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Rice variety identification using physical parameters

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Abstract
Rice is considered staple food as it is eaten in large quantity in all over world. And it serves as a crucial source of energy and nutrition. With the diverse array of rice varieties cultivated globally, the need for accurate and efficient identification methods becomes paramount. As all rice varieties are not equally valuable unscrupulous persons become tempted to mix up lower cost variety in costly one. Physical attributes of rice like size, shape, cooking characteristics etc. offer lot of avenues for identification of such practices. This study was conducted with objective of using these parameters to identify Basmati and Gujarat 17 verities. It was found in this study that rice variety identification is quite feasible using simple physical parameters particularly for those verities which differ in such parameters i.e. like Basmati and Gujarat 17 used in this study.

Keywords: Rice variety identification, physical parameters of rice

Introduction
Rice (*Oryza sativa* L.) is a staple food for a significant portion of the world's population, serving as a crucial source of energy and nutrition. With the diverse array of rice varieties cultivated globally, the need for accurate and efficient identification methods becomes paramount. As all rice varieties are not equally valuable unscrupulous persons become tempted to mix up lower cost variety in costly one. Physical attributes of rice like size, shape, cooking characteristics etc. offer lot of avenues for identification of such practices. Various similar studies are reported in literature [1–6] but no study is reported which focuses on comparing physico chemical paramours of cheap rice variety Gujarat 17 addition in Basmati rice for the purpose of adulteration detection. This study focuses on this less explored area.

Materials and Methods

Fig 1: Gujarat 17 and Basmati rice photographs

Rice samples of Gujarat 17 and Basmati were procured from local market. Vernier calipers were used to measure length as well as diameter. Weight of 100 kernels were obtained using precision analytical balance. Bulk density of rice was measured by filling 100 ml glass cylinder with grains and then weighing it. Volume of grains was determined by toluene displacement method. 25 g sample was taken grains were counted and then dipped in to toluene and average volume taken per grain was calculated. The same method gave true density. Hardness was tested using manual screw operated hardness tester and force was recoded when grain was broken.

Results and Discussion

Length and Diameter of Grains

Table 1: Basmati rice length and diameter

Length mm	9.35	9.07	8.36	9.5	9.03	9.85	9.37	9.08	9.18	9.35
Diameter mm	1.60	1.83	1.54	1.61	1.98	1.58	1.68	1.65	1.49	1.08

Table 2: Gujarat 17 rice length and diameter

Length mm	5.23	5.27	5.99	5.13	6.08	5.58	5.41	5.39	5.89	5.57
Diameter mm	1.84	1.51	1.51	1.62	1.54	1.95	1.55	1.80	1.76	1.42

Student's T test was performed to compare means of length and length of Gujarat 17 was significantly different from that of Basmati rice. Thus it is possible to detect rice variety using length data. Average length for 10 grains was 9.21 mm for Basmati rice while that of Gujarat 17 was found to be 5.55 mm.
On the contrary to length the average grain diameter of two varieties was not statistically significantly different when compared using Student's T test (α=0.05). Average diameter of Basmati rice was 1.60 mm. Average dimeter of Gujarat 17 was 1.65 mm.

Bulk Density

Table 3: Basmati weight, volume and bulk density

Sample Weight g	20	20	20	25	25
Sample Volume cm^3	27	26	27	34	33
Bulk Density g/cm^3	0.741	0.769	0.741	0.735	0.758

Table 4: Gujarat 17 weight, volume and bulk density

Sample Weight g	20	20	20	25	25
Sample Volume cm^3	25	24	25	30	31
Bulk Density g/cm^3	0.800	0.833	0.800	0.833	0.807

Average bulk density of Basmati was 0.749 g/cm3 while that of Gujarat 17 was found to be 0.815. Bulk density was statistically significantly different as tested by Student's T test (α=0.05). Possibly longer shape of Basmati hinders close packing and decreases bulk density.

Ture Density

Table 5: Basmati weight, volume and true density

Sample Weight g	25.0	25.0	25.0	25.0	25.0
Sample Volume cm^3	23.5	23.8	23.0	23.1	23.1
Bulk Density g/cm^3	1.06	1.05	1.09	1.08	1.08

Table 6: Gujarat 17 weight, volume and true density

Sample Weight g	25.0	25.0	25.0	25.0	25.0
Sample Volume cm^3	18.1	18.2	17.9	18.3	18.2
Bulk Density g/cm^3	1.38	1.37	1.40	1.37	1.37

Ture density reflects denseness of grains. It was expected that true density will be uniform across grains and same was found practically. It was found that on an average Basmati lower true density compared to Gujarat 17 i.e. Basmati grains in study were less dense than Gujarat 17. Average grain density for Basmati grains was 1.07 g/cm3 while that of Gujarat 17 was 1.38 g/cm3. The difference between mean values was statistically significant when compared using Students T test (α=0.05). This means true density can also be used to identify rice variety.

Hardness

Harness values are provided in Newton force required to crack the individual grain. As grains can vary in size and shape large variation is expected in values and same is observed in data. Thus value of hardness of single grain is of no use. But repeating same measurement on 10 grains was enough to clear idea about rice variety.
Basmati: 58.8, 70.56, 107.8, 105.84, 117.6, 103.88, 71.72, 90.16, 111.72, 111.72, 103.88, 117.6, 58.8, 107.8, 94.08
Gujarat 17: 68.6, 58.8, 74.48, 60.7, 70.5, 80.3, 78.4, 68.6, 72.52, 86.2, 86.2, 82.3, 88.2, 90.16, 60.7
Average hardness of Basmati rice grain was 95.46 Newton and that of Gujarat 17 was 75.11. Mean hardness values were statistically significantly different when compared using Students T test (α=0.05). It was observed that hardness recorded here is affected by grain size i.e. larger grains give greater hardness value due to shear mass. This also explains large variation in hardness as there was inherent variation in size of grains.

Weight of 100 Kernels

Weights are listed here for individual grains. They are in milligrams. As there is large diversity between grains we found lot of variation in measurement. Thus as with other measurement it is important to note that it is average of large number of sample that is fairly constant not single measurement. By weighing 100 grains of different varieties we were able to see clear difference between weights.
Basmati: 24.4, 23.9, 21.2, 21, 19.3, 20.2, 22.3, 23.1, 18.1, 24.6, 16.3, 21.5, 16.8, 21.2, 18.9, 18.2, 25.2, 27.3, 23.2, 23.7, 18.9, 21.2, 23.4, 21, 25.4, 21.9, 18.7, 20.4, 17.8, 17.3, 25.9, 20.8, 22.3, 25.5, 23.2, 23.7, 19.3, 19.5, 23.9, 21.9, 25.6, 23.3, 23.7, 22.1, 19.7, 21.5, 19.7, 19.5, 23, 17.8, 21.5, 20, 24.3, 19.9, 22, 24.1, 21, 21.9, 20.4, 19, 21, 25.1, 23.6, 20.9, 15.7, 21.9, 22, 24.6, 15.7, 23.6, 19.3, 21.3, 23.1, 29.1, 24.3, 21.8, 21.7, 24.1, 20.2, 23.2, 22.1, 21.9, 18.5, 16.7, 19.6, 22.1, 18, 22.7, 24.7, 20.3, 18, 18.5, 19.3, 22.1, 23.7, 19.8, 23.8, 19.8, 21.5, 24.1
Gujarat 17: 8.9, 8.8, 13.1, 10.8, 11.6, 12, 10.2, 10.5, 13.6, 12.2, 10, 12.7, 12.4, 11, 12.3, 12.3, 12, 10.2, 10.8, 12.2, 11, 10.6, 10.2, 7.2, 15.2, 9.4, 11.6, 14.6, 11.1, 10.5, 10.8, 9.9, 13.1, 11.3, 12.7, 9.6, 12.2, 8.5, 11.3, 10.3, 10.5, 11.5, 11.3, 12, 12.8, 10.4, 10, 10.6, 12.7, 12.2, 10.2, 7.7, 14.2, 11.8, 13.1, 9.8, 11.8, 13.8, 12.8, 9.2, 11, 7.5, 11.4, 11.7, 12.4, 11.7, 11.3, 12.2, 10.7, 8.1, 13.8, 12.9, 11.1, 11.4, 11.5, 9, 11.6, 12.2, 10.1, 13.1, 11.2, 10.9, 13.1, 12.2, 11.7, 11.1, 8.2, 10.9, 12, 11.7, 10.9, 10, 12.7, 11.4, 14, 10.3, 12.6, 13.9, 15.9, 16.6
Average weight of Basmati grain was 21.52 mg while that of Gujarat 17 was 11.43 mg. The mean weights were statistically significantly different when compared using Student's T test (α=0.05). Thus this simple method is of great significance in variety identification. Similar conclusions are already reported in literature and ours is in agreement with them [1–6].

Conclusion

It was found in this study that rice variety identification is quite feasible using simple physical parameters particularly for those verities which differ in such parameters i.e. like Basmati and Gujarat 17 used in this study. Not only we can identify pure sample but even detection of adulteration is looks possible and can be undertaken as future research direction.

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