A Comparative Study of Physical Properties of Paddy, Unpolished and Polished Rice of Kullan Thondi Rice Variety

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ABSTRACT:

Physical properties of rice are necessary for the designing of new containers to handle, process or even transport. The physical properties of Kullan Thondi rice variety was evaluated in different forms such as paddy, unpolished and polished rice. The length, breadth and thickness of paddy, unpolished and polished forms of rice further determines the other physical properties such as equivalent diameter, sphericity, volume and surface area. The bulk, tapped and true density was found to be $392.51 kg/m^3$, $425.50 kg/m^3$ and $1280.57\ kg/m^3$ respectively. It was found that at different level of processing the length, breadth and thickness of rice grains decreases. This may be due to the removal of husk and polishing of grains. This information will be helpful for optimizing milling operations, designing the storage structures and machinery, to avoid the postharvest and milling losses and to find the end use of the particular rice cultivar.

Key words: Paddy, Polished Rice, Unpolished Rice, Physical Properties of Kullan Thondi Rice Variety, Proximate Nutrients.

INTRODUCTION:

Rice is unique among cereal grains and it is consumed primarily as a whole grain. Rice is recognized as the staple food for more than half of the world's population. In the production of rice, India comes second after China. It is the second-largest rice producer, exporter and consumer after China. The contribution of India towards world paddy production is one fifth (Kumar and Prasad, 2017). In India, rice is grown in 43.86 million ha, and therefore the production level is 104.80 million tones and the productivity is about 2390 kg/ha (Agricultural Statistics at a glance, 2014). The paddy (also, rough rice or rice grain) consists of the hull or husk, an outer protective covering that surrounds the entire grain, which is hard and inedible; whereas the bran, germ and endosperm are the edible portion of the grain. The bran layers protect the inner parts of the kernel. It includes the layers of fibrous tissue with proteins, vitamins, minerals and oil. The fat is mostly of unsaturated type. Unlike the saturated fat, the unsaturated type lowers the cholesterol levels. It is also rich in vitamins like B1, B3, B5, B6 and also minerals like iron, zinc, and manganese and phosphorous. The germ

is that the plant embryo from which a plant emerges. The endosperm which makes up most of the kernel has a lot of starch in it. It is found beneath the bran layers. It is the largest portion of the rice grain. Before consumption, rice undergoes various processing methods. Rice milling comprises of removal or separation of the husk (dehusking) to obtain the edible portion for consumption. Milling procedures helps in the transformation of brown rice to white rice. Brown rice is unpolished whole grain rice that is achieved by removing only the hull or husk. In this process of removal of bran and germs, it results in the dramatic loss of many important nutrients that are essential to us (Zhou and Robards, 2002; Lamberts *et al*., 2007). Kullan Thondi rice variety is cultivated in the state of Kerala. This variety is well accepted among the South Indian mass. In this study the physical properties of paddy, polished and unpolished rice of Kullan Thondi variety has been evaluated.

MATERIALS AND METHODS:

'Kullan Thondi' variety of paddy was selected for determining physical properties of paddy, unpolished rice and polished rice. Kullan thondi rice cultivar was procured from Chandragiri Modern Rice Mill of Kerala state. Raw materials were stored at room temperature after cleaning the dirt and impurities. In addition to this, unpolished and polished grains were grounded to obtain its flour in an electrical mixer and sieved through 100 mesh giant sieve. They were also kept at room temperature for further analysis. In the present study, different forms of Kullan thondi rice cultivar were analysed i.e., paddy, unpolished rice and polished rice. Different types of experiments were carried out to analyse the properties of the selected rice variety.

Kullan thondi paddy, polished and unpolished rice.

PHYSICAL PROPERTIES:

Knowledge of the physical properties of grains is important in their engineering, handling, preservation, quality evaluation, distribution, marketing and utilization. For this reason, size, volume, surface area, thousand grain weights, density, porosity, angle of repose, coefficient

of friction, colour, hardness, cooking and eating qualities are of prime importance. The above mention properties influence the design and evaluation of rice processing including drying, husking, whitening and polishing as well as grading machines, storage and grain moving equipments. The physical properties were measured for paddy, unpolished rice and polished rice of kullan thondi rice variety.

Statistical analysis

The data were analysed statistically using package SPSS 18.0 (SPSS Inc. Chicago, USA) and the means were separated using the Duncan's multiple range test ($p < 0.05$). All the data are presented as the mean with the standard deviation.

RESULTS AND DISCUSSION:

Various physical properties were studied and the results are tabulated as follows

Table 1: Physical properties of paddy, unpolished rice and polished rice

Property	Paddy (Mean±SD)	Unpolished (Mean±SD)	Polished (Mean±SD)
Length (mm)	8.94 ± 0.43^a	6.47 ± 0.50^b	6.21 ± 0.21^b
Breadth (mm)	3.34 ± 0.13^a	2.96 ± 0.15^b	2.93 ± 0.26^b
Thickness (mm)	2.15 ± 0.06^a	2.14 ± 0.29^a	2.03 ± 0.14^a
Equivalent diameter (mm)	4.06 ± 0.21^a	3.46 ± 0.12^b	3.38 ± 0.10^b
Sphericity (%)	44.66 ± 2.00^b	53.29 ± 3.49^a	53.93 ± 3.24^a
Volume (mm^3)	33.69 ± 5.93^a	21.33 ± 2.25^b	19.70 ± 1.94^b
Surface Area (mm^2)	44.24 ± 5.04^a	31.65 ± 2.24^b	29.95 ± 1.79^b
Aspect Ratio	37.43 ± 2.10^b	45.60 ± 6.19^a	47.84 ± 3.97^a
Bulk density (kg/m^3)	392.51 ± 21.69^b	710.28 ± 0.00^a	714.28 ± 0.00^a
Tapped Density(kg/m^3)	425.50 ± 25.38^b	678.73 ± 48.67^a	696.51 ± 39.74^a
True Density (kg/m^3)	1280.57 ± 26.30^b	1312.46 ± 24.35^{ab}	1324.44 ± 34.95^a
Porosity (%)	69.35 ± 1.43^a	45.56 ± 0.98^b	46.04 ± 1.37^b
Angle of repose (degree)	24.35 ± 3.02^a	20.38 ± 0.96^b	20.6 ± 1.15^b

It shows that at different level of processing, length, breadth and thickness of rice grains decreases. This may be due to the removal of husk and polishing of grains. In agreement with the above result, Ghasemi *et al*. (2007) concluded that the average rough rice length, width and thickness for Sorkheh variety were found to be 8.45mm, 2.36 and 1.86mm, respectively. The mean equivalent diameter for paddy, unpolished and polished rice is resulted as 4.06mm, 3.46mm and 3.38mm respectively. Similarly, for Sorkheh and Sazandegi variety it was

3.3mm and 3.4mm respectively. The calculated values of surface area ranged from 44.24 to 29.95 mm^2 at all levels of processing. The bulk density value showed increasing significantly at each level of processing. This may be due to removal of outer layer of rice grain at each level. Zareiforoush *et al*. (2011) reported the results which showed that the grains bulk density increases linearly from 381.77 to 428.5 kg/m^3 with an increase in moisture content from 8 to 24% (d.b.). This was due to the fact that an increase in mass owing to moisture gain in the sample was higher than accompanying volumetric expansion of the bulk.

Porosity (%) of paddy is found to be highest followed by unpolished and polished grains. Calculated mean porosity (%) values along with standard of deviation for paddy, unpolished and polished grains are 69.35±1.43, 45.56±0.98 and 46.04±1.37 respectively. Porosity is a function of bulk density and true density. Significant differences of porosity are seen between paddy with that of unpolished and polished grains.

 Thousand grain weights were found to decrease significantly for every level of processing due to the removal of husk, bran and germ from paddy to polished grains. Mean weight of paddy is found to be 31.20g which is highest, followed by unpolished (27.91g) and polished (25.13g) grains. According to Razavi and Farahmandfar (2008) the thousand grain weight values of Tarommahali, Fajr, Neda cultivars varied from 16.76 to 27.88g. Fajr and Tarom mahali represented highest and lowest value of thousand grain weights in each level of processing, respectively. Thousand grain weights were found to decrease significantly for every level of processing by reason of husk, bran and germ removal from paddy and brown rice, respectively.

Table 2: Colour value of Kullan thondi paddy, unpolished and polished rice.

samples	l*	a*	b*	Hue	chroma
Paddy	55.02±0.27[a]	6.67±0.14[c]	26.32±0.60[a]	75.59±0.17[a]	27.17±0.61[a]
Unpolished	40.85±0.85[b]	9.77±0.29[a]	19.96±0.61[b]	56.39±0.68[c]	23.96±0.62[b]
Polished	54.21±0.35[c]	9.77±0.15[b]	17.43±0.10[c]	60.72±0.30[b]	19.98±0.15[c]

Highest L* value is observed in paddy and lowest in unpolished. However a* and b* values were observed highest in polished and paddy respectively. The values for hue are obtained as paddy(75.59), unpolished(56.39) and polished (60.72), respectively, whereas for chroma it was found to be 27.17±0.61 for paddy, 23.96±0.62 for unpolished and 19.98±0.15 for polished.

Swaminathan and Guha (2016) who studied physical and engineering properties of different rice cultivar stated that Colour parameters like L* (lightness) and average colour difference of paddy cultivars ranged between 75-92 and 7.65-20.17 which is relatively higher than the present study.

Table 3: Grain hardness of different samples.

Sample	Force (N)
Paddy	158.57±8.44
Unpolished	79.52±5.67
Polished	62.62±3.82

Hardness of paddy (158.57±8.44) is significantly higher than unpolished (79.52±5.67) and polished rice (62.62±3.82). A study conducted by Swaminathan and Guha (2016) resulted that lowest values for hardness (48.57 kg) were observed in Burmablack cultivars whereas Neelam Samba (60.28±0.05) and CO49 (61.33±0.04) showed closer values with polished rice in the present study.

CONCLUSION:

From the study, it is concluded that Kullan thondi rice variety showed significant results of physical properties. The mean axial dimensions (length, breadth, thickness) of paddy(8.94mm, 3.34mm, 2.15mm), unpolished(6.47mm, 2.96mm, 2.14mm) and polished rice (3.21mm, 2.93mm, 2.03mm)showed significant difference at each level of processing. Bulk density, porosity and angle of repose were markedly affected by the degree of milling. The true and bulk density of the rice grains increased significantly during the different steps of processing. Porosity of grain and angle of repose indicated significant decrease with the rice processing. Least sphericity value was observed in paddy (44.66%). Lower sphericity values suggest the kernels tend to have a cylindrical shape, which indicates difficulty in getting the kernels to roll than that of grains with high sphericity value.

The investigation has resulted that the physical dimensions and size related characteristics of the paddy, Unpolished rice and Polished rice of kullan Thondi rice cultivar vary significantly. This information will be helpful for optimizing milling operations, designing the storage structures and machinery, to avoid the postharvest and milling losses and to find the end use of the particular rice cultivar.

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