Effect of clearance on some rice cultivars quality

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Abstract
The effect of clearance between cylinders in husking machine (type) on maize cultivars of Jasmine (JA) and Mishkhab (MI-31) were tested during sheller at three clearance of 0.4, 0.5 and 0.6mm. The experiments were carried out in a factorial experiment under complete randomized design with three replications. The results showed that the JA cultivar was significantly better than the MI-31 in all studied conditions. The results showed a machine productivity, power required, husking efficiency, breakage percentage, cracked grain and head rice percentage 1.626 and 1.437 t.hr-1, 12.321 and 13.183 kW, 82.434% and 81.014%, 6.715 and 7.423%, 3.885 and 4.520% and 65.536% and 64.163% for AJ and MI-31, respectively. The clearance of 0.6 mm was significantly superior to the levels of 0.4 and 0.5 mm in all studied conditions.

Keywords: mechanical damage, processed rice, rice quality, husking

1. Introduction
Rice is eaten by a vast number of citizens worldwide. This is the world's second-largest grain which, along with wheat, produces a significant proportion (95 per cent) of the world's population's overall calories. As common and quickly digested, it is the everyday meal for more than 1.5 billion people. Rice is an important food in the diet of one third of the world's population and further reported rice production and consumption is concentrated in Asia where over 90 per cent of the world's rice is grown and consumed [1]. The damaged grain scale, which is less than a quarter of the length of the pill and back, is attributed to many reasons, including the structure of the process and grain moisture content during the processing period, in addition to the mechanical pressures faced during the pre-production phase by the grain harvest [2].

Chalkiness an opaque white endosperm discoloration increases the value of the head rice kernels and decreases the head-to-broken rice ratio generated during the milling cycle [3]. [4] Research found that the amount of moisture is a significant factor influencing the rice's milling efficiency. If the moisture content is too low or too high, the recovery of friction and head rice will decrease. The average fragmented rice was 14 percent moisture. It was also found that rubber roll huller and blade whitener as well as blade mechanism were less damaged relative to milling systems. Two varieties of TH and DM were checked for the impact of different forms of crunches and whitening machines on rice grains. The results showed that both the machine type and the rice type have a significant effect on the recovery of the milling [5].

Lanning, as well as [6], concluded that it was important to achieve maximum head rice yield, since head rice is more valuable than broken kernels. The aim of the milling activity was thus to mill rice to a required degree of milling, thus preventing over-milling and optimizing the yield of rice milling and the yield of head rice. [7], Stated that changes in the paddy surface area with an increase in moisture content could be due to an increase in paddy dimensions with an increase in moisture content. During the milling cycle, rice kernel breakage has been caused by numerous parameters such as paddy harvest conditions, physical properties of the paddy kernels, environmental factors, and the form and consistency of the components of the milling device [8], [9], observed that the percentage breakage of Furat 1 rice cultivar was 14.06 per cent while Jasmine cultivar was 11.46 per cent when rice was handled.

The goal was to test the efficiency of the hulling machine by using three different speeds for rubber rolls on technological properties for two rice cultivars, rendering long rice kernels more prone to breakage than shortens during the milling process, because rice breakage was mainly due to mechanical stress [10]. The main objective of this research is to test the impact of husking machine (type Satake BK 40) on rice Jasmine (JA) and Mishkhab (MI 31) cultivars at different cylindrical clearance.
2. Material and methods

This research was conducted to determine the impact of a husking machine (type Satake BK40) in 2019. The tests were performed at three clearance rates: 0.4, 0.5 and 0.6 mm cylinders. For the experiments, the cultivars Jasmine (JA) and Mishkhab (MI -31) were selected and the samples were taken by the probe and collected in the form of a heap, the number heaps being six and each heap weight being 160 kg according to the system used [11]. JA cultivar rice was kept in an oven at a temperature of 43°C and carefully monitored to determine the moisture content of grain at 14%-18%, then the samples were taken and placed in the precision divider to obtain a sample weight of 250 g and then the samples were carefully sealed in polyethylene bags. The Satake type machine was adjusted to 0.6 mm clearance between cylinders and 4.7 m / s linear speed and then the 250 g samples were placed in the machine (Figure 1). The sample was then removed from the system and put in a Satake style cylindrical insulating unit with running period set to 2 min. The angle of inclination for both measurements was 25° insulating the split and complete feed. For each running test it was calculated the machine productivity, power required, husking efficiency, breakage percentage, cracked grain percentage and head rice.

![Figure 1. The machine (Satake KB40 type), used for husking paddy.](image)

2.1. Machine productivity:

The machine was calculated as follow [4].

\[
P = \frac{W \times 60}{T \times 1000}
\]

Where, \( P \) is production process (t/h), \( W \) is weight of output (g), and \( T \) is time (min).

2.2. Power required:

Power required is the power a machine consumes to perform a particular job. Calculates the power needed for this research as [4].

\[
P = \frac{\sqrt{3}}{1000} \cdot V \cdot I \cdot \cos \phi \cdot E_{FE}
\]

Where, \( P \) is power consumed (kW), \( V \) is voltage (V) and \( I \) is the electric current A, and \( \cos (\phi) \) is the angle between the current and voltage thus \( (E_{FE}) \) is the motor's output (assuming 90%).

2.3. Husking efficiency

The husking efficiency was determined by [12].

\[
P = \frac{W_{s} - W_{RU}}{W_{s}} \times 100
\]

Where, \( P_{e} \) is the husking efficiency (%), \( W_{RU} \) is the weight of unpeeled paddy (g) and \( W_{s} \) is the weight of paddy sample used (g).
2.4. Breakage percentage
The proportion of head paddy and split in head grain separation cycle [13].

\[ P_{Br} = \frac{W_{Br}}{W_s} \times 100 \]

Where, \( P_{Br} \) is the proportion of breakage rice (%), \( W_{Br} \) is the weight of breakage grain (g) and \( W_s \) is the weight of rice sample used (g).

2.5. Cracked grain percentage.
The cracked grain percentage as follow [6].

\[ P_{Cg} = \frac{W_{Cg}}{W_s} \times 100 \]

Where, \( P_{Cg} \) is proportion of cracked grain (%), \( W_{Cg} \) is weight of cracked grain (g) and \( W_s \) is weight of sample used (g).

2.6. Head rice
The head rice percentage was calculated as follow [4].

\[ P_{H} = \frac{W_{H}}{W_s} \times 100 \]

Where, \( P_{H} \) is the proportion of head grain, (%), \( W_{H} \) is the weight of whole grain (g) and \( W_s \) is the weight of rice sample used (g). The results were statistically analyzed using the complete randomized design CRD , and according to the L.S.D test [14].the difference between treatments was tested for each factor.

3. Results and discussion
3.1. Machine productivity
The improvement in the clearance between cylinders corresponds to an increase in the efficiency of the system and the findings were respectively 1.103, 1.492 and 2.00 t .hr\(^{-1}\) from Table 1. It is indicated that the of the JA cultivar (1.626 t.hr) is significantly better than MI 31 cultivar (1.437 t.hr). The this is due to the type and size of grains for each variety .These results are consistent with the results of [5]. The interaction among JA hg cultivar and 0.6 mm clearance gave best result (2.014t.hr\(^{-1}\)).The level of the machine productivity at different conditions is show in Figure 2 for both rice cultivars and clearance between cylinders.

3.2. Power required
Table 2 shows the power clearance control needed for both cultivars The Jasmine ( JA) and Mishkhab (MI 31). The findings showed that that the clearance between cylinders contributes to a reduction of the machine's needed capacity, and the findings for various clearances were 13,738, 12,918 and 11,599 kW. This is attributable to the machine ‘s productivity in the job done and less time needed . When the clearance among cylinders increased, the capacity consumed was less, hence the power required increased. Such findings are compatible with the results obtained by [12] The JA cultivar (12,321 kw) is shown to be slightly higher than MI 31 cultivar (13, 183 kw). This is because of the grain type and size for each variety.Such findings are compatible with the results of [13]. The relationship between JA cultivar and the clearance of 0.6 mm provided the strongest outcome (11. 189 kw). 3 Of both rice cultivars and cylinders clearance.

3.3. Husking efficiency
The husking efficiency of the JA cultivar (82.434%) is significantly more than MI 31 cultivar (81.014). This is due to the thickness, length and type of the cultivar. Table 3. At clearance between cylinder of 0.4 has the highest husking efficiency of 79 .932 %. Attributed to that the engineering characteristics that characterized the machine type of Satake BK40, depending on the type of cultivar . These results are consistent with the results of [13].The relationship between JA cultivar and the 0.4 mm cylinder clearance culminated in optimum output (84.812 per cent). The level of the husking efficiency at different conditions is show in Fig. 4 for both rice and clearance between.
Table 1. The effect of clearance on machine productivity for two rice cultivar.

| Cultivar | Clearance mm | Means of cultivar |
|----------|--------------|-------------------|
| JA       | 1203         | 1.663             |
| MI-31    | 1.003        | 1.321             |
|          | 1.986        | 1.437             |
| LSD=0.05 | 0.161        |

Means of clearance 1.103 1.492 2.00
LSD=0.05 0.201

Figure 2. Impact of clearance of two rice cultivars on computer productivity.

Table 2. The effect of clearance on power required for two rice cultivar.

| Cultivar | Clearance mm | Means of cultivar |
|----------|--------------|-------------------|
| JA       | 12.562       | 11.189            |
| MI-31    | 14.286       | 13.274            |
|          | 12.010       | 11.599            |
| LSD=0.05 | 1.244        |

Means of clearance 13.738 12.918 11.599
LSD=0.05 1.732

Figure 3. The effect of clearance on power required for two rice cultivar.
Table 3. The effect of clearance on husking efficiency for two rice cultivar.

| Cultivar | Clearance mm 0.4 | Clearance mm 0.5 | Clearance mm 0.6 | Means of cultivar 0.4 | Means of cultivar 0.5 | Means of cultivar 0.6 |
|---------|------------------|------------------|------------------|----------------------|----------------------|----------------------|
| JA      | 82.315           | 80.175           | 82.434           |                      |                      |                      |
| MI-31   | 83.115           | 80.241           | 79.688           |                      |                      |                      |
| LSD=0.05|                  |                  |                  |                      |                      | 1.461                |
| Means of clearance | 83.963 | 81.278           | 79.932           |                      |                      |                      |
| LSD=0.05|                  |                  |                  |                      |                      | 2.043                |

Figure 4. The effect of clearance on husking efficiency for two rice cultivar.

3.4. Breakage percentage

The Breakage percentage of the JA cultivar (6.715%) is significantly more than MI-31 cultivar (7.423). This is due to the thickness, length and type of the cultivar. Table 4. At clearance between cylinder of 0.6 mm has the highest breakage percentage of 6.189%, and clearance between cylinder of 0.4 mm has the lowest breakage percentage of 7.860%. Owing to the lower collisions between the grain, which encourages high flow of grain within the husking chamber as the clearance between the cylinders improved. These findings are compatible with the results of that [7]. The relationship between JA cultivar and the 0.6 mm cylinder clearance culminated in a total breakage percentage of (5.887 %). The level of the breakage percentage at different conditions is show in Fig. 5 for both rice cultivars and clearance between cylinders.

3.5. Cracked percentage

Table 5 shows how clearance affects the proportion of broken grain. The findings revealed that, by growing the clearance between tubes, the cracked amount reduced, which was 4,875, 4,307 and 3,427 percent, respectively, at specific clearance. Due to the fragility of the rice grains and increasing the pressure led to increase the percentage of cracked grain with decrease clearance between cylinders, which is consistent with the results gained by [5]. It is indicated that the AJ cultivar was significantly greater than the MI-31 cultivar resulting 3.885% and 4.520%, respectively. From the overlap between AJ cultivar and 0.6 mm clearance, the best results of 3.087 percent were obtained. The degree of the cracked percentage is seen in Fig. 6 for both rice cultivars and cylinders clearance.

3.6. Head rice

Table 6 showed clearance 's influence on head rice percentage. The findings suggested that, the clearance between cylinders contributes to an increase of 63,146, 64,613 and 66,786 percent in head rice, respectively at specific clearance. Decreasing clearance between cylinders caused negative effects on the head rice ratio as the breakage percentage increased in line with the results obtained [4]. It is shown that the AJ cultivar was significantly higher than the MI-31 cultivar resulting in 65.536 percent and 64.163 percent respectively. The best results of 67.811 percent were obtained from the overlap between AJ cultivar and 0.6 mm clearance. Both for rice cultivars and for cylindrical clearing.
Table 4. The effect of clearance on breakage percentage for two rice cultivars.

| Cultivar | Clearance mm | Means of cultivar | LSD=0.05 |
|----------|--------------|------------------|----------|
| JA       | 6.551        | 6.715            | 1.122    |
| MI-31    | 8.013        | 7.423            | 1.409    |
| LSD=0.05 | 7.860        | 6.189            |          |

Table 5. The effect of clearance on cracked grain percentage for two rice cultivars.

| Cultivar | Clearance mm | Means of cultivar | LSD=0.05 |
|----------|--------------|------------------|----------|
| JA       | 4.001        | 3.885            | 0.055    |
| MI-31    | 5.180        | 4.520            |          |
| LSD=0.05 | 4.875        | 3.427            |          |

Figure 5. The effect of clearance on breakage percentage for two rice cultivars.

Figure 6. The effect of clearance on cracked grain percentage for two rice cultivars.
Table 6. The effect of clearance on head rice percentage for two rice cultivar.

| Cultivar   | Clearance mm | Means of cultivar |
|------------|--------------|-------------------|
|            | 0.4          | 0.5              | 0.6              |
| JA         | 65.016       | 67.811           | 65.536           |
| MI-31      | 62.518       | 64.809           | 65.762           |
| LSD=0.05   |              | 1.525            |
| Means of clearance | 63.146 | 64.613 | 66.786 |
| LSD=0.05   |              | 1.785            |

Figure 7. The effect of clearance on head rice percentage for two rice cultivar.

Conclusion

Studied the impact of clearance for two cultivars of Jasmine (JA) and Mishkhab (MI-31) on mechanical degradation of processed rice. In all situations tested the AJ cultivar was slightly higher than the MI-31 cultivar. The visibility of 0.6 mm between 0.4 and 0.5 mm cylinders was slightly preferable to the other two clearances. The findings indicated improved conditions for the rice AJ cultivar overlap and 0.6 mm clearance relative to the rice overlap with other clearances. All interactions were substantially different and the strongest findings in all situations tested were the difference between AJ cultivar and 0.6 mm clearance excluding husking performance.

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