Research article

Comparison of the OTAKE and SATAKE Rice Mills Performance on Milled Rice Quality

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Abstract Rice is the main diet in Central Asia. Quality of milled rice is good or bad and meets the international standard in terms of quantity of head rice as a result of appropriate rice mill. The objective of this study was to find out the better rice mill for better milled rice quality. In this research, two rice species (jasmine and fragrant) were milled by SATAKE and OTAKE rice mill machines at different conditions. The paddy rice specimens were dried to obtain the moisture content of 14% (recommended milling standard). Physical properties, percentage of lose, percentage of cracked rice, and capacity of peeling for millstone peel data were collected and analyzed statically using SPSS version 16.0. The results showed that milling two species of rice by SATAKE mill brand at role's gap 0.7 mm obtained about 95% (Jasmine) and about 94% (Fragrant) on head rice, while using OTAKE brand at 3970 revolution per minute received about 84% and 78% of Jasmine rice and Fragrant rice, respectively in terms of head rice. Thus, milling rice using small-scale SATAKE rice mill is better than OTAKE machine based on more quantity of head rice of both paddy rice species.

Keywords rice mill, role's gap, fan speed, jasmine rice, fragrant rice, capacity of peeling millstone

INTRODUCTION

Rice is the staple food of more than half of the world's population (AQIP, 2003). Cambodia plans to produce 10 varieties of paddy to export and these varieties (some name in Khmer language) includes: Sen Pidor, IR66, Julasa, Pka Romdol, Pka Romdeng, Jasmine, Pka chan sen sor, Reang chey, Kha4 and Kha6 (Chan, 2011). Agricultural sector has created job opportunities approximately 80-85% to Cambodian people (Pit Khun, 1991). In recent years, high quality rice of Cambodia has increasingly and globally been recognized since it was ranked No. 1 and won the World's Best Rice Award in Indonesia in 2012 and in Hong Kong, China in (Hor Kim, 2013). At the present, Cambodia can produce paddy over demand for domestic market, in which the total production of 3-4 million tons per year (Chun, 2013). Since the official integration in the ASIAN association in 1999, Cambodia began

actively working in terms of reforming to be a member of the World Trade Organization (WTO) (Meas, 2015). An increase of both quantity and quality of milled rice plays a crucial role in pushing up the national economy. Due to lack of rice mill, Cambodia exported paddy rice to neighboring countries without milling stage (AQIP, 2003). With a recent trend of improving rice mill machine program, a perfect principle has been created to develop and reconstruct the economy of Cambodia to enhance domestic rice production toward international market standard (Rickman, 2015).

OBJECTIVE

This study aimed to improve milled rice quality in Cambodia to meet an international standard. The specific objective was to find the better rice mill for better milled rice quality.

METHODOLOGY

In this research, two rice species (jasmine and fragrant rice) were selected to mill using two small scale mills, made by SATAKE model SB-10D and OTAKE model PM 1500N. Six treatments (Table1) were designed and done triplicate, containing 3 samples in each replication. Each sample composed of 10 kg of paddy rice with the moisture content of 14%.

Pre-test of paddy rice standard: 100 gram from each paddy sample was selected randomly to peel by hand to observe broken or cracked conditions before passing mill. From the amount of broken and cracked grains, the results were then calculated to find the efficiency of the machines through the test of grain quality.

Peeling levels determination: Samples were milled by SATAKE and OTAKE rice mill machines at different role's gaps (0.6 mm, 0.7 mm and 0.8 mm) and fan rotation speeds (4620 rpm, 3970 rpm and 3320 rpm).

Dividing sample: There were 6 treatments in the milling stage. In each treatment, there were 3 replications of selected 100 gram of brown rice. In each replication, it was divided into three times by using a homogenizer. As a result, 4 samples (25 gram/sample) were derived from one replication. Finally, only 3 samples were kept for grain quality checking.

Quality control: Checking process of selected brown rice were done to measure peeling millstone capacity percentage, head rice percentage, broken rice, cracked rice level. The checking process was handled manually following the method of OTAKE (2014).

Analysis: All recorded data of peeling millstone capacity, head rice, broken rice and cracked rice level were collected and analyzed statistically using SPSS version 16.0 for descriptive frequencies of mean value and t-test.

Table 1 Experimental design

Treatments	Rice species	SATAKE Role's gap (mm)	OTAKE Fan speed (rpm)
1	Jasmine	0.6	4620
2		0.7	3970
3		0.8	3320
4	Fragrant	0.6	4620
5		0.7	3970
6		0.8	3320

RESULTS AND DISCUSSION

Peeling Capacity of Brown Rice

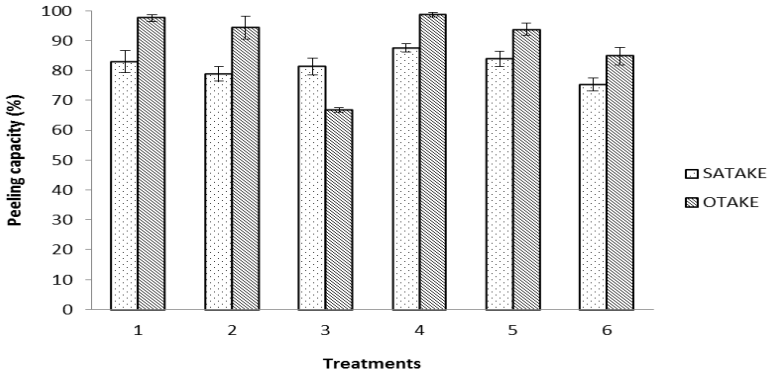

Fig. 1 Mean value of peeling capacity milled by OTAKE and SATAKE small-scale rice mills (treatment 1-3 are Jasmine rice and 4-6 are Fragrant rice)

Figure 1 shows peeling capacity of the two small scale mills on both rice species. The illustrated results were done by using different operation conditions of the two mills (OTAKE Company and SATAKE Company) on both rice species. The results show that there was no significant difference of the 3 different role's gaps of SATAKE on jasmine rice, whereas the percentage of peeling capacity of brown rice decreased a little when the role's gap increased from 0.6 mm (87%) to 0.8 mm (75%). On the other hand, the result of using OTAKE rice mill on peeling capacity showed a decreasing trend when using lower fan speed. The mean value declined between 4620 rpm and 3320 rpm and fan speed decreased from 98% to 67% and from 99% to 85% for jasmine rice and fragrant rice, respectively. Therefore, the obtained optimum percentage of peeling capacity was 87% (milled by SATAKE) and 99% (milled by OTAKE). The results met the standards, containing 84% and 99% for SATAKE and OTAKE rice mill (SATAKE, 2014 and OTAKE, 2014).

Percentage of Head Brown Rice

The results of head brown rice were indicated in Fig. 2 in the mean percentage value. Referring to this figure, by using SATAKE small scale rice mill with 3 different role's gaps, the obtained head rice were in ranges of 91-95% for jasmine rice, and 92-93% for fragrant rice. The maximum percentage was obtained by using 0.7 mm role's gap on both rice species. However, there was is no significant difference based on the number of standard deviation. Nevertheless, when milling the paddy rice specimens using small scale rice mill manufactured by OTAKE company model PM 1500N with the 3 sets of fan speed mentioned in Table 1, the achieved head brown rice ranged from 76% to 86% and from 73 to 76% for jasmine rice and fragrant rice, respectively. It can be concluded that, there will be more number of obtained head rice when applying lower fan speed (Fig. 2). Even though, there is no significant difference according to the number of standard deviation.

In comparison of the two small scale rice mills, SATAKE gave higher performance than OTAKE in terms of head brown rice percentage. The results agreed with the findings of OTAKE Agricultural Machinery Co. Ltd. (OTAKE, 2014) and SATAKE company (SATAKE, 2014), shown the quantity of head rice was 73.00% on average for OTAKE PM 1500N, and 85.10% for SATAKE SB-10D. The quantity of head rice after milling showed a marginal percentage difference when comparing to the Company's testing results. Proper physical characteristics of grain before milling and different experiment periods of time could influence the results of head rice.

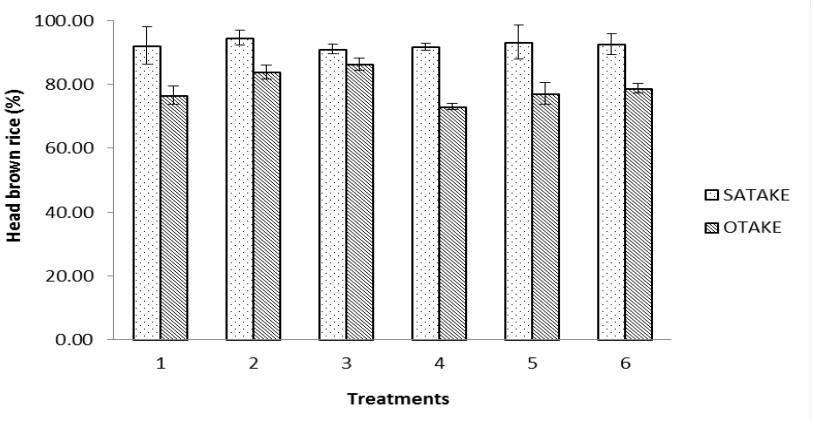

Fig. 2 Mean value of full milled brown rice in percentage

Percentage of Broken Brown Rice

The percentage of broken rice of paddy milled by the two milling machines from different companies is shown below (Fig. 3). It was no significant difference on milling the jasmine rice and fragrant rice in the 3 set role's gap operations (0.6 mm, 0.7 mm and 0.8 mm) of SATAKE. However, treatment number 2 (at 0.7 mm) provided the lowest broken quantity on average of 6%. In contrast, milling the two rice varieties by OTAKE with fan speed performance of 4620 rpm, 3970 rpm, and 3320 rmp, the results showed that the percentage of broken rice decreased when applying less speed on both rice species.

In terms of the broken rice percentage, milling by OTAKE at 4620 rpm was about 3 times higher than using SATAKE, while milling at 3320 rpm still obtained about 30% higher than that of SATAKE for jasmine rice. For fragrant rice, it was much higher in all treatments.

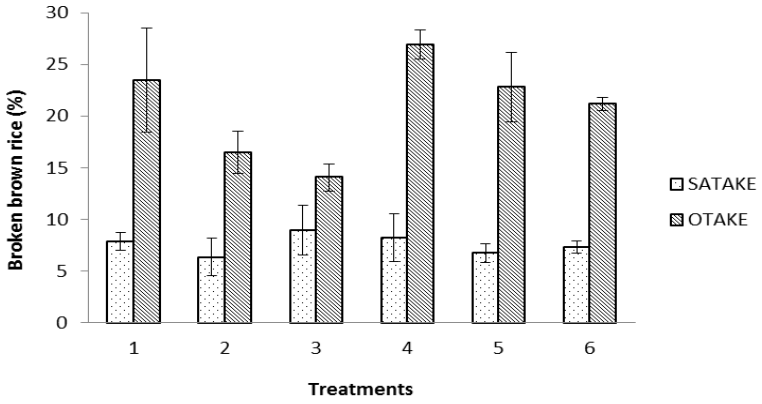

Fig. 3 Percentage of broken brown rice, as a result of milling jasmine rice and fragrant rice by SATAKE and OTAKE small scale rice mills

Percentage of Cracked Brown Rice

Figure 4 shows that even using 3 different role's gaps, brown rice milled by SATAKE model SB-10D consisted about 7% and 18% of cracked rice for jasmine and fragrant species, respectively. Comparing these findings to the brown rice milled by OTAKE PM 1500N using 3 different fan speeds, milling the rice by SATAKE composed more number of cracked milled rice for both of jasmine and fragrant. The average percentages of cracked rice milled by OTAKE rice mill were in ranges of 2.89% to 5.44% and

3.22% to 7.44% for jasmine rice and fragrant rice, respectively. The maximum percentage of cracked brown rice from OTAKE mill was at treatment 2 (jasmine) and treatment 3 (fragrant rice). Comparing with the standards of OTAKE Agricultural Machinery Co., Ltd., cracked rice was at 7% on average for OTAKE PM 1500N at 3970 rpm (OTAKE, 2014), and SATAKE SB-10D was at 23.33% on average for a role's gap of 0.7 mm for fragrant rice variety (SATAKE, 2014). Accordingly, they were dramatically lower than the standards.

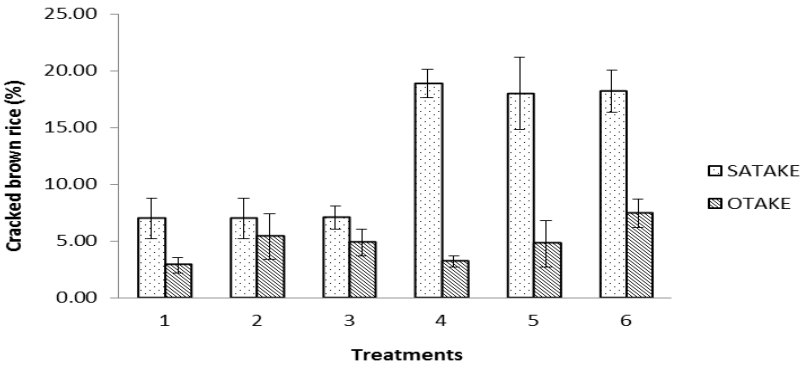

Fig.4 Cracked brown rice after milled by OTAKE and SATAKE small scale rice mills

Table 3 Comparison on efficiency of SATAKE and OTAKE mills on rice quality before and after milled brown rice

Mill types	Varieties	Treatments	Before milled (%)		After milled (%)		Efficiency (%)	
			Broken	Crack	Broken	Crack	Broken	Crack
SATAKE	Jasmine	1	1.33	7.33	7.84	7	6.51	0.33
		2	1.33	16.33	6.34	7	5.01	9.33
		3	1	14.66	8.98	7.11	7.98	7.55
	Fragrant	4	1.66	9.33	8.2	18.88	6.54	9.55
		5	1	10	6.75	18	5.75	8
		6	1.33	16	7.3	18.22	5.97	2.22
OTAKE	Jasmine	1	1.33	7.33	26.92	2.89	25.59	4.44
		2	1.33	16.33	22.81	5.44	21.48	10.89
		3	1	14.66	21.19	4.89	20.19	9.77
	Fragrant	4	1.66	9.33	26.92	3.22	25.26	6.11
		5	1	10	22.81	4.77	21.81	5.23
		6	1.33	16	21.19	7.44	19.86	8.56

Table 3 indicates the number of broken and cracked rice in percentage of both paddy rice species before and after milled by the two rice mills. Before getting milled is the results obtained from peeling by hand to check the origin of broken and cracked rice affected by other sources rather than the machine. After getting milled illustrates the quantity of the damaged rice as the effect of machine using at different conditions (different role's gaps for SATAKE and different fan speeds for OTAKE). Efficiency expresses the percentage of damaged level comparing between before milled and after milled.

As shown in Table 3, jasmine rice had 1.33%, 1.33%, and 1% broken rice and 7.33%, 16.33%, and 14.66% cracked rice before milling, representing treatments 1, 2, and 3 respectively. After milling by SATAKE, the percentages increased to 7.84%, 6.34%, and 8.98% (broken); 7.00%, 7.00%, and 7.11% (cracked). The efficiencies received by 6.51%, 5.01%, and 7.98%; 0.33%, 9.33%, and 7.55% of broken and cracked rice, respectively. Thus, using role's gap at 0.7mm offered the lowest percentage of broken rice after milled, but the highest of cracked rice in comparison with other two conditions (0.6 mm and 0.8 mm).

For fragrant rice, on the other hand, the rice was broken at 1.66%, 1%, and 1.33%; and cracked at 9.33%, 10.00%, and 16.00%, representing treatments 4, 5, and 6. The efficiencies were 6.54%, 5.75%, and 5.97% in terms of broken rice and 9.55%, 8.00%, and 2.22% of cracked rice. The results are similar to jasmine rice mentioned earlier that the minimum of broken rice obtained with 0.7 mm of role's gap, but the lowest percentage of cracked rice received when milling at 0.6mm role's gap.

When milling the same starting specimens of the two rice varieties at the same percentage of broken and cracked rice before milling. The efficiency of rice milled by OTAKE small scale rice mill accounted in a range of 20-25% and 4-11% for broken and cracked rice, respectively. The maximum percentage of broken rice occurred at higher fan speed used.

CONCLUSION

In conclusion, this study compared the quality of rice milled by two different small scale rice mills made by OTAKE Company and SATAKE Company. The results showed that OTAKE machine is better than SATAKE in terms of peeling capacity, lower cracked parameter, lower percentage of head rice quantity, and more number of broken rice on both rice types. The maximum of head rice milling by SATAKE rice mill was up to 95% using 0.7 mm role's gap, while OTAKE obtained just about 86% at 3320 rpm of fan speed. However, comparing with the standards of the machines, they were higher.

In addition, in terms of efficiency of broken and cracked rice parameters investigated to compare between before milled and after milled, the paddy milled by OTAKE machine received about 3 times higher on broken percentage with a slightly higher on cracked rice than milling by SATAKE machine. Based on the results, therefore, we can conclude that milling jasmine rice and fragrant rice using SATAKE machine at role's gap 0.7 mm or by OTAKE machine at 3320 rpm fan speed are the optimum conditions. In comparison between both machines, SATAKE machine performed better than OTAKE since it produced higher head rice with lower broken and cracked proportion.

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