DETERMINING POSTHARVEST QUALITY OF MILLED RICE IN LAVUN LOCAL GOVERNMENT AREA OF NIGER STATE, NIGERIA.

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ABSTRACT

This study examined quality differences of milled rice collected from three milling stations each from Doko, Gaba, Jima and Busu all of Doko Area Council in Lavun Local Government Area of Niger State. Three milling machines per town and five rice processing women were selected at random for this study. Data on the percent mixture of seeds; percent unmilled paddy grains found in the samples; Percent broken heads in the samples; percent inclusions (foreign materials and percent chaff contained in the milled samples) were collected. Result showed that rice mills in the study area yielded high whole grains, low foreign and burnt materials. No red rice or chalky grains were found from any of the mills sampled or from the villages. This could be an indication that red rice either no longer grows in the area or that the farmers had removed/rouged them out of the fields such that they could not grow hence found in the milled rice.

Keywords: Postharvest quality of milled rice, Resource convenient farmers.

INTRODUCTION

Rice is an important staple crop in Nigeria. It is the sixth major crop in terms of land area put into its cultivation which covers all the agro-ecological zones of Nigeria (Singh *et. al.*, 1997). It also ranks as one of the most important cereals in all parts of the country and it is consumed in different forms at various occasions as a source of energy. There are about twenty-five species of rice but only two are cultivated - *Oryza sativa* (white rice) and *Oryza glaberrima* (brown rice) are reported to have originated in Asia and West Africa respectively (Imohelin, 2000). Among the two cultivars *O. sativa* is the most consumed by over half the world's population (Juliano 1985). The total world production of unmilled rice (paddy) is around 592 million tons (based on the average production for 2000 and 2001). Ninety percent of this total is grown in developing countries, mostly in Asia, while Latin America and African produce 3.8 and 2.8 percent respectively (FAOSTAT, 2001). Nigeria's potential area for rice production is between 4.6 and 4.9 million hectares but actual production as at 2003 was estimated at approximately 3 million metric tons (Imohelin, 2000; Daramola, 2005). According to Daramola (2005) production figures show that during the period from 2000-2003, Kaduna State was the largest producer of rice, accounting for about 22% of the country's rice annual production followed by Niger State (16%), Benue State (10%) and Taraba State (7%). The annual domestic output of rice still hovers around 3.0 million metric tons; leaving the huge gap of about 2 million metric tons annually, a situation which has continued to encourage dependence on importation. The area put into the production of high yielding varieties – HYV, is expanding (Phan, 1998). Methodology on the impact of the improvement of productivity on postharvest operations has been developed by FAO for several crops including rice. As HYVs are increasingly used, the post-harvest system for the rice must be improved. This should include infrastructure development and the dissemination of technologies, allowing small and medium

farmers to prevent food losses and consequently to achieve the food security for most nations. Rice is harvested when head grains turn golden brown but before they shatter. In Nigeria, harvesting is done manually involving cutting the rice stalk, reaping of the panicles; laying out of the paddy or stacking it to dry; and then threshing. Correct harvesting and handling operations can considerably reduce post production losses. Excessive post-harvest handling systems however, creates problems in terms of both quality and quantity.The sequence of manual harvesting, field drying, bundling and stacking in traditional systems can cause losses of between 2 and 7 percent (Toquero and Duff 1994). Also, delayed harvest can cause shattering losses during harvesting and transportation. Rice paddy grains can be stored in sacks, clay pots, tins and similar containers which are kept in stores or kitchens. In some cases, the containers are placed on planks to facilitate ventilation of the paddy. It could also be stored in silos, rumbus and drums by resource convenient farmers. Hardly can rice stored in drums be affected by any storage pests. High grain moisture can however, lead to total loss of grains in this storage methods. The main objective of this study was to identify the quality differences in the local milled rice of Doko Area Council of Lavun Local Government Area (LGA) of Niger State.

CONCEPTUAL FRAMEWORK

Rice cultivation is extensive in West Africa, especially in Nigeria but with low yields - between 1.5 and 3.6 tons of paddy rice per hectare (Anon. 2006). This low productivity, high processing and marketing costs hinders the competitiveness of local rice on the regional markets. Many of these West African countries depend on international imports for up to 40% of their rice supply. Thailand, and increasingly, Vietnam, and the United States are the region's main rice suppliers. The quality of the milled rice output from these exporting countries give them the edge above home grown rice.In Nigeria three systems of rice milling are known: the traditional hand pounding; the small rice mills system and the large mills processing system. Whereas the traditional hand pounding system is fast fading out because of the presence of electric operated mills and whereas there are very few large mills in the country, the small rice mills is the interest of this study. It is the most prominent of the three milling systems. Its milling output is small (about 1 ton/hour) and may contain a high percentage of broken grains or stones. In this study, an attempt to determine the quality performance of small milling units, especially in the mixture of rice grains; amount broken heads in the samples and quantity of inclusions (foreign non-agricultural and agricultural material) was done.

LITERATURE REVIEW

During the milling of rice, paddy passes the machines where there is a separating of the kernels from the seed grain. Here the seed grain encased in an inedible hull or husk is removed producing chaff after the machine has removed the hull. What remains is brown rice, with the bran layer still surrounding the kernel. The grains of brown rice are polished by the same or other machines that rub the grains together under pressure. This abrasion removes the bran layer, revealing white or "polished" rice.Most Nigerian mills produce parboiled rice. Parboiling is the steaming process in which paddy rice is soaked, steamed and dried before milling. Milled white rice, at its best, is made up of clean, polished, whole kernels. In many developed economies like in the United States, rice mills use laser sorters that look for broken or discoloured kernels and

sort them from the whole kernels of rice. Technology has enabled the U.S. rice industry to consistently produce a high-quality product (Anon, 2009). The modern technology employed by American rice producers and millers is, in part, responsible for the reputation of quality of rice that has been sold around the world.

METHODOLOGY

The Study Area

The study was carried out between July and September of 2009, at Doko Area Council, Lavun Local Government Area (LGA) of Niger State. Lavun LGA is geographically located on Longitudes 9°27' N and Latitudes 5°38'E. The National Census of 2006 puts the population of the local government area at 207,917 people with a land area of 2835Km^2. Most farmers of the LGA, but in particular the Area Council, grow sorghum, maize, early millet and rice principally. Very little legumes and tubers are grown. Of particular interest however, is rice produced at Doko, Gaba, Jima and Busu towns in the study area. This is the heart of rice growing area of Lavun LGA. Doko the headquarters of Doko Area Council is surrounded by Bida, Gbako, Katcha and Edati LGAs. The National Cereal Research Institute (NCRI), Badeggi is within the area council. Presented in Table 1, the geographical distribution of the sampling areas.

The climate of this area is characterized by an annual rainfall of about 100 – 150cm and a relative humidity of over 90% in the afternoon (Adebukun, 1986). The environment also maintains an average temperature of 32°C and dry season of 4 – 5 month respectively. The people (Nupe tribesmen) are predominantly resource-poor farmers whose activity is subsistence farming growing mainly cereal crops, rice being the chief of them. Most of the rice paddy is sold to local women who process it into grains with only very small amount consumed locally.

Sampling Procedures

Preliminary visits were made to these women processing the rice paddy in these areas to understand differences in local varieties of milled rice. Three (3) milling machines per town were selected while five rice processing women were picked at random. During milling, a 5kg weight of per-boiled paddy rice was poured into the receiving funnel of the milling machines. Rice samples were allowed to be processed (turned) for sixty seconds before the experimental samples were obtained as described by USDA standards (USDA, 1997). Collections of samples were done in three replicates.

Sources and Types of Data

The milled rice samples from the milling stations were brought into the laboratory for analysis. Information on the following were the parameters collected; (i) mixture of rice grains; (ii) a rate of unprocessed whole grains in the milled samples; (iii) amount broken heads in the sample; (iv) quantity of chalky head grains in the sample; (v) quantity of inclusions (foreign non-agricultural and agricultural material).

Method of Data Analysis

Data collected were subjected to analysis of variance using the MINITAB Release 14 Statistical software (Minitab, 2003). Means were separated using the method described by Gomez and Gomez (1985).

RESULTS AND DISCUSSION

Difference in broken rice grains found in milling stations in Doko Development Area

The amount of broken grains did not differ significantly between the towns survey. Rice mills at Gaba produced the highest percentage broken grains of rice (9.57%), followed next by mills at Busu with 9.45% while samples from Doko and Jima were 8.02% and 6.91% respectively (Table 2). The poor drying procedure after parboiling of rice may cause high levels of broken rice. Phan (1998) reported that very dry brittle grains result in brokenness of milled rice. Traore *et. al.*, (2004) reported also that broken grains can result when paddy to be processed is made up of may rice varieties. The level of drying will vary in the situation where paddy is made up of a mixture of long, medium and short grains. The lowest broken milled rice as reported for milling stations at Jima and Gaba (6.63 and 6.98%), may not be unrelated to the possibilities of the stations receiving similar parboiled paddy that had a similar method of drying before milling cannot be excluded. Foreign matter content of milled rice was different between the samples these difference was however not statistically significant ($P > 0.05$). The highest value of 1.24% was found from milling station three (3) at Busu village. That village also had the highest total mean of 1.13% as shown in Table 3.

The presence of foreign matter in the samples as observed in the villages may not be unconnected with improper cleaning of paddy from the field or proper hygienic handling of post parboiling activities. Lantin (1997) and Daramola, (2005) have said that the lack of clean paddy often results in a higher concentration of contaminants. Anon (2008) had also shown that there was no acceptable qualitative standard way for measuring or comparing quality characteristics in Nigeria. That report added that, in general, factors as purity, foreign matter and defective grains could lower the quality and hence the market value of most rice's. Analysis of the contaminants showed that they included dried grasses, rice straw, stones, charcoal or other material that may come with packaging material prior to milling. They may also be found in milled rice when not properly cleaned.

Difference in mean percent burnt material contained in rice samples collected from milling stations in Doko Development Area.

The burnt material found in the milling station 2 at Jima village (Table 4) was highest at 1.32%. Milling stations 3 and 1 had the next higher values of 1.12 and 0.95 percent respectively. There was significant difference between the village means. The highest village mean of 1.13% was recorded for Jima village (1.13%). This was followed next by 0.80% recorded for Busu village. These values may be due to delaying in the milling process. NRI (1991) and Anon (2008) reported that delay in drying of parboiled rice results in non-enzymatic browning (stack burning) in steeped paddy. The lowest burnt material was 0.30% found in milling station 2 for Gaba, meaning that parboiling and cleaning of rice grains prior to parboiling and milling was better at this station than others. Personal communications with mill operators showed that they had newer mills and therefore they had always taken care to advice women on how to dry paddy before bringing them for milling.

Difference in mean quality of whole rice grains contained in rice samples collected from milling stations in Doko Development Area.

The result for mean quantity of whole grains is presented in Table 5. The villages surveyed showed differences in whole grains recovered after milling. The highest value of 91.41% whole grains was obtained from Doko village. While the highest mean value of 90. 40% whole grains was recorded for milling stations 3. The result of whole grains observed in this study for samples from Doko village might not be unconnected with proper drying of paddy rice or reduction of moisture content in the paddy to be milled. Phan (1998) showed that ideal moisture content for milling is 14 percent. Higher moisture content resulted in powdery products while very dry brittle grains resulted in broken and powdery material after milling. Goodman and Rao (2006), studying the effect of grain type and milled rice kernel hardness on head rice recovery showed a correlation between moisture content of paddy rice at the milling stage and the degree and quantity of whole grains in the milled head rice.

Milled rice output is the proportion of the whole grain in the milled rice. It varies depending on the variety, grain type, chalkiness, cultural practices and drying conditions (USDA, 1997).

CONCLUSION

Improved varietal purity and threshing, including low technology options such as hand threshing on a plastic tarpaulins, can significantly improve the quality of paddy, as can improved parboiling and drying technologies.Improving processing can be done thpaddy more efficient parboiling and milling technologies, and establishing clear market grades and standards that are effectively linked to price differentials for higher quality rice. The creation of market grades and standards must be applied to both domestic and imported rice to help establish nationwide quality benchmarks for the consumers. This will gradually replace imported rice over time.

RECOMMENDATION(S)

Processors will be able to work with producers and buyers to successfully establish what can be acceptable as good quality rice for consumption. There is currently no known local brand of milled rice that is acceptable to the urban consumers. Local rice is not currently available in most urban markets because of low it's low quality. Much can be done by producing high value paddy. Also along the value-chain, much needs to be done in order to deliver rice that can be good substitutes for imported rice especially for urban consumers who recognizes good quality. The use of modern facilities that can produce clean polished and branded rice can help local rice match the quality of imported rice.Are a few areas that need closer investigation and attention by policy-makers in order to make the rice sub-sector more competitive include: strengthening the resolve of the rice processors associations (where they currently exist) to emphasize quality, with a view to encouraging capacities thpaddy training on value addition, consumers' preference, packaging and other useful skills that enhance efficiencies of operation. Still working with processors on the demand side for uniform rice paddy, should be the availability of sufficient quantity of paddy, in order to complement the efforts of multilateral organizations like AfDB, WARDA-FAO/NSPFS, World Bank/FADAMA II in the dissemination and cultivation of NERICA and other productivity-enhancing initiatives at the farm level. In order to achieve good success, government policies on agricultural inputs especially with respect

to fertilizers, credit, improved seeds, and equipment availability needs to be revisited. The need also exists for the conduct of a detailed analysis of the Nigerian rice industry in order to know where competitiveness can be easily achieved given the available conditions (especially with irrigation systems and using NERICA seeds). Secondly, determine the profitability and competitiveness of local rice under different tariff regimes the sensitivity analysis of this may improve the quality of Nigerian rice. It might be important to establish the profitability of every player along the rice market/value chain considering value addition to improve quality. Finally, it is essential to evaluate the strength and weaknesses of the market forces to provide and facilitate the delivery of required services necessary to push Nigerian grown rice to a new level.

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TABLE 1.Geographical locations of rice mills in Doko Area Council where samples were collected

S/N	LOCATION	STATION	LONGITUDE		ESTING'S (M)	NORTHING'S (M)
1	GABA	1	08°55.191'	06°04.415'	178136	987176
		2	08°55.303'	06°04.499'	178291'	987381
		3	08°55.129'	06°04.537'	178361	987059
2	BUSU	1	08°54.847'	06°03.274'	176036	986559
		2	08°54.789'	06°03.278'	176040	986153
		3	08°54.713'	06°03.242'	175976	986313
3	DOKO	1	08°56.538'	05°58.032'	826333	989696
		2	08°56.199'	05°58.173'	826598	989074
		3	08°57.961'	05°57.964'	826208	989840
4	JIMA	1	08°58.560'	05°55.069'	820868	993384
		2	08°58.653'	05°55.199'	821106	993558

Source: Global Positioning System (GPS)

Table 2. Mean percent broken grains of milled rice grains from the four towns

Village	Sampled Mills			
	1	2	3	Mean
Doko	7.78	8.82	7.45	8.02
Gaba	12.76	9.33	6.63	9.57
Jima	5.73	8.02	6.98	6.91
Busu	8.41	9.85	10.21	9.49
Means	8.67	9.01	7.82	

Source: Field survey, 2009

Table 3: Mean percent foreign material found in the samples collected per village

Village	Sampled Mills			
	1	2	3	Mean
Doko	0.38	0.27	0.39	0.35
Gaba	1.07	0.34	0.76	0.72
Jima	1.20	0.57	0.98	0.92
Busu	1.15	0.99	1.24	1.13
Means	0.95	0.54	0.84	

Source: Field survey, 2009

Table 4: Mean percent burnt material found in the samples collected per village

Village	Sampled Mills			
	1	2	3	Mean
Doko	0.43^{e}	0.34^{f}	0.39^{e}	0.39^{C}
Gaba	0.35^{f}	0.30^{f}	0.31^{f}	0.32^{D}
Jimn	0.95^{c}	1.32^{a}	1.12^{b}	1.13^{A}
Busu	0.89^{c}	0.62^{cd}	0.89^{d}	0.80^{B}
Means	0.66	0.72	0.68	

Means in the same column followed by the same capital letters are not significantly different ($P \geq 0.05$)
Means in the same row and columns followed by the same lowered case letters are not significantly different ($P \geq 0.05$).
Source: Field survey, 2009

Table 5: Percent Whole Grains of Milled Rice Found the Samples Collected per Village Area

Village	Sampled Mills			
	1	2	3	Mean
Doko	91.63^{ab}	91.64^{ab}	$90\ 97^{ab}$	91.41
Gaba	83.99^{d}	90.67^{ab}	92.58^{a}	89.08
Jimn	92.48^{a}	90.61^{ab}	89.98^{b}	91.02
Busu	89.64^{c}	88.21^{cb}	87.79^{c}	88.54
Means	89.44	90.11	90.49	

Means in the same row and column followed by the same letter are not statistically significant ($P \geq 0.05$).
Source: Field survey, 2009