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Evaluation of improved pigeon pea (*Cajanus cajan*) varieties for organoleptic dal quality in India

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Pigeon pea (*Cajanus cajan* L.) is an important pulse crop in the Indian diet and one of the most important sources of dietary protein for the population. Organoleptic qualities of pigeon pea dal were tested to draw conclusions on the preferred varieties. Organoleptic qualities such as taste, texture, aroma, tenderness, sweetness and overall acceptance were tested by a trained sensory panel. Available and commercially viable improved varieties were selected for the analysis. All samples were milled and cooked under the same conditions. Results indicated that PUSA ARHAR 16, one of the improved varieties, presents a good potential in terms of agronomic characteristics for farmers and is also well accepted by the sensory panel during the organoleptic evaluation. Generating sound scientific evidence on organoleptic characteristics of pigeon pea is important for the breeders, as they will evaluate which varieties have a commercial potential and are accepted by the consumers.

Key words: Consumer preferences, organoleptic qualities, pigeon pea, India

INTRODUCTION

Pigeon pea (*Cajanus cajan*) is an important pulse crop in the Indian diet and one of the most important sources of dietary protein for the population. In the context of the fifth phase of the Indo-Swiss Collaboration in Biotechnology (ISCB), an assessment of the physical and organoleptic qualities of dal made from pigeon pea seed was carried out. In India, pigeon pea is mainly consumed as dal which is the preparation in the form of soup made from split seeds of pigeon pea. Its preparation involved cooking (boiling) of split seeds in water followed by frying in vegetable oil with various spices. Dal of pigeon pea is consumed all over the India and constitutes the main constituent of vegetarian diet. Studies of the natural genetic variability of pigeon pea and the presence of its wild relatives in the region indicate that India is the primary center of origin of pigeon pea (Joshi et al., 2001; Saxena, 2008; Saxena et al., 2010; Parray et al., 2019). Several physical, biochemical and organoleptic factors affect dal quality (Singh Raghuvanshi et al., 2011; Chandegara and Joshi, 2002). Thus, an assessment of

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Table 1. Varieties evaluated for organoleptic traits.

Varieties	Pedigree	Agronomic characteristics	Seed color	Seed weight (g/100 seeds)	Place of origin	Year of release
PUSA 992 (Control)	Selection of 90306	Indeterminate growth, semi-spreading, early maturing (135-140 days), yields about 1200-1500 kg/ha, suitable for pigeon pea and wheat cropping system	Yellow brown	8.2	IARI, New Delhi	2002 (CVRC)
AL 882	PUSA 982 X ICPL 85024	Determinate growth habit, early maturing (132 days)	Yellow brown	7.6	IARI, New Delhi	2018
PAU 881	H-89-5 X ICPL 85024	Indeterminate growth, early maturing, semi-spreading, suitable for pigeon pea and wheat cropping system	Yellow brown	7.5	PAU, Ludhiana	2007 (SVRC)
PUSA ARHAR 16	Selection of single plant progeny of superior recombinants selected from the population improvement approach involving diverse genotypes viz., ICP 85059, ICPL 390, ICPL 267, Manak, H-92-39 and ICP 85024	Determinate, erect and compact, extra early, matures in about 120 days, yields about > 1000 kg/ha	Brown	7.4	IARI, New Delhi	2018 (SVRC)
BSMR 853	(ICPL 736 X BDN 1) X BDN 2	Indeterminate growth, spreading, resistant to wilt and sterility mosaic disease	White	11-12	ARS, Badnapur	2001 (SVRC)
BSMR 736	CTP 7217 X No. 148	Red seeds, resistant to wilt and SMD	Red	10-11	ARS, Badnapur	1994 (SVRC)
BDN 711	Sel. From BPG 111	Indeterminate growth, spreading, resistant to wilt and sterility mosaic disease, escape terminal drought	White	10-12	ARS, Badnapur	2012 (SVRC)

these factors and acceptance to consumers is an important aspect of quality in pigeon pea. The overall goal of the ISCB program was to contribute towards food security and sustainable agriculture in India through innovative biotechnology approaches. One component of the program was to breed pigeon pea varieties to overcome production constraints such as low yields, resistance to pod borer (*Helicoverpa armigera*) and maruca pod borer (*Maruca vitrata)*, and early maturity. The study also aimed at identifying market preferred seed types and traits; and understanding of seed supply systems along with utilization of quality seed of improved varieties. Additionally, the study determined which types of pigeon pea varieties farmers grow, the farmers', processors' and consumers' preferences in choice of the grain type, and constraints to production. With these results, research strategies for improvement of pigeon pea production could be formulated (Fromm and Egger, 2018; Fromm and Singh, 2019). An organoleptic evaluation of selected improved pigeon pea varieties was conducted using methods and recommendations found in the literature on best practices for sensory evaluations (Beckley and Kroll, 1996; Lawless and Heymann, 1998; Moskowitz et al., 2003; Lyon, 2001). The aim of this organoleptic evaluation was to identify which newly released variety had acceptable sensory characteristics and is preferred by the panelists.

MATERIALS AND METHODS

Plant material and sample collection

The seeds of the varieties were procured from the Breeding Institutes which developed that variety (Table 1). In the present investigation, the leading pigeon pea varieties of India were utilized to assess the organoleptic evaluation. The major pigeon pea growing area in India is Central zone which comprises about 82% area of India. The leading varieties of these zones are BSMR 853, BDN

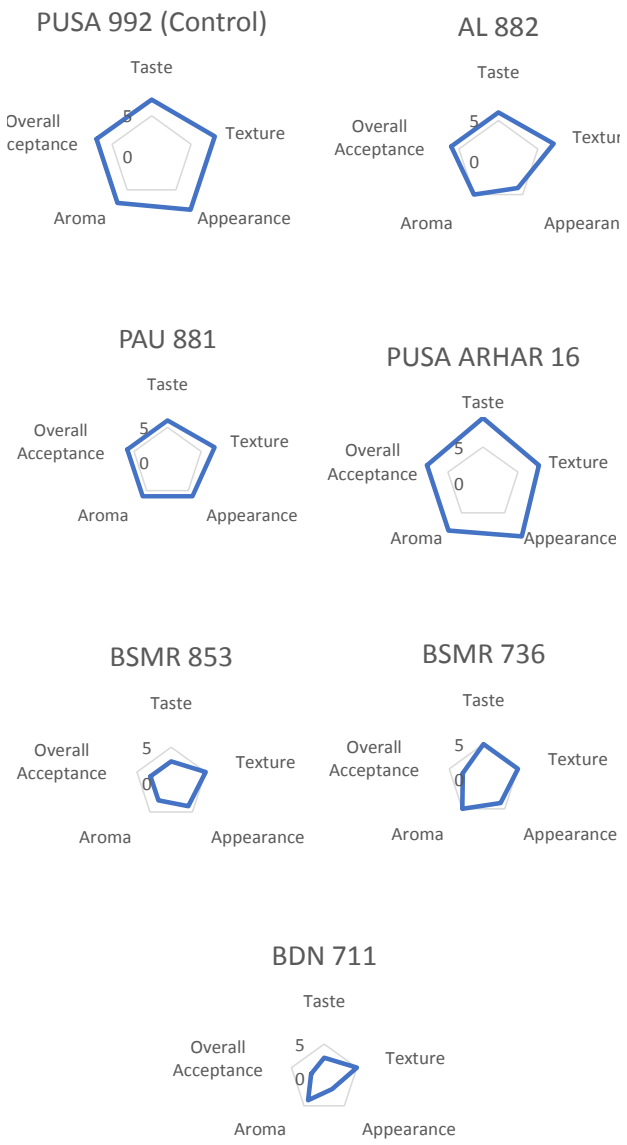

Figure 1. Comparison of organoleptic evaluations.

711, BSMR 753, Maruti and Asha. Out of these, three latest varieties BSMR 853, BDN 711 and BSMR 753 were included in the study. Moreover, from the NWPZ (North West Plain Zone), 5 varieties PUSA 992, PUSA ARHAR 16, AL 882 and PAU 881 were evaluated. In this zone, varieties with short vegetation period are preferred as in the Rabi season wheat crop is taken up after the harvest of pigeon pea. The demand for such varieties with short vegetation is increasing day by day. However, there is always a concern about the organoleptic quality of the pigeon pea dal made from the seeds of such varieties. There is a common understanding that the early maturing varieties do not have good organoleptic quality of dal as compared to traditional varieties. Therefore, it was imperative to test the varieties to come up with conclusive and scientific evidence for the breeders.

Milling of pigeon pea varieties into split dal

A standard protocol was used for milling of seeds into split dal as described (Wani et al., 2011; Navnath et al., 2018). The grains were cleaned and graded initially. Before milling clean-graded grains were subjected to thermal treatment in a temperature controlled rotary roasting equipment in which heating element was centrally placed. Rotational speed of the equipment was adjusted in such a way to have residence time of the grains 3 min. Temperature of roasting was set at 250°C using temperature controller. An amount of 0.5 kg of thermally treated pigeon pea seeds sample was milled in a small manually operated disc mill made up of two iron discs with corrugations. The distance between lower stationary and upper moving disc was kept constant for all samples. After milling, fractions of the samples (gota, unmilled grain, hull, split cotyledons that is, dal and fines) were separated and dhal was obtained (Table 1).

Sensory evaluation

Pigeon pea dal/ soup from the mentioned varieties was prepared by mixing in 1:3 ratio of split dal and water, and pressure cooked until three whistles. The pressure was allowed to be released on its own and then prepared for serving to a trained group of panelists in three sessions. A sensory evaluation of pressure-cooked pigeon pea dal was conducted with an expert panel, using on a 9-point hedonic scale for the traits like appearance, texture, taste, aroma, and overall acceptance. The hedonic scale defined was:

9= Like extremely
8= Like very much
7= Like moderately
6= Like slightly
5= Neither like nor dislike
4= Dislike slightly
3= Dislike moderately
2= Dislike very much
1= Dislike extremely

Sweetness and tenderness were evaluated using a 5-point scale. The defined criteria for sweetness was:

5= Sweet
4= Moderately sweet
3= Neither sweet nor tasteless
2= Tasteless
1= Undesirable

The 5-point scale used to evaluate tenderness was:

5= Desirably soft
4= Moderately soft
3= Neither soft nor hard
2= Moderately hard
1= Very hard

No further statistical analysis was made due to the small sample of pigeon pea.

RESULTS AND DISCUSSION

The results of the sensory evaluation indicated that pigeon pea variety PUSA ARHAR 16 was favored in terms of taste, texture, appearance, aroma and overall acceptance (Figure 1). Pigeon pea variety PUSA 992 was used as the control variable and was favored by the panel in terms of the organoleptic characteristic tested. Pigeon pea varieties BSMR 853 and BDN 711 were the

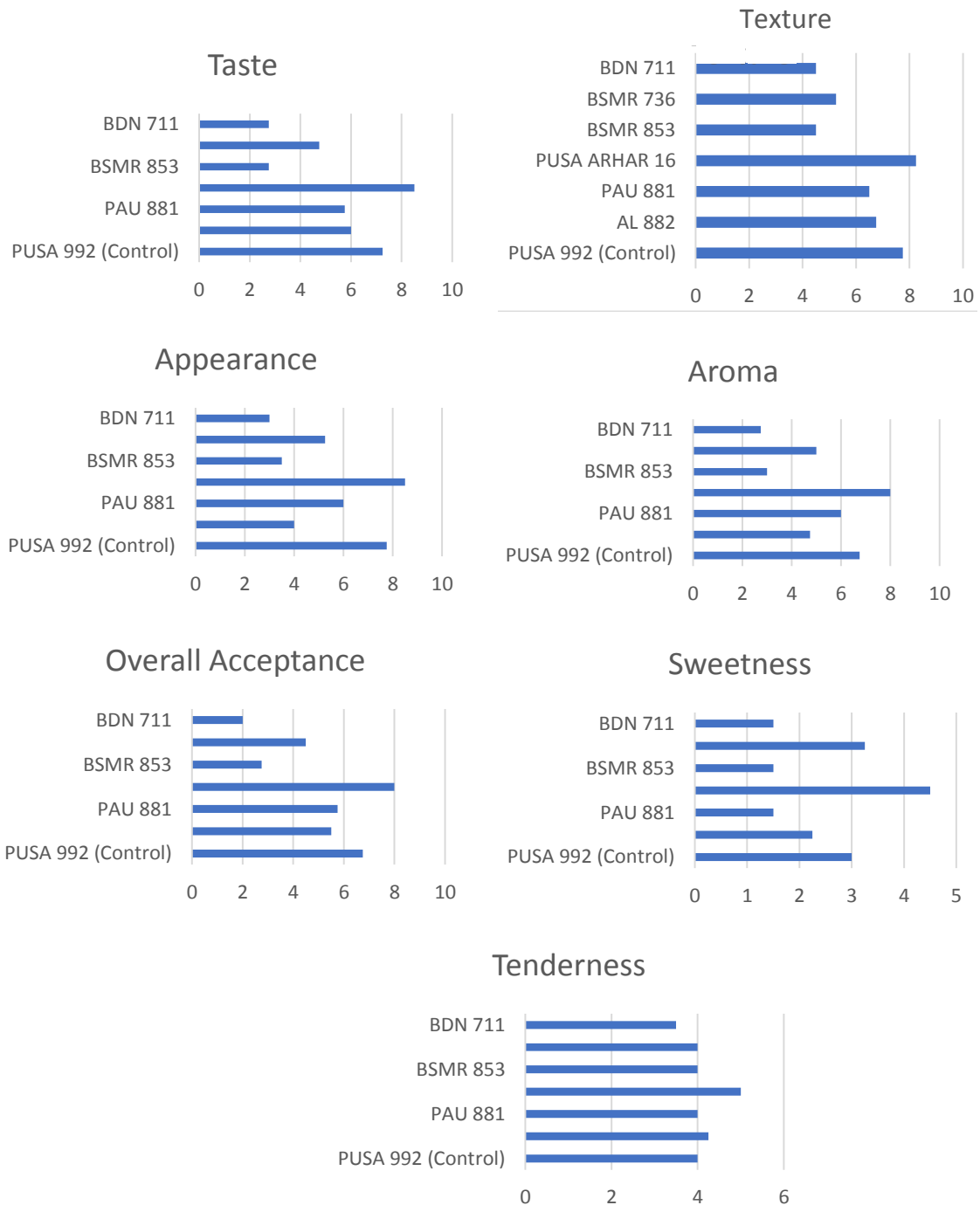

Figure 2. Ratings of organoleptic evaluations per characteristic.

least favored varieties.

Pigeon pea variety PUSA 992 was used as a control because of its wide availability in the market and wide consumption across India. Both the control and improved variety PUSA ARHAR 16 was rated highest scores, 8 and 9, for overall acceptance (Figure 2). Sweetness and tenderness where rated using a different scale. Sweetness of pigeon pea dal in India is understood as a positive characteristic and although dal is consumed as a savory dish, notes of sweetness are favored by the local consumers. PUSA ARHAR 16 and BSMR 736 were evaluated as having this sweetness quality. The results indicated that most varieties are moderately soft, PUSA ARHAR 16 having the most tender quality. Tenderness is also considered a desirable trait by the local consumers and is also perceived as an indication of faster cooking

time.

Conclusion

The organoleptic evaluation of the selected improved pigeon pea varieties gives an indication of which of the varieties can be released to the market with a higher possibility of commercial success. It is of paramount importance to breeders that the genetic material and varieties they have worked on for many years are not only accepted by the farmers because of their improved characteristics (that is early maturity, drought and pest resistance, higher yields) but also accepted by the consumers because of their good organoleptic characteristics. Based on the results of the organoleptic evaluation, PUSA ARHAR 16 presents the most favorable scores, which are likely to be accepted by consumers. The agronomic traits of this improved variety are also favorable for the farmers and present a good potential for wider cultivation in India.

CONFLICT OF INTERESTS

The authors have not declared any conflict of interests.

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