized for lab scale trials, enzyme treated samples are used. Various classes of enzymes are used in different concentrations in order to determine which enzyme exhibits the highest yield dehulling. The enzyme stock used for treatment is usually a cocktail of active compounds with various side activities.
After successful lab trials with an enzyme showing reproducibility, it is run on a large scale. The results are then interpreted on the basis of dehulling yield, enzyme efficiency and mass balance. Sensory analysis of samples- every month the storage study of stored samples is done, in order to determine the storage stability of the sample after enzyme treatment. The tests include:

- RVA, that is, Rapid Visco Analyser test for pasting properties of sample.
- Sensory panel tests the quality of the sample, on the basis of colour, insect infestation, broken seeds, powder, texture and post cooking quality.



2.11. PROTEIN ANALYSIS

Every month, the protein/ amino acid concentration of seeds is done using the LECO protein analyser. The samples to be tested are crushed into fine powder and stored in small Appendorf tubes immediately [4]. The samples are weighed in the weighing balance on a special aluminium cone provided with the machine apparatus. The sample weight should range from 0.050 to 0.100 gm. The aluminium cones are then formed into small balls and kept in their special case and carried to the machine [9]. Once the sample is put in the machine, it takes a few minutes and displays a range of data; from nitrogen content to moisture content of the sample. This test is done to analyze the effect of enzyme on the protein concentration of the sample.

3. WATER CALCULATION

On dry basis calculation Moisture content of the seeds	**10% MC on wet basis / (100 - moisture content on wet basis)]*100**
If 100 g grains has 10% moisture on wet basis, them MC(db) equals	11.11111
% total solids equals	100 -11.11 = 88.89 g
88.89 g total solids = 10% moisture (wb) to attain above to 14% M.C(Wb) So amount of water=	88.89* (14-10)/10 35.556g of water to added to 88.89 gm to get 14% MC(Wb)
Moisture content of the pitting samples (i)	9.41
Moisture content of the pitting samples (ii)	6.66
Moisture content of the pitting samples (iii)	9.43
If 100 g grains has 9.41% moisture on wet basis, then MC(db)equals	10.38746
% total solids in 100 g equals	89.613
% total solids in 700 g equals	4480.63
So, amount of water required for 89.61 g seeds	3.059597
So, amount of water required	152.9798

for 627.29 g seeds	
Initial moisture content	9.41%
Water added	3.06ml/100g sample
Final moisture after overnight incubation	Control1- 12.6 Control2-13.1 Celluclast-1.5

3.1. The **basic protocol followed for everyday trial is:**

Suitable amount of chickpea sample were taken.

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Pit the sample (certain abrasion on the surface of grain which helps in absorption of moisture and enzyme solution.)

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Take initial moisture of sample and add *p*H 8 RO water accordingly for control, and test samples. Make the enzyme stock of different concentrations and add them to the pouch containing samples.

↓

Close the seal pouches and mix the samples well.

↓

Keep the samples for incubation for 15 hours, at 30 °C and check the moisture after incubation. If the moisture is 10-12%, start the dehulling; else dry the sample at 45 °C to attain the optimum moisture.
(Heat drying at 45°C is advisable, since it is an industrial practice)

4. CONCLUSIONS

Significant differences were observed between the conventional dehusking method and the enzyme assisted one. The total dehusking efficiency increased by 4-5% upon application of enzymes.

While the other benefits observed were:

- Enzyme treated target grains were found to utilize less time for dehusking as compared to water treated grains used in conventional milling.
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- The enzyme treated grains were found to be brighter in colour in comparison to untreated grains.
- Additionally there were changes observed in the amount of broken grains and powder formation i.e., after processing of the grains, the powder formation and number of broken grains reduced significantly which bolsters the overall reason for application of enzymes for dehusking.
- Also due to the application of enzymes, the protein quality or cooking quality were not affected.
- With all these reasons it can be concluded that, use of enzymes for dehusking improved the overall acceptability and quality of target grains.

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