

Short Communication

Physicochemical and cooking characteristics of some promising Basmati genotypes

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Abstract

The experiment was conducted to determine the physicochemical and cooking characteristics of seven Basmati rice genotypes. Among the genotypes, hulling, milling and head rice out-turn ranges from 72 - 80%, 64% - 75% and 52 - 61.9% respectively. The highest HR and MR were 80% and 75% respectively found in Type-3 genotype and lowest were 72% and 64% respectively in genotypes Basmati-386 and Taroari Basmati. On the other hand, HRR was the highest (61.9%) in Kasturi and lowest (52%) in both Pusa Basmati-1 and Randhir Basmati. KL, KB and L/B ratio of the genotypes were found highest in Pusa Basmati-1 (7.36mm), Type-3 (1.93mm) and Taroari Basmati (4.24) and lowest in Basmati-386 (6.81mm), Pusa Basmati-1 (1.70mm) and Type-3 (3.55) respectively. Basmati genotypes WU, VER, KEaC and KER range from 130 - 318ml/100g, 3.5 - 4.8, 12.40 - 15.50 and 1.80 - 2.11. Kasturi exhibited significantly higher WU (318ml/100g) whereas Pusa Basmati-1 exhibited the lowest (130ml/100g). The highest VER, KEaC and KER were 4.8, 15.50mm and 2.11, respectively found in Taroari genotypes. Type-3 was lowest (3.5) in VER and Kasturi in both KEaC and KER were 12.40mm and 1.80 respectively. AC of the genotypes ranges from 17.60 to 26.15%. The highest AC (26.15%) was estimated in Basmati-386 and lowest (17.60%) in Kasturi genotypes. ASV ranges from 1.70 to 1.93 of the tested genotypes, highest (1.93) and lowest (1.70) found in Type-3 and Pusa Basmati-1.

Keywords: *Oryza sativa*, milling, physical, thermal, chemical, HR, MR, HRR, VER, KER, India.

Introduction

Basmati rice (*Oryza sativa* L.) is the staple food for more than half of the world's population. About 90% of the world's rice is grown and consumed in Asia [1]. Rice is ranked as the world's number one human food crop [2] and an economically important food crop with nutritional diversification that helps in poverty alleviation [3]. Rice is mostly consumed in whole milled form. Rice milling is a combination of several unit operations to convert paddy into well-milled

silky-white rice, which has superior cooking quality attributes. Grain quality of rice is determined by factors such as grain appearance, nutritional value, cooking and eating quality. Rice is consumed principally as a whole grain and the texture of the whole grain is a matter of primary importance. Rice quality is of great importance for all people involved in producing, processing and consuming rice, because it affects the nutritional and commercial value of grains. Grain quality is based upon objective and subjective criteria, the relative importance of which depends upon the particular end-use. The most important quality components, common to all users, include appearance, milling, aroma, cooking, processing and nutritional quality. Grain quality has become an important issue affecting domestic consumption and international trade of rice [4].

The physicochemical characteristics include grain length, grain breadth, L/B ratio, hulling and milling percentage. The cooking qualities are amylose content (AC), alkali spreading value (ASV), water uptake (WU), volume expansion ratio (VER) and kernel elongation ratio (KER). Grain quality is a very wide area encompassing diverse characters that are directly or indirectly related to exhibit one quality type [5]. Different cultivars showed significant variations in morphological, physicochemical and cooking properties [6]. The gelatinization temperature (GT), gel consistency (GC) and AC are major rice traits, which are directly related to cooking and eating quality. On the other hand, AC, amylopectin structure and protein composition explain the difference in cooking quality of rice [7].

The cooking quality of rice is determined on the basis of physicochemical properties and AC [8]. Cooked rice is composite food consisting of different biopolymers, including starch and proteins, along with moisture as a plasticizer [9]. GT is responsible for cooking time, water absorption and the temperature at which starch irreversibly loses its crystalline order during cooking. The GC is responsible for softness and the AC for texture of cooked rice [10]. Today, the consumers prefer to eat unpolished rice especially traditional rice because of the nutrient value in the bran and their reputation for nutritional excellence. Therefore the demands for brown and parboiled rice are increasing amongst the population [11].

Basmati rice may be graded as export quality rice with normal nutritional quality. Under the above circumstances, this study was undertaken to analyze, evaluate and compare the physicochemical and cooking characteristics of some promising Basmati genotypes.

Material and Methods

The laboratory experiment was conducted during 2010-11 in the Laboratories of the Department of Agricultural Biochemistry, C.S. Azad University of Agriculture and Technology. For this purpose, seven Basmati rice genotypes viz. Taroari Basmati, Basmati-370, Basmati-386, Type-3, Pusa Basmati-1, Ranbir Basmati and Kasturi were procured from the Rice Improvement Unit of the university. Hulling recovery was calculated by dividing the weight of hulled rice by total weight of rough rice sample and multiplying by 100 in the laboratory through Dehusking Machine (Laboratory Rice Sheller, Make-INDOSAW). For milling recovery, sample was placed in the chamber of a Laboratory Polishing Machine (Laboratory Rice Grain Polisher) and processed for one minute, polished rice was determined and milling percentage was calculated by dividing the weight of milled rice by weight of brown rice (50g) and multiplying by hulled rice recovery/100g paddy. The HRR percentage and broken rice were calculated using the standard formula [12]. Milled rice samples were visually observed for the presence of white belly in the kernels and the observations on translucency/chalkiness were recorded. The L/B ratio was calculated by dividing the average length by the average breadth of rice kernel. Based on the L/B ratio, grains were classified into long slender (LS), short slender (SS), medium slender (MS), long bold (LB) and

short bold (SB) [12]. Seed grade on the basis of average length/breadth ratio of the kernel, recorded as per above methods, the samples were categorized into different grade according to Ramaiah Committee (1965). For water uptake (ml/100g), sample was taken into a large test tube containing 10ml distilled water and was cooked by placing the test tube in water bath at 77°C for 35 minutes. The amount of water absorbed by sample was determined by subtracting the unabsorbed water volume from the original volume of water added (10ml). Apparent water uptake on cooking was calculated by multiplying the absorbed water volume by 50. The volume expansion ratio of rice after cooking was calculated in terms of original volume [13]. Kernel elongation ratio was calculated by dividing the average length of cooked kernel by the average length of the raw (uncooked) rice [13]. GT was estimated based on ASV of milled rice. The method developed by Little *et al.* [14] was used to score ASV. The extent of disintegration of kernel due to alkali was rated visually based on a 7-point numerical spreading scale as under. The simplified procedure of [15] was used for estimating the AC. The observed data of the experiment were analyzed by the fixed affixed model using Completely Randomized Design (CRD). The method of analysis of variance employs list square method of estimation for estimating the treatment effects. The hypothesis of the quality of the treatment mean is tested by employing t-test and the quality of paired treatments is tested by t-test.

Results and Discussion

Milling characteristics

In the present investigation, the Basmati genotypes Type-3 recorded maximum mean value for milling characteristics as hulling (80.0 %), milling (75.0%) and Kasturi (61.9%) were head rice recovery respectively, as indicated in Table 1 and Figure 1. The range of variation observed in the present study for hulling (72-80%), milling (65-75%) and head rice out-turn (46.2-61.9%) is satisfactorily comparable to the reported values by Khush *et al.* [16] for HRR (25-65%), Dipti *et al.* [17] for milling out-turn (64-70%) & HRR (61-82%), Bhonsle and Sellappan [18] for hulling (63-81%) & HRR (45-74%), respectively. A significant relationship between hull weight and milling recovery (-0.88**, -0.58*), has been reported by Shobha Rani *et al.* [19].

Physical characteristics

The genotypes recorded maximum mean value for physical characteristics as kernel length (KL), kernel breadth (KB) and kernel L/B ratio (LBR) were Pusa Basmati-1 (7.36 mm), Type-3 (1.93mm) and Taroari Basmati (4.24%) respectively, as indicated in Table 1. All the seven Basmati genotypes studied had long-slender, translucent, white-kernels and recorded genotypes having 6.81 to 7.36mm kernel length, 1.70 to 1.93mm breadth and 3.55 to 4.24 L/B ratio, thus, possess the physical characteristics for Basmati rice as indicated above [20]. However, all the genotypes were satisfactorily qualified to the standard parameters for Basmati rice in respect of grain length, breadth and L/B ratio and appeared to be better in respect of physical characteristics (Table 1, Figure 2). These results are in conformity with Dipti *et al.* [17] who also reported wide variation in grain length from 3.6 to 6.5mm and breadth from 1.7 to 3.7mm in six fine rice varieties grown in Pakistan. Wide variation in L/B ratio from 2.21 to 4.12, 2.62 to 4.55 and from 1.5 to 3.5 have been reported [18, 21, 22] respectively.

Thermal characteristics

Inquisition of the Basmati genotypes Kasturi exhibited significantly higher WU (318ml/100g) than all other Basmati genotypes while Taroari Basmati shown highest VER, KEaC and KER were 4.7, 15.40mm and 2.10, respectively. Among the Basmati genotypes, Taroari Basmati proved to be the best in respect of VER, KEaC and KER on cooking, whereas Pusa Basmati-1, though exhibited lowest WU (130ml/100g), Type-3 in VER 3.5 and Kasturi in both KEaC and KER were 12.40mm and 1.80 respectively as shown in Table-1, Fig.-3.1 & Fig.-3.2. All the

Basmati genotypes had long-slender, translucent, white. Similar results also reported [23, 24]. AC of the Basmati genotypes varied ranges from 17.60 to 26.15%. The highest percentage of amylose (26.15%) was estimated in Bassmati-386 followed by Ranbir Basmati (23.90%) and

Table.1: Mean Performance on Different Physiochemical and Cooking Parameters

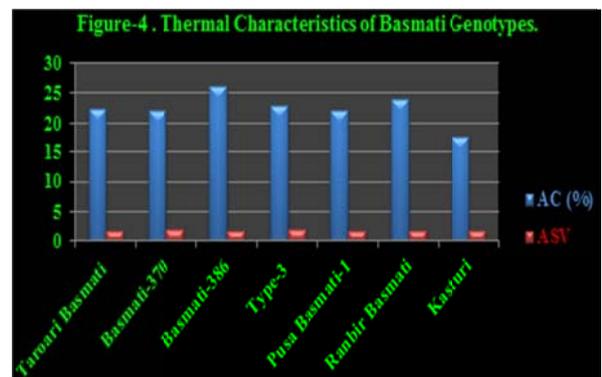
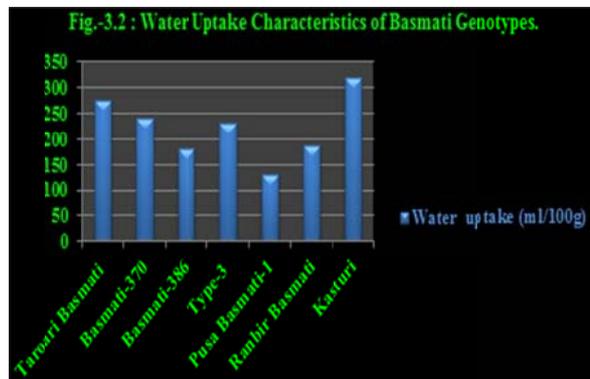
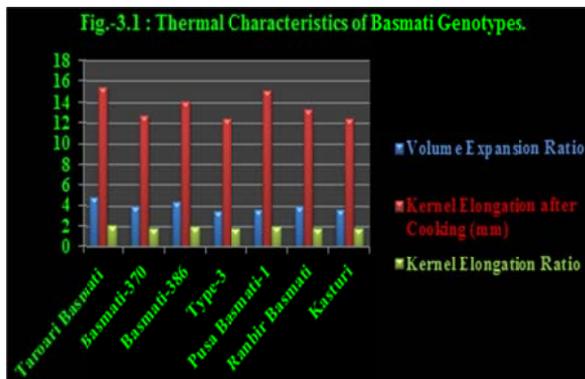
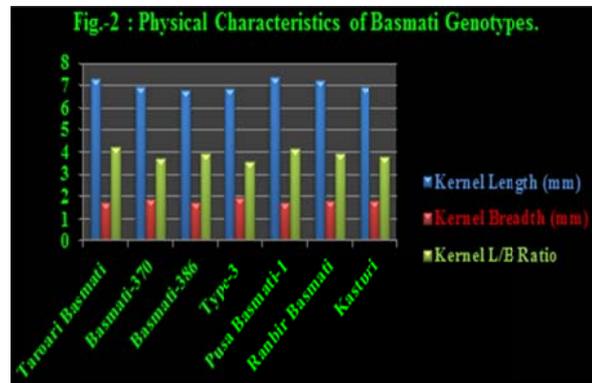
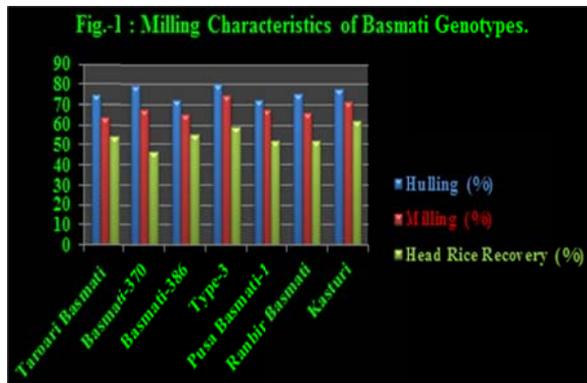
Basmati Genotypes	*HR	*MR	*HRR	**KL	**KB	L/B R	***WU	VER	**KEaC	KER	*AC	ASV
Taroari Basmati	74.9	64.0	54.1	7.34	1.73	4.24	275	4.8	15.50	2.11	22.30	1.73
Basmati-370	79.6	67.9	46.2	6.93	1.86	3.73	240	4.0	12.80	1.85	22.05	1.86
Basmati-386	72.0	65.0	55.3	6.81	1.75	3.89	180	4.4	14.10	2.01	26.15	1.75
Type-3	80.0	75.0	59.0	6.87	1.93	3.55	230	3.5	12.50	1.82	23.00	1.93
Pusa Basmati-1	72.5	68.0	52.0	7.36	1.70	4.13	130	3.7	15.17	2.07	22.20	1.70
Ranbir Basmati	75.5	66.0	52.0	7.20	1.80	3.90	187	3.9	13.36	1.86	23.90	1.80
Kasturi	77.9	71.8	61.9	6.94	1.82	3.81	318	3.7	12.40	1.80	17.60	1.82

*(%) HR=Hulling Recovery, MR=Milling Recovery, HRR=Head Rice Recovery, AC=Amylose Content

** (mm) KL=Kernel Length, KB=Kernel Breadth, KEaC=Kernel Elongation after Cooking

*** (ml/100g) WU=Water uptake

L/B R=Length/Breath Ratio, VER=Volume Expansion Ratio, KER=Kernel Elongation Ratio, ASV=Alkali Spreading Value



lowest (17.60%) were in Kasturi as indicated in Table 1, Figure 4. AC of rice determines the hardness and stickiness of cooked rice. ASV ranges from 1.70 to 1.93 of the tested varieties. The highest ASV found in Type-3 (1.93) followed by Basmati-370 (1.86) and the lowest in Pusa Basmati-1 (1.70).

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