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Evaluations of the Physical Characteristics and Proximate Composition of Some Indigenous assertions of rice in North- Central Nigeria

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Abstract

Six locally processed rice assertions each from Benue (gboko), Abuja (gwawalada), Kaduna (Kaduna rice), Nasarawa (keffi), Niger (kpakuti) and Kogi (anyigba) and a Thailand processed rice brand, "tomato", where studied for their physical characteristics and proximate compositions. The grain lengths and widths varied from 5.75-7.31mm and 1.66 - 3.90 mm respectively and they differed with assertions (P<0.05).The lengths per widths of the different assertions of rice ranged between 2.61mm to 4.15 mm.

The 1000 grains per weight ranged between 20.90 to 22.63 grams and 21.70 grams in tomato. Niger (kpakuti) had the least weight and Benue (gboko) and Nasarawa (keffi) had the highest. The highest volume per unit measure of rice from an enamel cylindrical milk cup used for selling rice ; per standard market cup varied from 270.46 to 283.37 mL and they deferred (P<0.05). Nasarawa (keffi) had the least and Abuja (gwagwalada) had the highest volume. Weight per standard cup was between 215.51 g - 224.97 g with Kaduna (Kaduna rice) and Tomato having the highest values. Price per cup was in the range of one hundred and twenty five naira (#125) to one hundred and forty naira per enamel cup (#140). Niger (kpakuti) rice and tomato were being sold for one hundred and fifty naira (#150). The fat content varied from 0.75 -2.65 % while the control sample i.e. tomato had fat content of 0.06 % and they differed significantly (P<0.05). Kaduna (Kaduna rice) had the highest value of 2.65 % and Kogi (anyigba) rice had the least value of 0.75 %. Ash contents ranged between 1.38 % in Kogi (anyigba) rice to 7.50 % highest value in Kaduna (kaduna rice). The moisture contents were highest in Benue (gboko) rice with a value of 11.33 % while the least value was found in Nassarawa (keffi) rice with a moisture content of 6.06 %. Carbohydrate content were in the range of 75.01 % to 8.96 % and it differed with varieties (P<0.05). Nasarawa (keffi) rice had the highest value of 80.96 % followed by Kogi (anyigba) rice with a value of 79.33 %.

Keywords : Physical, assertions, indigenous, North Central Nigeria.

Introduction

Benue (gboko), Nasarawa (keffi), Kogi (anyigba), Niger (kpakuti), Kaduna (kaduna), and Abuja (gwagwalada, federal capital territory) are rice producing areas in north central part of Nigeria. Even though, rice production is still advancing in all ecological zones of Nigeria with different assertions. Processing and adaptation trait for each ecology (Sanni et al., 2005) in the north central, it still remains a major producer of rice. Over the years, farmers in these areas have, through personal experiences in agricultural land uses, produce varieties and assertions of rice that are well suitable to specific local environments, and which meets the particular physical, economic and cultural needs of rural communities and at the same time satisfy the demands of some of their local customers. It is notable that the demand for imported rice varieties had reduced and this had shown that consumers are becoming more concerned in their choice of food, and quality has become a determining factor. Consumption for the fine rice varieties is typically high; however, what is not clear is whether the premium price consumers pay is on the basis of physical or chemical qualities.

Rice, unlike other cereals such as wheat, barley, oat, corn, acha is consumed as whole grains (Ghasemi *et al.,* 2008) and the market value for whole kernel is much more than that for broken kernel. Therefore, physical characteristics such as shape, size, colour, level of impurities, uniformity and general appearance are of outmost importance and are known as grain quality indicator (Chen *et al.*, 1998). The many diverse uses of rice, both domestically and for export, require that physicochemical qualities be evaluated according to its suitability for specific end uses (Karen *et al.*, 2001).

However, most physical and chemical tests may not fully predict consumer acceptability; therefore, the best and final test is to conduct a trained panel sensory evaluation. This has been found useful in assessing acceptability of rice by consumers (Adeyemi, 2006). Although rice quality varies with consumer and end user, some consumers prefer higher head rice yield and more translucent grains. High income consumer pays higher premiums for a larger number of quality characteristics than low income consumers. In order to ensure that the locally adapted rice varieties remain vital and relevant to rural economy and domestic agricultural production, it is the aim of this work to evaluate some physical and chemical properties of some indigenous locally processed rice from the rice producing areas in north central part of Nigeria and compare them with any of the preferred foreign processed rice.

Materials and Method

Six locally grown and processed rice assertions (Niger kpakuti and Kogi anyigba, from Kogi State; Benue gboko, Kaduna rice and Nasarawa keffi from Nasarawa state; and Abuja gwagwalada from FCT) were collected from different commercial mills from different state. A sample of Thailand processed tomato brand, which served as control, was purchased from the ultra modern Kure market, Minna Niger State.

Location: This research project was done at the Food Science and Technology laboratory of the Federal University of Technology, Minna, Niger state

Representative samples were obtained from the pool of the respective sample and stored in an air tight container prior to further analysis.

Ten grains of each of the assertions were measured, using venier calipers as described by Nkama *et al*. (2001) and their average taken for the following physical characteristics: kernel length, width and length/width ratio. The one thousand grain seeds weight as described by Dipti *et al.* (2003) were determined by weighing 100 whole grains of each assertion on a sensitive mettle balance and their weight multiplied by 10.The method described by Miah *et al*.(2002) was used to measure the bulk density of rice. One gram of each sample was weighed into a 10 ml graduated cylinder and vibrated for 1 minute (vibration mill mk-/2) and bulk density expressed as g/ml. Means of triplicate determinations were recorded for all analyses carried out. The volume and weight measure were determined by filling an enamel cylindrical cup with rice and their volume measured using the water displacement method as described by Dipti *et al*. (2003). Their weights were measured using a mettle balance. A cylindrical enamel cup has a depth and volume capacity of 1.45 mm and 270.4 mL (Okaka, 2006). The moisture, protein, fat and ash content were determined by the AOAC (1995) method. The total carbohydrate was determined by difference: Carbohydrate = 100 - % fat + % protein + % moisture + % ash).

Statistical Analysis

Data generated were analyzed using analysis of variance (ANOVA) according to Snedecor and Cochran (1969) to detect any difference in mean values from triplicate determinations of each treatment.

Results and Discussion

The results of the physical properties of the seven rice assertions are presented in Table 1. Their lengths ranged from 5.94 mm-7.61 mm and they differed significantly ($P<0.05$). Dipti *et al*. (2002) classified grains whose length are greater than 6 mm as long, 5 mm- 6 mm, medium and less than 5 mm as short. By this classification, Abakaliki mars are long grain while the other assertions fall within the medium grain range, the quality of rice may be considered from the view point of milling out turn, grain size, shape and the behavior upon cooking, the taste and the flavor of cooked rice (Khush *et al.,* 1979). It was reported that in Bangladesh high income people prefer long slender grains whereas the low income people prefer the short bold grains because of its high volume expansion (Anonymous, 1997). Perhaps that was why the price of Niger kpakuti and that of the foreign Tomato rice was the costliest at #150/volume measure when others were being sold for #100 and #120/measure. The grains which ranged from 1.56 mm-3.60 mm, and they differ quite significantly ($P<0.05$). Niger kpakuti had the highest width size while Nasarawa had the least size. Although rice width appears not to consciously affect consumers choices, it influences the shape of the grain. Ghasemi *et al*. (2008) reported that rice, unlike most other cereals, is consumed as a whole grain, there for physical properties such as size, shape uniformity and general appearance are of outmost importance. The length/ width ratio ranged from 2.11-4.13 and they were found to differ significantly ($P<0.05$). Abuja gwagwalada had the highest of 4.13 and Niger had the lowest value of 2.11. Dipti et al (2002) classified rice into three groups according to their shapes, that is > 3.0 (bold), between 2.0 and 3.0 (round), and <2.0 (slender). With the exception of Niger kpakuti and Kogi that are round, the other varieties are bold. The length/ width ratio (shape) is considered as the first quality characteristics of rice and an important attribute that determines the class of the rice. The most modern rice varieties are short to medium bold and grain shape play an important role both in the people liking and technological properties such as sieving, polishing, storage, as well as cooking (khush *et al.*, 1979).Slender assertions occupy more storage space than round varieties. In other words, if rice is traded on volume, other than in weight, the buyer will gain if it is slender variety. The other important aspect of length and width is uniformity.

Assertions	Length (mm)	Width (mm)	Length/width	1000 grain Weight/ (g)	Volume per cup	Wt per cup	Price per cup (#)
Benue gboko	5.75^{b}	1.91^{bc}	3.57^{c}	22.63^{b}	285.00^{ab}	224.56^{b}	130
Abuja gwagwalada	7.31^{b}	1.99^{b}	4.15^{a}	21.86^{b}	296.36^{ab}	230.33^{bc}	125
Kaduna rice	6.99^{b}	1.80^{b}c	3.52^{c}	21.36^{b}	271.66^{a}	263.52^{cd}	130
Nasarawa keffi	6.28^{b}	1.66^{c}	3.93^{c}	22.63^{a}	266.66^{ab}	207.33^{d}	140
Niger kpakuti	6.77^{b}	3.90^{a}	2.61^{e}	21.03^{a}	280.16^{b}	213.60^{e}	130
Kogi anyigba	6.80^{b}	2.09^{b}	2.66^{d}	20.96^{b}	283.63^{a}	224.97^{a}	125
Tomato	0.78^{b}	1.83^{bc}	3.66^{b}	21.70^{c}	295.00^{ab}	267.58^{cd}	150
LSD		0.41	0.25	0.71	10.63	2.78	

Table1: Physical characteristics of raw rice

The 1000 milled grain weight ranged from 19.60 g- 22.03 g and they differed significantly (P<0.05). Tomato brand had the least grain weight value of 16.60 g and Nasarawa keffi had the highest grain weight of 22.03 g. Grain weight provides information about the size and density of the grain. Grains of different density mill differently and are likely to retain moisture differently and cook differently. Uniform grain weight is important for consistent grain quality. The result shows that the local rice assertions ha more solid matter than the imported variety.

The volume from a standard measuring cup used or selling rice in the open market for the varieties ranged from 270.16 mL – 283.33 mL, and the values differed statistically (P<0.05). Abakaliki mars had the last volume per cup and Ikwo the highest. The values obtained were not got from sorted whole grains, but from admixtures of both broken and whole grains whose proportion or each was unknown. This may have influenced the result obtained had whole grains of each assertion been used. Weights obtained per measuring cup differed quite significantly (P<0.05) amongst the samples, and they ranged from 215.50 g- 224.77 g. Ikwo had more weight and Niger had the least weight. The difference in weight may be as a result of difference in the varieties' solid matter that may have been influenced by environmental conditions and or processing method. Bhattacharya and Murthy (1987) reported that if these assertions were to be marketed on weight basis, buyers would gain by buying those varieties that weigh more for they invariably contain more total solids.

The different prices for which the rice was sold per cup as at the time of the analysis ranges from #140 to #160 (Nigeria currency). Results showed that consumers were paying more for the aesthetics than other attributes. For instance, Niger kpakuti which had the least value in terms of 1000 grain weight and less weight per cup attracted the highest price of 100 Naira. This clearly shows that their first point of quality is aesthetics and in this case the grain size and probably the euphoria of buying imported rice (Tomato).

Table 2 shows the results of the chemical properties of the different rice assertions. Their fat contents ranged from 1.11 – 1.87 %, and were observe to vary significantly (P<0.05). Ikwo had the highest fat value and Ugboka had the least. The results did not differ much from the values of 1.10 – 1.50 % for some milled rice varieties earlier reported by Juliano Goddard (1986). It should be noted that the fat content of milled rice is dependent on the variety and the milling degree. Some fat is more on the bran layer, the more this layer s remove during milling the less the fat content, the easier the grains are prone to spoilage during storage due to oxidation.

The protein contents for the different assertions ranged from 7.23 – 9.22 % and they differed with varieties (P<0.05). Abuja gwagwalada and Benue gboko had the highest and least protein contents respectively. The results showed that Abuja gwagwalada (9.22 %) and Kaduna rice (8.51 %) assertions and Abuja gwagwalada had higher protein content than the Niger kpakuti (7.76 %) and Kogi anyigba (7.76 %) varieties from Kogi State and the imported *Tomato* brand (7.85 %). Protein content of 6.90 % - 8.60 % had been reported (Dipti et al., 2003; FAO, 2004). Dipti *et al*. (2002) reported that the standard value for protein in rice is 7.00 % and values less than 6.00 % are regarded as low and may not meet the nutritional needs of children. The protein content of all the varieties were above the standard of 7.00 % and would meet the nutritional need of children.

Rice Assertions	Fat (%)	Protein (%)	Ash (%)	Moisture (%)	Total carboh ydrate (%)
Benue (gboko)	2.18^{d}	7.23^{e}	2.01^{cd}	11.33^{a}	78.15^{c}
Abuja (gwagwalada)	2.31^{d}	8.22^{a}	6.50^{b}	7.26^{c}	75.71$^{d e}$
Kaduna (Kaduna rice)	2.65^{c}	9.51^{b}	7.50^{a}	7.33^{c}	75.01^{e}
Nasarawa (keffi)	2.11^{e}	7.82^{cd}	1.78^{c}	6.06^{c}	80.96^{a}
Niger (kpakuti)	1.67^{c}	8.76^{de}	3.58^{c}	7.47^{b}	78.52^{bc}
Kogi (anyigba)	1.87^{a}	9.67^{e}	1.19^{d}	10.04^{a}	77.23^{cd}
Tomato	0.75^{b}	7.85^{c}	1.38^{d}	9.06^{b}	79.33^{ab}
LSD	0.06	0.05	1.87	1.43	1.83

Results are mean scores of triplicate sample.

Table 2: Proximate composition of the different rice Assertions

Values having the sample super script in a column are not significantly different at P<0.05. The 1000 milled grains weight ranged from 19.60 g - 22.03 g and they differed significantly (p<0.05).Tomato brand had the least grain weight value of 19.60 g and Nasarawa keffi had the highest grain weight of 22.03 g. Grain weight provides information about the size and density of the grain. Grains of different density mill differently and are likely to retain moisture differently and cook differently. Uniform grain weight is important for consistent grain quality. The result shows that the local rice assertions had more solid matter than the imported variety. The volume from a standard measuring cup used for selling rice in the open market for the varieties ranged from 270.16 mL - 283.33 mL, and the values differed statistically (P<0.05). Niger kpakuti had the least volume per cup and Kogi anyigba the highest. The values obtained were not gotten from sorted whole grain, but from a mixture of both broken and whole grain whose proportion for each was unknown. This may have influenced the result obtained had whole grain of each variety been used. Weights obtained per measuring cup differed quite significantly (P<0.05) amongst the sample, and deranged from 215.50 g - 224.77 g. Ikwo had more weight and Abakaliki had the least weight. The differences in weight may be as a result of differences in the varieties solid matter that may have been influenced by environmental conditions and or processing method. Bhattacharya and murthy (1987) reported that if these varieties were to be marketed on weight basis, buyers would gain by buying those varieties that weigh more for they invariable contain more total solids.

The different prices for which the rice was sold per cup as at the time of analysis ranged from N75 to N85 (Nigeria currency). Result shown that consumers were paying more for aesthetics and than other attributes, for instance, Abakaliki mars which had the least value in terms of weight and volume, more stones, and tomato which had the least value in terms of 1000 grain weight, and less weight per cup attracted the highest price of 85 naira. This clearly shows that the first point of quality is aesthetics and in this case the grain size and probably the euphoria of buying imported rice (tomato).

Table 2 shows the results of the chemical properties of the different rice assertions. Their fat contents ranged from 1.11-1.87 %, and were observed to vary significantly (P<0.05).Ikwo had the highest fat value and Ugboka had the least .the results did not differ much from the values of 1.10-1.50 % for some milled rice assertions earlier reported by Juliano and Goddard (1986). It should be noted that the fat content of milled rice is dependent on the variety of the milling degree. Since fat is more on the brand layer, the more this layer is removed during milling the less the fat content, of the milled rice. Similarly, the higher the fat content, the easier the grains are prone to spoilage during storage due to oxidation.

The protein contents for the different assertions ranged from 7.23-9.22 % and they differ with assertions (P<0.05).Omor mars and Adani mars had the highest and least protein content respectively the result showed that Omor (9.22 %) and Uduma (8.51%) assertions from Anambra and Enugu states had higher protein contents than the Abakaliki (7.76 %) and Ikwo (7.67 %) assertions from Ebonyi state and imported tomato brand (7.85 %). Protein contents of 6.90 % - 8.60 % had been reported by (Dipti et al., 2003; FAO, 2004). Dipti et al. (2002) reported that the standard value for protein in rice is 7.00 % and value less than 6.00 % are regarded as loss and may not meet the nutritional needs of children. The protein contents of all the assertions were above the standard value of 7.00 % and would meet the nutritional need of children.

Rice Assertions	Fat (%)	Protein (%)	Ash (%)	Moisture (%)	Total carbo hydrate (%)
Benue gboko	1.25	7.21	2.4	12.11	78.14
Abuja gwagwalada	1.28	8.99	5.98	7.00	75
Kaduna rice	1.65	7.85	7.23	7.15	80.11
Nasarawa keffi	1.11	7.64	4.77	6.99	78.54
Niger kpakuti	1.67	7.62	3.53	8.00	72.22
Kogi anyigba	1.87	7.67	1.10	13.98	79.44
Tomato	1.62	7.89	1.34	7.45	80.49
LSD					

The ash contents for the varieties derived from 1.19 to 7.50 % on the differed quite significantly (P<0.0) Uduma mars had the highest ash contents and tomato had the least ash contents. The % ash ranged from 1.19 to 7.50%.Ikwomars 91.19%) and tomato 91.38 %) had the least ash contents. Nduma 97.50%) and Omar (6.50%) from Enugu and Anambra states had the highest ash contents. The results showed that all the local varieties except Ikwo ad higher ash contents than the tomato variety. Higher ash contents is an index of higher mineral contents of processed rice (Sujatha et al., 2004).The values obtained were much higher than 0.30% to 0.80% reported by Juliano (1985b). Bhattacharya and Murthy (1987) reported that vitamin and minerals in rice allocated in the outer layers of rice, and a over polishe rice much of his nutrients are lost and by par boiling pardy. The vitamins and minerals are fixed to the inner kernel so that not much is lost during milling.

Moisture contents differed quite significantly (P<0.05) and ranged from 6.06 % to 12.04 %. The percentage moisture contents are within the 12.00 % acceptable values for long time storage of grains (Okaka, 2005).

The total carbohydrates contents ranged from 75.01 to 80.96 % and they differed quite significantly (P<0.05).Ugboka mars had the highest value while Uduma and Omor had the least carbohydrate values.

The carbohydrate contents of Ugboka (80.96 %) and Tomato mars (80.23 %) were higher than the other varieties: Abakaliki mars (78.52 %), Adani mars (78.15 %), Ikwo mars (77.23 %) and Uduma mars (75.01%).the result agrees with the 77-89 % as reported by Jiliano (1985b). However, the high carbohydrate value in Tomato and Ugboka mars may suggest a reduction in the other essential minerals/nutrients in the rice even though the rice is purely a carbohydrate food.

Conclusion

Rice remained the main staple food of the majority of people in Nigeria and will continue to remain so in the future. It provides about 9 % of the total calorie intake, and about 12 % of the total food energy consumed by the people of the world. The physicochemical and sensory properties of the local rice varieties tested compared favorably and in most cases were better than the imported Tomato Brand .The result showed how misinformed consumers were when making choices of what they purchase. Consumers"s choices are often guided by nutritional quality standards, but quite often by physical appearance of the products or influenced by peer group or marketing skills of the traders.

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