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Research Article

Effects of Moisture Content on the Motor Efficiency of African Locust Bean (*Parkia biglobosa*) Depulping Machine

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Abstract

This paper examines the effects of wet and dry moisture content basis on the efficiency of an existing African Locust Bean depulping machine. The study was carried out in the Workshop of Agricultural Engineering, Rufus Giwa Polytechnic, Owo, Ondo State, Nigeria The operating speed of the machine was kept constant at 173 rpm while the moisture content on wet and dry basis of the ALB samples were 60%, 71%, 78% and 10%, 15% and 20% respectively. The weights of samples, the moisture content and depulping time were measured using an electronic weighing machine, a hygrometer and a stop-watch respectively. Each sample was depulp and the time for depulping was taking and the weight of the output taken as well. The efficiency of the depulping machine was thereafter calculated and analysed. The results showed that depulping efficiency increases as the moisture content of the African Locust Bean for both the wet and dry basis increases. The highest efficiency of the machine was 83% at moisture content of 78% wet basis, while the efficiency of the machine was 70% at a moisture content of 20% on dry basis. It is concluded that a linear relationship exists between the moisture content and the depulping efficiency at a constant speed of 730 rpm. These results are therefore recommended for the use of farmers and African Locust Bean processors.

Keywords: *African Locust Bean; Depulping; Machine; Moisture Content; Efficiency*

Abbreviation

ALB: African Locust Bean; CED: Comparism Experimental Design; D.E: Depulping Efficiency; T.P: Throughput; S.M.E: Specific Mechanical Energy; t: Time to Depulp; MC: Moisture Content; MCwb: Moisture Content Wet Basis; MCdb: Moisture Content Dry Basis

Introduction

ALB is a member of the *leguminoseae* family commonly grown in Africa and used basically as condiment and ingredients in soup and food preparation [1-3]. In Nigeria, especially in the Southern and Northern part of the country, ALB is called "iru" or "dawadawa" which serve as traditional seasoning for soup and stew [1]. The traditional extraction of ALB from its pod start with sun drying after harvesting, once the farmers through visual test see that the pods are dried enough to break by beaten, they put them inside a sack and beat them against hard object, usually, the wall or hard floor or big stones to break the pods giving access to the pulp enveloping the seed. The seeds with its pulp are thereafter put inside woven basket and placed inside a flowing river, as the water drenched the pulp, and with hands used in washing the pulps, the seeds are removed while the flowing water wash away the pulp [4]. The disadvantages of this process include provision of large volume of water, loss of seeds, time consumption and intensive labour [4,5]. Reference [6] developed a water / thermal for the separation of ALB seed from its pulp, but this method leaves the seed with dis-colouration due to excessive heat during steaming. This work was improve on by other researchers who observed that this method of ALB depulping only gives 50% efficiency and may not be efficient among peasant farmers who are cultivating the seeds in large scale [7]. Reference [8] now developed ALB thresher which operated by drying the ALB upon harvesting and introduction of dry air instead of heated steam to blow off the pulp from the seed. But this method did not give a clean separation of the seed from the pulp. We still have the pulp glued to the seeds and there is also discolouration of the seed due to the excessive exposure to heated air. In view of this problem, it becomes imperative to develop another mechanical way of removing ALB from its pulp without any damage and discolouration. This is what led us to develop an affordable, simple to operate and maintained ALB depulping machine.

Materials and Methods

Comparism Experimental Design (CED) was used in this study. The moisture content of ALB samples were on wet and dry basis. The study followed the procedure explained below.

Procedure

Six samples of ALB called the input variables were weighed as W_1 using electronic digital weighing balance on dry basis in respect to their different moisture contents as 10%, 15% and 20% measured with hygrometer. Three out of the six samples were each depulp at a constant machine speed of 730 rpm, The time taken, t, for each process to end was taken with a stopwatch, while the depulp ALB, called the output variables were also weighed as W_2. Cold water at temperature 21°C was added to the remaining three initial input variables to increase their moisture contents to 60%, 71% and 78% respectively. This represents the wet basis measured with hygrometer. The procedure for depulping the dry basis was repeated for these samples as well at constant machine speed of 730 rpm. There were three output variables each for the wet and dry basis now subjected to evaluation.

The effect of the moisture content on the machine depulping efficiency (D.E) was calculated according to (9) from the relationships in equations (1).

$$D.E. = \frac{W_2}{W_1} \times 100 \quad \text{---- (1)}$$

Where D.E. (%) is the depulping efficiency, W_1 (kg) is the initial weight of ALB before depulping and W_2 (kg) is the weight of the seed after depulping.

Results and Discussion

The results of the experiment is as presented and discussed below.

Effects of moisture content wet basis on the efficiency of depulping machine

It was observed in figure 1 that an increase in the moisture content of the ALB on a wet basis leads to an increase in the efficiency of the depulping machine. Specifically, the efficiency of the machine was 46% when the MCwb of ALB was 60%. When the MCwb was increased to 71%, the efficiency of the machine also increased to 76% and by the time the MCwb was again increased to 78%, the efficiency increased to 83%. This can be adduced to the hydrophilic nature of the pulp to absorb water and thereby softening its walls making it easy for easy depulping. As reported by (1) in respect to the work of other researchers in related crops like ALB have shown that an increase in the moisture content leads to an increase on the efficiency of the machine.

Effects of moisture content dry basis on the efficiency of depulping machine

As presented in figure 2 for dry basis moisture content of ALB, increase in the MCdb of ALB leads to an increase in the efficiency of the machine. Just like the wet basis, when the MCdb was 10%, the efficiency of the depulping machine was 46%. Whereas, at MCdb of 15%, the efficiency of the machine increased to 61%. A further increase of the MCdb to 20% leads to an increase in the efficiency of the depulping machine to 70%. This is in agreement in a related study by (4) while evaluating the performance of a melon depodding machine where the efficiency of the machine increases as the moisture content increases.

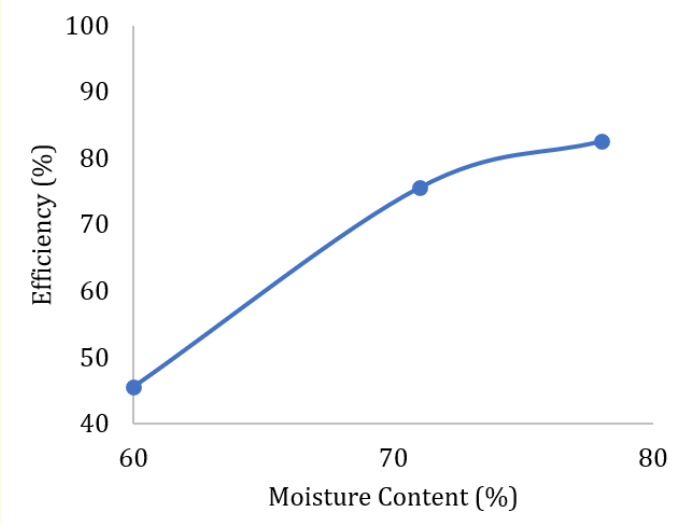


Figure 1: *Effect of moisture content (wet basis) on efficiency.*

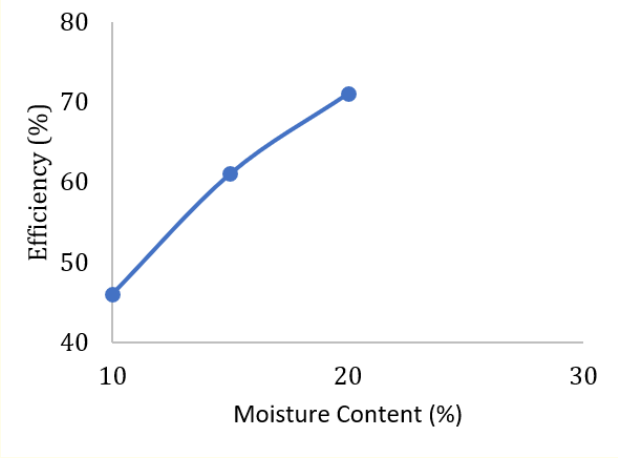


Figure 2: *Effect of moisture content (dry basis) on efficiency.*

Analysis of variance of the effects of MC on depulping machine efficiency

The Analysis of Variance (ANOVA) carried out at significant level of 0.05 on the effect of MCwb and MCdb on the efficiency of the depulping machine is presented in table 1. It is seen that the p-value is 0.023 which is lesser than 0,05; this implies that the moisture content of ALB at wet and dry basis has significant effects on the depulping machine efficiency.

Source of Variation	SS	Df	MS	F	P-value	F crit
Between Groups	9821.240833	1	9821.240833	7.188250549	0.023049503	4.964603
Within Groups	13662.90833	10	1366.290833			
Total	23484.14917	11				

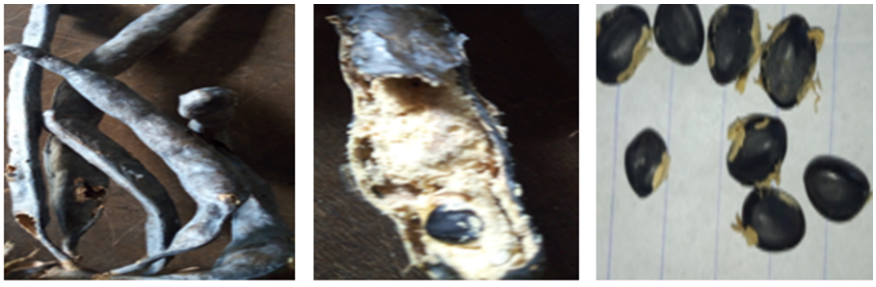
Table 1: *ANOVA-single factor test on effect of MCwb and MCdb on depulping machine efficiency.*

Conclusion

From this study, it is concluded that the moisture content of African Locust Bean (*Parkia biglobosa*) on wet and dry basis affects the efficiency of ALB depulping machine. It is concluded that the depulping machine efficiency increases with increase in the moisture content both on wet and dry basis at a constant machine speed of 730 rpm. The highest efficiency of the machine was 83% at a moisture content of 78% for the wet basis. While the efficiency of the machine was 70% at a moisture content of 20% on dry basis. There is a linear relationship between the moisture content of the ALB and the efficiency of the depulping machine. The results are recommended for peasant farmers and ALB processors.

Appendix

Pictures taken while carrying out the experiments and evaluation is shown below.



African Locust Bean Pod African Locust Bean Pulp African Locust Bean Seeds

African Locus Bean Depulping and Evaluation of Data Obtained

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