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Research article

Effectiveness of industrial rubber as roller material for rice processing machine

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Abstract

The purpose of this study was to evaluate the performance and effectiveness of a developed roller rice dehusking and destoning machine at the Department of Agricultural and Bioresources Engineering, Federal University of Agriculture, Abeokuta, Nigeria by using an industrial rubber as roller material to replace Teflon rollers. This study modified and evaluated the performance of the dehusking and destoning machine on four varieties of paddy: NERICA L-42, NERICA 2, FARO 55 and OFADA, dried at five different ranges of moisture content (wet basis): A (11.00–12.99%), B (13.00–14.99%), C (15.00–16.99%), D (17.00–18.99%) and E (19.00–20.99%). Analysis of variance of the two main factors for the four paddy varieties was used to obtain the optimum machine operational parameters. The optimum values obtained for the coefficient of dehulling (E_h), coefficient of wholeness (e_w), dehulling efficiency (e_h) and cleaning efficiency (CE) were 0.77, 0.88, 65.65% and 97%, respectively, which were better than for the Teflon rollers. The effects of moisture content on E_h, e_w, and e_h were significant ($p < 0.05$).

Introduction

The trend of milled rice consumption from 1960 to 2013 in Nigeria was used to forecast milled rice consumption in 2020 and was well over six million t (Tiamiyu et al., 2014). However, local rice production was just about 70% of annual demand (Food and Agricultural Organization, 2012). To bridge this gap between supply and demand, over 852 million USD was spent to import milled rice into the country (Agricultural Transformation Agenda, 2011). To meet this demand, national rice production will have to increase by 100% of the current production which then calls for improved production technologies among rice farmers (Tiamiyu et al., 2014).

In the past, various types of roller materials for rice dehusking and destoning have been developed in Nigeria to solve the problems associated with the manual processing of locally produced rice, particularly to remove pebbles, chaff and other impurities from the rice. However, these designs have their advantages and operational limitations, thus compelling Nigeria consumers to have greater preference for the imported milled rice which is of high quality. Adewumi et al. (2007) reported that there are three methods of dehusking used in Nigeria: the traditional or hand pounding method, the small milling processing method and the large-mill processing method.

Adisa in 1991/1992 at the Federal University of Technology, Minna, Nigeria began development of a roller rice dehusker using locally suitable materials to find an alternative source of power to drive the machine for local production (Adisa, 2013). Recently

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in 2010, a team of researchers took a step further to design and construct a dehusker with a destoner for rice processing at the Federal University of Agriculture, Abeokuta, Nigeria sponsored by the Institute of Food Security, Environmental, Rural and Research (IFSERAR) in the University (Adisa et al, 2017). In order to add value to local rice production, the machine has recently been subjected to a series of performance evaluations in search of suitable and effective local materials for fine tuning and possible patenting and mass production in Nigeria. The performance evaluation of the prototype rice dehusking and destoning machine using Teflon as rollers was carried out with four varieties of paddy; however, the performance results were not satisfactory (Adisa et al., 2016). In developing a new agricultural machine, refinement is a major stage to select and determine the best available local materials for machine production. Hence, the current study involved further research to determine the effectiveness of industrial rubber as roller material in place of the Teflon used in the earlier rice processing machine using local rice varieties at the Federal University of Agriculture, Abeokuta, Nigeria.

Materials and Methods

Equipment and research location

Modification and adjustment of machinery parts and performance evaluation were carried out at the College of Engineering, Federal University of Agriculture, Abeokuta, Nigeria. The four major units of the rice dehusking and destoning machine are: destoning, grain metering, dehusking, cleaning and final destoning.

Determination of shaft diameter of rollers

The torque on the shaft (T) was calculated using Equation 1:

$$T = \frac{P}{\omega} \quad (1)$$

where P is the power (3.75 KW), ω is the angular velocity (1440 rpm = 151 rad/s) and so T = 24.86 Nm.

The shaft diameter was determined using combined stress theory (Kruzt et al., 1984) and Equation 2:

$$d^3 = \frac{5.1}{\tau\text{max}} \sqrt{(K\text{m}M)^2 + (K\mathit{t}\text{T})^2} \quad (2)$$

where τ max is the maximum allowable stress of the shaft (6,000 psi = 41.379 × 10^6 N/m²), M is the maximum bending moment (65 Nm from force and bending moment calculation) and T is the torque on the shaft (measured in newton meters), Km and Kt are the shock loading factors of the shaft, d is the diameter of the shaft (in meters) where d = 0.025 m = 25 mm.

Selection of variety of paddy

Four paddy varieties (Nerica L-42, Nerica 2, Faro 55, Ofada) with samples each approximately 5 kg were collected from the African Rice Centre, International Institute for Tropical Agriculture (IITA), Ibadan, Nigeria.

Aerodynamic consideration

An aerodynamic mechanism in the destoning unit design and setting was considered in the calculation of the terminal velocities of the paddy varieties based on the geometric mean diameter as shown in Equations 3 and 4. The geometric mean diameter (D) was calculated using Equation 3:

$$D = \sqrt[3]{L \times B \times T} \quad (3)$$

where L is the length (m), B is the width and T is the thickness of the grain with all parameters measured in meters.

Terminal velocity

The terminal velocity (VT) was calculated using Equation 4:

$$V_T = 7\sqrt{Z \times \rho_P \times D} \quad (4)$$

where V_T is the terminal velocity (measured in meters per second), Z is the volume shape factor and for rice = 0.27 (Gorial and O'Callaghan, 1990), ρ_P is the particle density (in kilograms per cubic meter) which for rice is 1,370 kg/m³ (Gorial and O'Callaghan, 1990) and D is the geometric mean diameter (in millimeters).

Fig. 1 shows the isometric view of the rice dehusking and destoning machine, Fig. 2 provides the orthographic view of the machine and Fig. 3 shows the industrial rubber rollers that were used to replace the Teflon rollers.

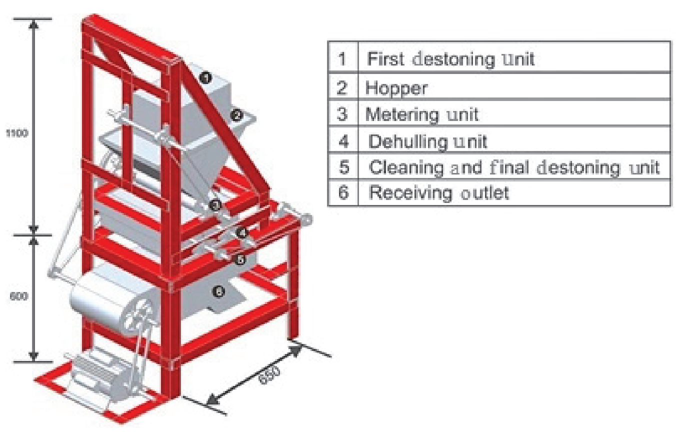

Fig. 1 Isometric view of the rice dehusking and destoning machine (All dimensions are in mm)

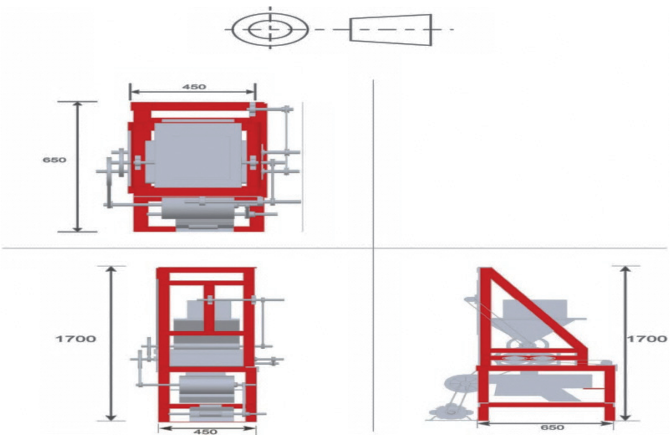

Fig. 2 Orthographic view of rice dehusking and destoning of prototype machine after modification and adjustment. (All dimensions are in mm)

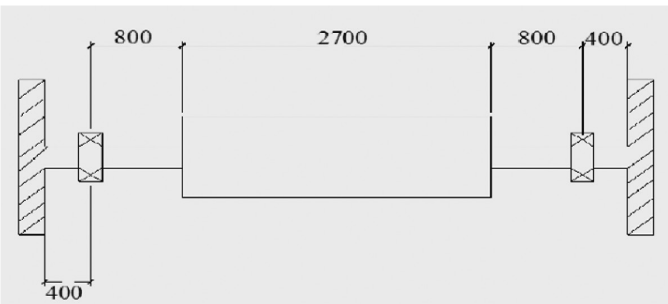

Fig. 3 Bearing and industrial rubber roller arrangement on the shaft (All dimensions are in mm)

Rice evaluation procedures

Several trial runs were conducted to obtain the right settings for the machine metering rate, effective roller gaps (based on average dimensions) and fan cleaning speeds (based on terminal velocity ranges) at the five different moisture contents for the four rice varieties. Approximately 30 kg of paddy rice was used for each varieties. Approximately 500 g of parboiled paddy samples at each moisture content were fed evenly by the metering unit into the first destoning unit of the machine where 30 kg of paddy was used. The destoner was driven at a reciprocating speed of 4 s/revolution which was timed using a stopwatch. The metering and dehusking speed were measured using a tachometer (Lutron DT-2234B phototype 0.1–5 revolutions per minute (5 rpm ≈ 999.9 rpm). The speed of one of the fixed rollers rotated at 1,398 rpm, about 30% faster than the adjustable roller speed (853 rpm). The metering and shaker speeds were 566 rpm and 257 rpm, respectively. The roller clearance was 1.50 mm for the Faro and Ofada varieties while 1.80 mm was used for the Nerica varieties. During each test run, three 200 g samples were weighed using an electronic balance (Amput electronic scale, sensitivity 0.01 g). A sample was randomly collected from the huller for analysis to determine the hulling efficiency. Samples of 100 g and 200 g were used for laboratory analysis and the other half (100 g) was used for reference purposes or for a possible second check in case of review. At the cleaning and final stage in the destoning unit, a large amount of air was blown from a radial fan in the blower unit which separated the dehulled samples into three items (chaff, hulled rice, stones). The blower had three outlets and separation was carried out using the terminal velocity equation according to Gorial and O'Callaghan (1990) as shown in Equation 4 to determine the speed and volume of the air blown by the fan. The velocity of air was measured using a digital air flow meter (DAFM3 CFM anemometer/pyschrometer; Texas Instruments) with an air velocity of 0.1 m/s resolution, and the relative humidity (RH) and temperature were also measured to 0.1 accuracy).

Moisture content determination of the paddy sample

The moisture content on a wet basis (MCwb) was determined by placing about 10 g of each sample in three replicates and heating in an electric oven at 130°C for 16 hr in accordance with National Cereals Research Institute (NCRI) and West Africa Rice Development Association (WARDA) (2007). This method is called the air-oven method and the final weights of the samples were measured after 16 hr. Thus, MWwb was calculated using Equation 5 (National Cereals Research Institute (NCRI) and West Africa Rice Development Association (WARDA), 2007):

$$\text{MCwb}(\%) = (M_o - M_i) / M_o \times 100 \quad (5)$$

where M_o is the initial mass of the sample and M_i is the mass of the dry test portion, with all measurements in grams.

Determination of experimental grain variety sizes and shapes

Twenty whole grains were randomly picked from the paddy samples and their physical dimensions (length, width, thickness) were determined using vernier calipers and a lens. The mean values of the dimensions were calculated using Equation 6 and classified based on the international standards (ISO 7301; International Organization for Standardization, 2002):

$$\text{Paddy shape } (P_s) = L / W \quad (6)$$

where L is the average length of paddy and W is the average width of paddy both measured in millimeters.

The length classifications after hulling and the grain shape based on the ISO classification were used to determine effective roller gap settings for each variety during the dehulling operation.

Coefficient of dehulling

Three 100 g samples from the huller output were separated manually into brown rice and unhulled paddy to determine the coefficient of hulling using Equation 7 (Philippines Agricultural Engineering Standard 215, 2004) as:

$$\text{Coefficient of dehulling } (e_h) = 1 - (W_u / W_s) \quad (7)$$

where e_h is the coefficient of hulling, Wu is the weight of unhulled paddy and Ws is the weight of the sample (a mixture of brown and unhulled paddy) with all weights measured in grams.

Coefficient of wholeness

Three 100 g samples of brown rice were drawn and separated into broken brown rice and whole brown rice. The coefficient of wholeness was determined from the mean weight of the components with at least 8/10 of the length of the whole grain in accordance with Philippines Agricultural Engineering Standard 215 (2004) and calculated using Equation 8:

Coefficient of wholeness (e_w) = W_w / W_T (8)

where W_w is the weight of the whole brown rice and W_T is the weight of the total brown rice hulled (whole and broken grain) with weights all measured in grams.

Dehulling efficiency

The dehulling efficiency was calculated using Equation 9 (Philippines Agricultural Engineering Standard 215, 2004):

Dehulling efficiency (E_h) = $e_h \times e_w \times 100$ (9)

where e_h is e_h is the dehulling efficiency and e_w is the coefficient of wholeness.

Determination of cleaning efficiency of the grain

The cleaning efficiency is the amount of rice grain free from foreign matter expressed as the total weight of the sample. Each 500 g dried sample variety was fed into the machine. The impurities and samples were collected at the huller outlets. The impurities were handpicked from each of the three samples and the clean grain was collected from the sub-samples and then analyzed. The weight of clean grain was recorded for each variety. Equation 10 was used to calculate cleaning efficiency:

Cleaning efficiency (CE%) = W_c / $W_s \times 100$ (10)

where CE is the cleaning efficiency (%), W_c is the weight of the clean rough rice sample and W_s is the weight of the paddy sample (mixture of brown rice, unhulled paddy and dockage) with all weights in grams.

Determination of broken rice and head rice

Three samples of 100 g paddy obtained at the huller receiving outlet were separated manually into whole brown and broken rice. The head rice is grain which has a size equal to or greater than 8/10 of the length of the whole grain (Philippines Agricultural Engineering Standard 215, 2004), while broken rice has grain less than 8/10 of the whole length.

The weights of the head and broken grain were weighed, with the mean of each component determined based on three sub-samples. Equations 11 and 12 were used to compute the percentages of broken rice and head rice, respectively:

Broken rice (BR%) = W_b / $W_T \times 100$ (11)

where Wb is the weight of broken brown rice in the sample WT is the weight of the total brown rice hulled (whole and broken) with all weights in grams.

Head rice (HR%) = W_w / $W_T \times 100$ (12)

where W_w is the weight of the whole brown rice and W_T is the weight of the total brown rice hulled (whole and broken grain) with weights all measured in grams.

Dehulling capacity

The dehulling capacity is the quantity of paddy that the huller can dehull per total hulling time. It was determined using Equation 13 by timing the input and output streams using two stop watches:

Dehulling capacity (H_c) = $H_o \times e_h$ / T_o (13)

where H_o is the total huller output (in kilograms), e_h is the dehulling efficiency and T_o is the operating time (in hours).

Experimental design

The experimental design of the machine involved four rice varieties (Nerica L-42, Nerica 2, Faro 55, all obtained from IITA, Ibadan, and the fourth variety, Ofada, was obtained from FUNAAB, Abeokuta), five levels of moisture content on a wet basis: A (11.00−12.99%), B (13.00−14.99%), C (15.00−16.99%), D (17.00−18.99 %) and E (19.00−20.99 %) all replicated in triplicate.

The analysis of variance (ANOVA) was set at the 5% level of significance ($p < 0.05$). The Excel software package (version 2010; Microsoft Corp.; Redmond, WA, USA) was used for the charts, graphs and tables related to the experimental data. The Minitab software package (Minitab v.16 and Microsoft excel 2010 version, USA) was used to run and interpret both the one-way and the two-way ANOVA results of the two factors in five groups of moisture content factorial of the paddy varieties.

Results and Discussion

Table 1 shows the calculated terminal velocity of the hulled paddy rice used for the blower speed air volume setting.

Table 1 Ranges of terminal velocity of hulled paddy varieties

S/N	Paddy variety	Terminal velocity (m/s)	Geometric mean diameter (m)
1	Nerica L-42	8.1	0.0036
2	Nerica 2	7.6	0.0032
3	Ofada	7.0	0.0027
4	Faro 55	7.1	0.0028

The moisture content had a significant effect on the coefficient of dehulling but the variety had no significant effect on the coefficient of dehulling (Table 2). The effect of moisture content on the coefficient of dehulling is illustrated in Fig.4 which shows that the dehusker maximum coefficient of dehulling was 0.77 for Nerica-42 at an MCwb of 11.00− 12.99% for group A while the minimum coefficient of dehulling was 0.44 for Ofada at an MCwb of 19.00−20.99% for group E. Generally, the coefficient of hulling decreased as the moisture content increased as a result of increased breakage. This agreed with the inverse relationship of Malik et al. (1980) who reported that rice breakages at the point of minimal breakage corresponded to that of maximum whole

The average dimensions of the studied parboiled paddy at 13% moisture content wet basis is shown in Table 3, where the Nerica L-42 and Nerica 2 varieties had grains with average lengths 7.10 mm and 6.80 mm, respectively, and average widths 2.60 mm and 2.43 mm, respectively. The length-to-width ratios of Nerica L-42 and Nerica 2 were 2.73 and 2.80, respectively, while their thickness ratios were 2.43 and 1.96, respectively. Faro 55 had grains with an average length

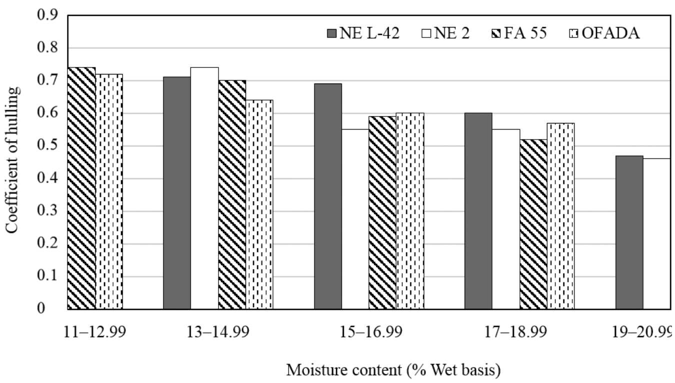

Fig. 4 Effect of moisture content on coefficient of dehulling, where rice varieties are NE L-42 = Nerica L-42, NE 2 = Nerica 2, FA 55 = Faro 55 and OFADA = Ofada

of 6.31 mm and width of 2.22 mm and a length-to-width ratio of 2.84 while the thickness was 1.58 mm. The Ofada variety had grains with an average length of 5.44 mm, an average width of 2.38 m and a length-to-width ratio of 2.29.

Table 3 shows the ANOVA mean performance parameters of the rubber roller dehuller with paddy variety. Table 4 shows that the moisture content had a significant effect on the coefficient of wholeness where groups A and B were more significant than groups C and D, while group E had the least effect. Moreover, paddy variety had no significant effect with the moisture content. The effect of the moisture content on the coefficient of wholeness is shown in Fig. 5 with the maximum coefficient of wholeness for the dehuller being 0.88 for Nerica L-42 at an MCwb of 13−14.99% (group B) while the least coefficient of wholeness was 0.55 for Ofada at an MCwb of 19.00−20.99% (group E).

It was observed that the moisture content had a significant effect with dehulling efficiency but the variety had no significant effect on the moisture content. The effect of the moisture content on the dehulling efficiency is illustrated in Fig. 6. The prototype dehuller maximum dehulling efficiency was 66% for Nerica 2 at an MCwb of 11−12.99% (group A) while the minimum dehulling efficiency was 24% for Ofada at an MCwb of 19.00−20.99%. The minimum hulling efficiency for Nerica 2 was 31% at an MCwb of 19−20.99% (group E). The overall minimum hulling efficiency was observed for group E as a result of increased thickness due to excessive moisture in the grains, which agreed with Reichert et al. (1979) who reported that the hulling efficiency was affected by the moisture content and machine parameters.

Table 2 Average dimensions of studied parboiled paddy at moisture content of 13% (wet basis)

Variety	Nerica L-42		Nerica 2		Faro 55		Ofada	
Type	Paddy	Hulled	Paddy	Hulled	Paddy	Hulled	Paddy	Hulled
Length (L, mm)	9.50	7.10	9.40	6.80	8.12	6.31	7.12	5.44
Width (W, mm)		3.70	3.51	2.43	2.34	2.19	3.40	2.38
Thickness (mm)	2.90	2.43	2.30	1.96	1.90	1.58	1.88	1.59
L-to-W ratio	2.56	2.73	2.68	3.80	3.47	2.88	2.09	2.29
Shape		Medium		Slender		Medium		Medium
Length classification		Long		Long		Medium		Short

Table 3 ANOVA mean performance parameters of the rubber roller dehuller on paddy.
NE L-42 = Nerica L-42; NE 2 = Nerica 2; FA 55 = Faro 55; OFADA = Ofada.
[a,b] = values in the same row with the same lowercase superscript are not significantly ($p < 0.05$) different.
efficiency was 82% for Ofada at an MCwb of 19.00-20.99% (group E). Fig. 7 shows the relationship between the moisture content and the cleaning efficiency.

Variety	NEL-42	NE 2	F 55	Ofada
Operating Time (min)	1.992[b]	1.982[b]	2.472[a]	1.922[b]
Coefficient of hulling	0.648[a]	0.612[a]	0.618[a]	0.5938[a]
Coefficient of wholeness	0.812[a]	0.768[a]	0.764[a]	0.71[a]
Hulling efficiency (%)	52.8[a]	47.8[a]	48.4[a]	43.2[a]
Dehulling Recovery (%)	62.8[a]	59.2[a]	57.4[a]	54.2[a]
Cleaning Efficiency (%)	95[a]	94.2[a]	89.8[b]	89.2[b]
Output capacity (kg/hr)	14.006[a]	13.678[a]	11.17[b]	14.532[a]
Hulling capacity (kg/hr)	9.024[a]	8.38[a]	6.952[a]	8.74[a]
Capacity Utilization (%)	92.6[a]	90[a]	92[a]	90.4[a]

Table 4 Performance evaluation of prototype rubber roller effectiveness at different moisture contents on paddy varieties

Description	A = MCwb of 11.00–12.99%				B = MCwb of 13.00–14.99%				C = MCwb of 15.00–16.99%				D = MCwb of 17.00–18.99%				E = MCwb of 19.00–20.99%			
Tested rice variety	NE L-42	NE 2	FA 55	OFADA	NE L-42	NE 2	F 55	OFADA	NE L-42	NE 2	F 55	OFADA	NE L-42	NE 2	F 55	OFADA	NE L-42	NE 2	F 55	OFADA
M (%)	11.80	11.97	12.77	12.63	13.67	13.70	13.83	13.40	15.77	15.77	15.73	15.20	17.40	17.13	17.40	17.63	19.50	19.43	19.30	19.50
Operating time (hr)	2.05	2.05	2.41	2.01	2.05	2.10	2.46	1.75	2.10	1.98	2.50	1.47	1.98	1.98	2.49	2.19	1.78	1.80	2.50	2.19
Coefficient of hulling	0.77	0.76	0.74	0.72	0.71	0.74	0.70	0.64	0.69	0.55	0.59	0.60	0.60	0.55	0.52	0.57	0.47	0.46	0.54	0.44
Coefficient of wholeness	0.84	0.86	0.86	0.85	0.88	0.80	0.81	0.82	0.85	0.75	0.76	0.75	0.77	0.75	0.72	0.58	0.72	0.68	0.67	0.55
Hulling efficiency (%)	64.00	66.00	64.00	61.00	62.00	60.00	57.00	53.00	58.00	41.00	47.00	45.00	46.00	41.00	37.00	33.00	34.00	31.00	37.00	24.00
Dehulling recovery (%)	76.00	75.00	72.00	70.00	71.00	73.00	68.00	61.00	66.00	53.00	55.00	57.00	58.00	53.00	46.00	47.00	43.00	42.00	46.00	36.00
Cleaning efficiency (%)	97.00	93.00	93.00	93.00	97.00	93.00	92.00	92.00	92.00	95.00	91.00	92.00	95.00	95.00	89.00	82.00	94.00	95.00	84.00	87.00
W_T of sample fed into hopper (kg)	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50
W_T of sample received at outlet (kg)	0.48	0.48	0.46	0.50	0.47	0.47	0.48	0.47	0.47	0.43	0.47	0.44	0.47	43.00	0.46	0.44	0.44	0.44	0.43	0.43
Output capacity (kg/h)	14.08	14.11	11.40	14.87	13.80	13.46	11.82	15.91	13.36	13.06	11.29	18.12	14.09	13.06	10.99	11.97	14.70	14.70	10.35	11.79
Hulling capacity (kg/h)	10.80	10.79	8.44	10.65	9.85	10.01	8.32	10.17	9.19	7.20	6.71	10.86	8.41	7.20	5.66	6.80	6.87	6.70	5.63	5.22
Capacity utilization (%)	96.00	96.00	92.00	97.00	94.00	94.00	97.00	93.00	93.00	86.00	94.00	89.00	93.00	86.00	91.00	87.00	87.00	88.00	86.00	86.00

MCwb = moisture content on wet basis; W_T = is the weight of the total brown rice hulled (whole and broken grain)

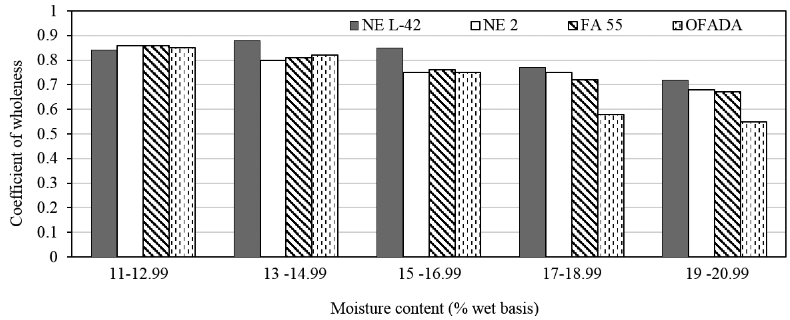

Fig. 5 Effect of moisture content on coefficient of wholeness, where rice varieties are NE L-42 = Nerica L-42, NE 2 = Nerica 2, FA 55 = Faro 55 and OFADA = Ofada

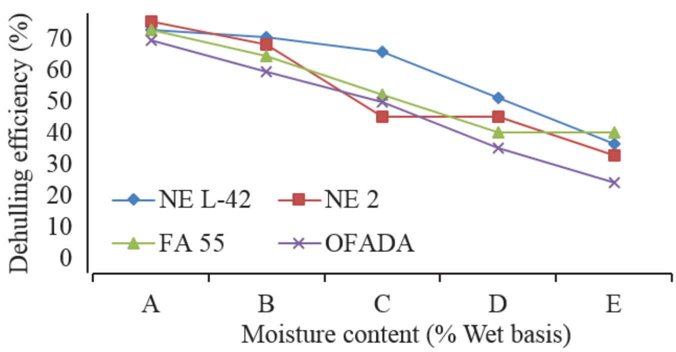

Fig. 6 Effect of moisture content on dehulling efficiency, where rice varieties are NE L-42 = Nerica L-42, NE 2 = Nerica 2, FA 55 = Faro 55 and OFADA = Ofada and A = 11.00−12.99%, B = 13.00−14.99%, C =15.00−16.99%, D =17.00−18.99% and E = 19.00−20.99%

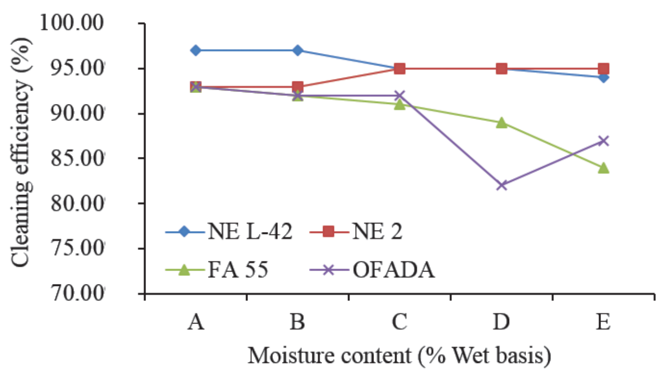

Fig. 7 Effect of moisture content on cleaning efficiency, where rice varieties are NE L-42 = Nerica L-42, NE 2 = Nerica 2, FA 55 = Faro 55 and OFADA = Ofada and A = 11.00−12.99%, B = 13.00−14.99%, C =15.00−16.99%, D =17.00−18.99% and E = 19.00−20.99%

The results of the past research on rice dehulling machines are summarized in Table 5. The moisture content had no significant effect on the cleaning efficiency as shown in Table 4 whereas paddy varieties had a significant effect on the moisture content. The dehuller maximum cleaning efficiency was approximately 97% for Nerica L-42 at an MCwb of 11−12.99% and an MCwb of 13.00−14.99%,

Table 5 Past and current data on rice dehusking machines

S/N	Rice mill	Coefficient of wholeness	Coefficient of dehulling	Cleaning efficiency (%)	Dehulling efficiency (%)
1	FUNAAB locally fabricated rice dehuller and destoner.	0.44–0.85	0.30–0.63	84.72– 94.73	53.55
2	FUT Minna locally fabricated rice dehuller and destoner	0.44	0.94–0.95	88.90–90.20	41.80
3	Standard rice dehuller (satakeThuzja)	0.44–0.68	0.71–0.81	–	55.08
4	McGill rice sheller	0.23–0.62	–	–	–
5	Modified rubber roller dehusker	0.55–0.88	0.44–0.77	82– 97	65.65

Sources for rice mill data: Adisa et al. (2016) for 1; Dauda et al. (2012) for 2; Subudhi et al., (2012) for 3; Malik et al. (1980) for 4; the results of this study (Table 4) for 5.

(groups A and B) while the minimum cleaning The results of the performance evaluation for the test machine indicated the maximum dehulling efficiency was 65.65%, the coefficient of dehulling was in the range 0.44–0.77, the coefficient of wholeness was in the range 0.55–0.88 and the cleaning efficiency was in the range 82–97% (Table 5).

Two rubber rollers of shaft diameter 25 mm were used to replace the existing Teflon rollers. A roller clearance of 1.50 mm is recommended for Faro and Ofada varieties while 1.80 mm clearance is recommended for Nerica varieties. It was found out that all paddy varieties hulled better between 12.00−16.00% moisture content from group A to group B. The performance evaluation results showed that the modified rubber rollers in the rice dehusker were more efficient than the Teflon roller previously used in the machine. Based on the results of the performance evaluation of the prototype rubber roller dehusking and destoning machine, requiring less operator skill and having greater availability of spare parts, it was concluded that the machine was suitable for use by subsistence farmers.

Conflict of Interest

The authors declare there are no conflicts of interest arising from this study work that was a research project to determine the appropriate material for the paddy rice dehulling.

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