Effect of machine types, speed and moisture content on wheat Nida cultivar

Mousa, A, Aljubory[1,2]. Mohammed H. Kianmeher[1]. Akbar Arabhosseini, Shahriar Kouravand[1]

[1.] Department of Agrotechonlogy, College of Abouraihan, University of Tehran, Tehran, Iran.
[2.] Department of Agricultural Machinery, University of Al- Euphrates, Iraq)
Corresponding author: salih_alsh1971@yahoo.com

Abstract: the effect milling process on wheat Nida cultivar, was studied based on some technical indicators, Two types of machines (Cylinder and Hammer), were tested at three moisture content of grain 13-15%, 15- 17% and 17-19%, and three ranges speed of 0.717, 0.820 and 0.921. The experiments were done in a factorial experiment under complete randomized design with three replications. The results showed that the Cylinder machine was significantly better than Hammer machine in all studied condition. The results showed a production process of 1.581 and 1.451 ton\hr, power consumption of 15.136 and 15.824 kW, milling recovery of 70.107 and 69.947 %, degree milling 10.845 and 10.125% and milling efficiency of 81.222 and 80.808 % for Cylinder and Hammer machines, respectively.http://www.sciencepub.net/researcher.

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1. Introduction

The grinding of wheat into flour is mankind's oldest continuously practiced industry and the parent of all modern industry; all modern particle breakage operations have wheat milling in their ancestry. In pursuing the need for efficient and ubiquitous milling of wheat, millers and millwrights of old developed a practical mastery of several of the fundamental engineering disciplines: fluid dynamics and aerodynamics for power generation from water wheels and windmills, mechanical engineering for the transmission of power via gearing and control mechanisms and particle handling, breakage and separation operations. "Abu Al khair et al, (2005)". reported that the organizing machine has a direct effect on the productivity of the machine the more the organization is set whenever the high productivity because of the low percentage of break-up and this is reflected positively on the increase machine productivity due to increased efficiency of the existing work. "Almaamouri et al., (2008)", the effect of different types of crunches and whitening machines on the paddy grains were tested on two varieties of Amber 33 and Abasiya. The results showed that there is a significant effect to the machine type as well as the type of paddy on milling recovery. "Ahmed, (2007)" concluded that the productivity of machine crunches affected by grain type and the type of machine and process speed. "Clarke et al (2006)'. cereal seeds have a different behavior under the action of compression forces, depending on their moisture content, variety, development stage, geometric sizes, individual mass, glassiness, (soft cereals and hard cereals) etc. "Al-Mogahwi et al., (2005)" investigated breakage in both break and reduction roll systems in a commercial mill and suggested some alternative approaches for characterizing the particle size distribution relationships of flour stocks from these operations. Their approaches might allow simpler forms of the breakage function to be developed, as well as facilitating extension of the breakage equation approach developed here for First Break to the rest of the milling process.

"Pujol et al., (2000)" be scribed a micro mill designed to measure accurately the mechanical energy consumption during milling of small quantities of wheat. Specific Roller Milling of Wheat 419 milling energy under the conditions of their study ranged from 13.2 kJ/kg for a soft wheat to 19.6 kJ/kg for a hard wheat, and correlated well with NIR hardness. This work underlines the importance of including the energy consumption in models of wheat breakage during roller milling and relating this to the particle size distribution produced, "Posner et al., (2005)". wheat kernel physical characteristics, such as uniformity in kernel hardness and size, are important for milling traditional wheat flour because they maximize separation of the bran from the endosperm during roller milling. These parameters may not be important for milling whole wheat flour, since separation of kernel components is not the goat. "Kihlberg et al., (2004)" the two predominant techniques for grinding whole grain flours are stone and roller mills. Whole grain flours could also notionally be produced with an impact or hammer mill.

The main goal of this research is to study the effect of machine types (Cylinder and Hammer) on wheat, Nida (NI) cultivar at different speed between cylinders and different ranges of grain moisture content.

2. Material and Methods

The study was conduction in 2015 to evaluated machines (Cylinder and Hammer) were done at three levels of grain moisture 13-15%, 15-17% and 17-19% and three levels of speed of 0.717, 0.820 and 0.921. The Nida cultivar by probe and collected on form of heaps, which number heaps were six each heap weight was160kg, according to the method used by (Alsharifi et al. 2016a). The wheat samples were by using sieves to cleaned to remove all foreign matters, broken and immature grains. Then the random samples which are taken from rach heaps 1000g weight. The initial moisture content of wheat grain was determined by oven drying at 103C for 48h (Andres et al., 2012). The Nida cultivar was kept in an oven at temperature of 43C and monitored carefully for determining moisture content of grain at 17-19% then the sample are taken and placed in Precision divider to get a sample of 200g weight than the samples were carefully sealed in polythene bags, the cylinder type machine was adjusted on 0.8mm clearance and speed of 0.921, the sample of 200g weight was placed in the machine of the type cylinder. than the sample was taken out of the machine and placed in a cylindrical insulation device from Cylinder type operating time of adjust for 2 minute. The angle of inclination 25 degree insulate the broken and full of grain of all size. The production process, power consumption, milling recovery, degree milling and husking efficiency were calculated for each running test.

2.1. Production process: Equation 1 (Al sharifi 2007)

$$P = \frac{W \times 60}{T \times 1000}$$

Where: P: Production process (ton/hr), W- Output weight.(kg) and T- time (hr)

2.2. Power Consumption: Equation (Chaitep 1998 and Alsharifi et al., 2016 a)

$$P = \frac{\sqrt{3}}{1000} \cdot v \cdot I \cdot \cos\varphi \cdot E_{FE}$$

Where: P – Power consumed. (kw), V – Voltage, I- The current (Am), cos φ Angle between the current and voltage.-$cos\,\varphi$ and E_{FE} - The efficiency of the motor (%).

2.3. Milling Recovery: Equation 3 (Alsharifi et al., 2016b)

$$M_{r=}\frac{W_M}{W_S}\times 100$$

Where: M_r-Is the Milling process. (%), W_M -Is the weight of milling paddy. (g), and W_s-Is the weight of sample used (g).

2.4. Degree of Milling: Equation 4 (Al sharifi et al., 2017)

$$D_{M=}\frac{W_{MR}}{W_{bR}}\times 100$$

Where: D_M – Milling Degree (%), W_{MR} -Weight of Milling Paddy.(g), and

W_{bR} - Weight of brawn Paddy. g

2.5. Efficiency mechanical: Equation 6 (Minaei et al., 2007 and Alsharifi et al., 2016 c)

$$E_{M=}\frac{P_{N-}P_W}{P_N}\times 100$$

Where: E_M -Is efficiency mechanical (%), P_N -Is productivity theory. (g) and P_W -Is productivity work. (g).

same method was used with the same cultivar Nida to test the Cylinder type machine, at grain moisture content of 15-17%, 17-19% and speed 0.717, 0.820 in three replications. Results were analyzed statistically using the design C R D the difference among treatment each factor according to the LSD test. (Oehlent 2010).

3. Results

3.1. Production process

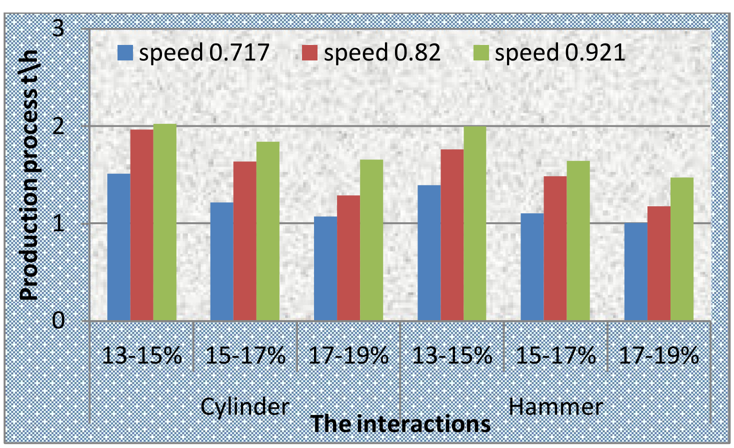

Figure 1. Effect of speed and grain moisture on the production process for two machines.

Influence of machine type, speed and grain moisture in the production process ton\hr was in show in Table 1. The results shows indicate that the cylinder type machine is significantly better than the Hammer type machine, because efficiency and type machine, when used the machine type Cylinder, compared the machine type Hammer. These results consistent with the results of (Abu Al Khair *et al*., 2005). Increasing the speed leads to increase the production process. The production process were 1.219, 1.555 and 1.773 ton\hr. this is due to increased production with increased the speed, increasing grain moisture leads to decrease the production process the values of production process were 1.777, 1.488 and 1.282 ton\hr.. This is due to increased moisture of grain led to hamper milling process, hence decreased production process. These results are consistent with the results that gained by (Ahmed, 2007). The levels of the production process at different conditions are shown in Figure 1 for both machine types (Cylinder and Hammer).

3.2. Power consumption:

Table 1. The effect of machine types, speed and grain moisture on the production process ton\hr.

Machines	**Grain Moisture**	**Speed %**			**The average machines at each moisture**
		0.717	0.820	0.921	
Cylinder	13-15%	1.516	1.964	2.027	1.836
	15-17%	1.221	1.639	1.842	1.567
	17-19%	1.076	1.291	1.657	1.341
Hammer	13-15%	1.395	1.764	1.998	1.719
	15-17%	1.104	1.484	1.642	1.410
	17-19%	1.005	1.187	1.475	1.222
L.S.D=0.05		0.059			0.059
Average of speed		1.219	1.555	1.773	
L.S.D=0.05		0.041			
Machines	The average speed for the machines				Average of machines
Cylinder	1.271	1.631	1.842		1.581
Hammer	1.168	1.478	1.705		1.451
L.S.D=0.05	0.241				0.034
Grain moisture	The average grain moisture at each Speed				Average of grain moisture
13-15%	1.456	1.864	2.012		1.777
15-17%	1.163	1.561	1.742		1.488
17-19%	1.040	1.239	1.566		1.282
L.S.D=0.05	0.072				0.041

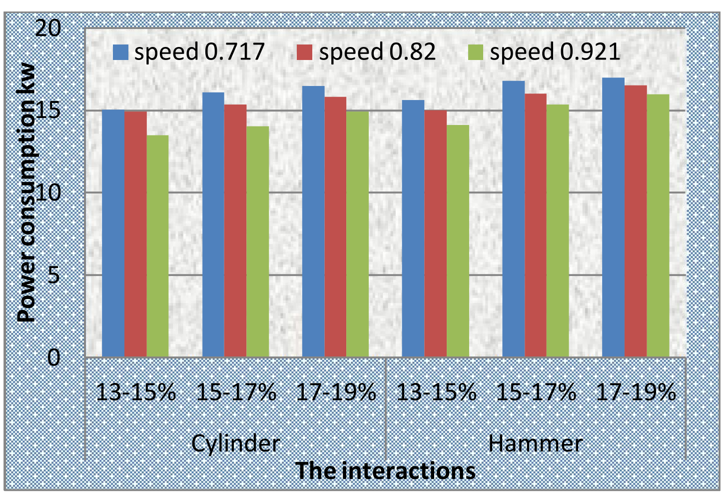

Figure 2. Effect of speed and grain moisture on the power consumption for two machines.

Table 2 shows the influence of machine type, speed and grain moisture on power consumption kW. The results indicated that increasing the speed leads to decrease the power consumption of the machine, and the results were 16.179, 15.612 and 14.650 kW for different speed. This is due to the efficiency of the machine in the work achieved and less time. The capacity consumed was less when the clearance among cylinders increased, hence power consumption increased. These results are consistent with the results that gained by (Chaitep et al., 2008). As increasing the grain moisture leads to increase of the power consumption kW and the results were 14.709, 15.607 and 16.125 kW at different moisture content. This is due to the increased Damocles effort on grains during the milling process, hence increased capacity consumed with increasing moisture content of grain. However, cylinder machine was significantly better than the Hammer machine, while the results gained from this process were 15.136 and 15.824 kW for cylinder and Hammer machines respectively. Because of high quality in hulling process, less capacity was consumed when cylinder machine was used to compare with Hammer machine. These results are consistent with the results of (Al maamouri et al., 2008). The levels of the power consumption at different conditions are shown in Figure 2 for both machine types (Cylinder and Hammer).

Table 2 the effect of machine types, speed and grain moisture on the power consumption kw

Machines	Grain Moisture	Speed %			The average machines at each moisture
		0.717	0.820	0.921	
Cylinder	13-15%	15.062	14.938	13.495	14.498
	15-17%	16.106	15.354	14.042	15.167
	17-19%	16.481	15.829	14.921	15.744
Hammer	13-15%	15.641	15.018	14.102	14.920
	15-17%	16.784	16.009	15.346	16.046
	17-19%	16.999	16.525	15.993	16.506
L.S.D=0.05	0.200				0.115
Average of speed		16.179	15.612	14.650	
L.S.D=0.05		0.081			
Machines	The average speed for the machines				Average of machines
Cylinder	15.883	15.374	14.153		15.136
Hammer	16.474	15.851	15.147		15.824
L.S.D=0.05	0.115				0.066
Grain moisture	The average grain moisture at each Speed				Average of grain moisture
13-15%	15.351	14.978	13.798		14.709
15-17%	16.445	15.681	14.694		15.607
17-19%	16.740	16.177	15.457		16.125
L.S.D=0.05	0.141				0.081

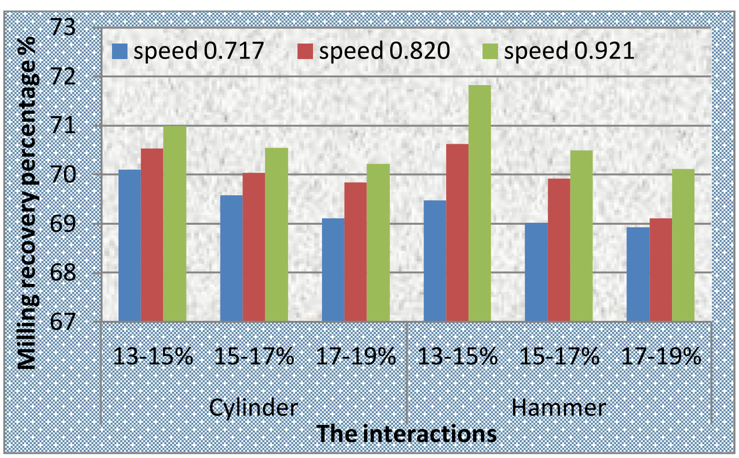

Figure 3. Effect of speed and grain moisture on milling recovery percentage the for two machines.

3.3. Milling recovery

Table **3** indicates that increasing the grain moisture leads to decrease the percentage of milling recovery percentage. The milling recovery levels were 70.593, 69.934 and 69.656 % at different moisture contents. Higher grain moisture content leads to difficulty in separation of the crust from the grains hence decrease in percentage of milling recovery.

These results are consistent with the results of (Alsaidi 1983). The Cylinder machine (70.307%) was significantly better than the hammer machine (69.947%). This is due to the characteristics design of engineering, which characterized by Cylinder machine compared with Hammer machine. In addition, increasing the speed leads to increase the percentage of milling recovery of the machine. The results were 69.372, 70.013 and 70.697 % at different speed. This is due to increased mechanical energy for separation process of the husking of grain. The increase in speed, leads to increase in percentage of milling recovery. These results are consistent with the results that gained by (Posner et al., 2005). The levels of the milling recovery percentage at different conditions are shown in Figure 3 for both machine types (Cylinder and Hammer).

Table 3 the effect of machine types, speed and grain moisture on the milling recovery %.

Machines	**Grain Moisture**	**Speed %**			**The average machines at each moisture**
		0.717	0.820	0.921	
Cylinder	13-15%	70.101	70.537	70.987	70.542
	15-17%	69.583	70.040	70.547	70.057
	17-19%	69.113	69.836	70.224	69.724
Hammer	13-15%	69.480	70.629	71.825	70.645
	15-17%	69.024	69.921	70.492	69.812
	17-19%	68.930	69.116	70.110	69.385
L.S.D=0.05	0.084				0.120
Average of speed		69.372	70.013	70.697	
L.S.D=0.05		0.207			
Machines		The average speed for the machines			Average of machines
Cylinder		69.599	70.138	70.586	70.107
Hammer		69.345	69.889	70.809	69.947
L.S.D=0.05					0.069
Grain moisture		The average grain moisture at each Speed			Average of grain moisture
13-15%		69.791	70.583	71.406	70.593
15-17%		69.303	69.980	70.520	69.934
17-19%		69.021	69.476	70.167	69.555
L.S.D=0.05		0.147			0.084

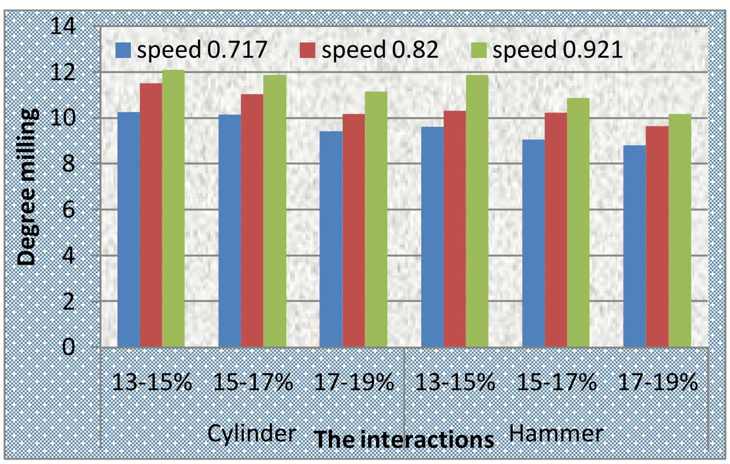

Figure 4. Effect of speed and grain moisture on degree milling the for two machines.

3.4. Degree of milling

Table **4** shows the influence of the type of machine, speed, grain moisture in the degree of milling %. The results indicated that the machine type Cylinder was significantly better than the machine type Hammer, because efficiency and type machine, when used the machine type Cylinder, compared the machine type Hammer. Increasing the speed leads to increase the percentage of milling degree. The percentage of degree milling were 9.545, 10.579 and 11.332. This is due to increased milling recovery with increased the speed. Increasing grain moisture leads to decrease the percentage of degree milling, the values of degree milling percentage were 11.041, 10.529 and 9.886 % respectively. This is due to increased moisture of grain led to hamper milling process, hence increased milling recovery when used machine type Cylinder. These results are consistent with the results that gained by (Al sharifi 2007). The levels of the milling degree at different conditions are shown in Figure 4 for both machine types (Cylinder and Hammer).

Table 4. The effect of machine types, clearance and grain moisture on the degree milling.

Machines	**Grain Moisture**	**Speed %**			**The average machines at each moisture**
		0.717	0.820	0.921	
Cylinder	13-15%	10.252	11.509	12.101	11.287
	15-17%	10.144	11.019	11.855	11.006
	17-19%	9.429	10.158	11.141	10.243
Hammer	13-15%	9.602	10.922	11.861	10.795
	15-17%	9.053	10.224	10.879	10.052
	17-19%	8.792	9.640	10.156	9.529
L.S.D=0.05		0.074			0.105
Average of speed		9.545	10.579	11.332	
L.S.D=0.05		0.183			
Machines		The average speed for the machines			Average of machines
Cylinder		9.942	10.895	11.699	10.845
Hammer		9.149	10.262	10.965	10.125
L.S.D=0.05		0.105			0.061
Grain moisture		The average grain moisture at each Speed			Average of grain moisture
13-15%		9.927	11.216	11.981	11.041
15-17%		9.599	10.622	11.367	10.529
17-19%		9.110	9.899	10.648	9.886
L.S.D=0.05		0.129			0.074

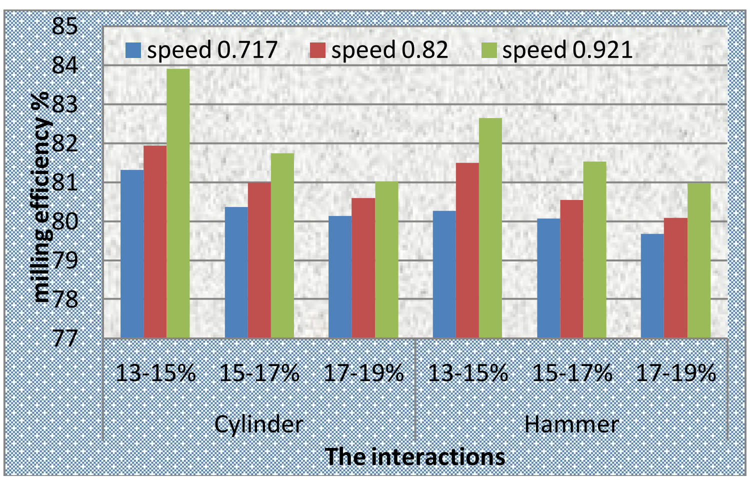

Figure 5. Effect of speed and grain moisture on milling efficiency the for two machines

3.5. Efficiency of milling

Table **5** indicates to the influence of machine type, speed and grain moisture on the milling efficiency. The results showed that increase in speed leads to increase milling efficiency of the machine. The results were 80.304, 80.939 and 81.801% at different speed. It indicates the Cylinder machine with higher milling efficiency (81.222) was significantly better than the Hammer machine (80.898%). As the increase of grain moisture leads to decrease of milling efficiency, the results were 81.759, 80.873 and 80.413 % at different moisture content. The increase in moisture content of grain also leads to obstruct the milling process hence decreasing milling efficiency. These results consistent with the results of (Minaei et al., 2007). The best results (82.910%) achieved by Cylinder machine at grain moisture of 13-15% and 0.921 speed. The levels of the efficiency milling at different conditions are shown in Figure 5 for both machine types (Cylinder and Hammer).

Table 5. The effect of machine types, clearance and grain moisture on the milling efficiency %.

Machines	Grain Moisture	Speed %			The average machines at each moisture
		0.717	0.820	0.921	
Cylinder	13-15%	81.310	81.933	82.910	82.051
	15-17%	80.371	80.984	81.740	81.032
	17-19%	80.127	80.601	81.020	80.582
Hammer	13-15%	80.263	81.498	82.641	81.467
	15-17%	80.071	80.539	81.532	80.714
	17-19%	79.682	80.082	80.966	80.243
L.S.D=0.05		0.047			0.067
Average of speed		80.304	80.939	81.801	
L.S.D=0.05			0.116		
Machines		The average speed for the machines			Average of machines
Cylinder		80.602	81.173	81.890	81.222
Hammer		80.005	80.706	81.713	80.808
L.S.D=0.05		0.067			0.038
Grain moisture		The average grain moisture at each Speed			Average of grain moisture
13-15%		80.787	81.715	82.775	81.759
15-17%		80.221	80.762	81.636	80.873
17-19%		79.904	80.341	80.993	80.413
L.S.D=0.05		0.082			0.047

Conclusions:

The Cylinder type machine is significantly better than the Hammer type machine in all studied conditions. The grain moisture content 13-15% was significantly superior to the two levels 15-17% and 17-19%. The 0.921 speed was significantly superior to the other two clearances 0.717 and 0.821. The results showed better conditions for the overlap between the Cylinder type machine and grain moisture content of 13-15% and also for the overlap between the Cylinder type machine and 0.921 speed compared to the overlap of the Hammer type machine with other moisture grain contents and speed. The best result was obtained by Cylinder type machine at grain moisture content of 13-15% and 0.921 speed.

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Corresponding Author:
Dr: Mousa, A, Aljubory
E-mail: salih_alsh1971@yahoo.com

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