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INTRODUCTION

Cooking time and sensory quality are two important traits when selecting dry beans for consumption, but have largely been overlooked by breeders in favor of yield and other traits. Dry beans are an affordable, nutrient-rich food, but often require long cooking times, particularly without prior soaking. They also display a range of sensory characteristics, with consumers preferring cooked beans that are sweet and soft[1]. Increased interest in dry beans to make new products necessitates studies assessing the diversity of sensory traits in beans, which would allow beans to be selected for specific products. In this study, the Andean Diversity Panel[2] (ADP) was assessed for cooking time and sensory characteristics in order to identify diversity for these traits.

MATERIALS AND METHODS

Cooking Time Evaluation: 398 genotypes of the ADP were harvested in Hawassa, Ethiopia in 2015, six months prior to evaluation. Prior to cooking, each sample was soaked for 12 hours in 250 ml distilled water after ensuring moisture content was between 10-14%. Two replicates per genotype of 25 seeds each were cooked in random order in boiling distilled water using the Mattson cooker method for determining cooking time[3]. The Mattson cooker uses twenty-five 85g stainless steel rods with 2mm diameter pins that pierce beans loaded in wells when sufficiently cooked. For this study, the 50% and 80% cooking times were recorded, and the 80% cook time is regarded as the time required to cook each genotype to completion. The cooking time data was analyzed using the MIXED procedure in SAS with genotype as a fixed effect and rep as a random effect.

Sensory Analysis: Before sensory evaluations were made, a panel of reviewers was trained to rate boiled beans using the determined hedonic scales (Table 1). Once training was complete, sensory evaluations of 388 genotypes from the ADP commenced. The beans were prepared by boiling to the length of time determined using the Mattson cooker, and lemon water was used as a palette cleanser between genotypes. Four panelists tasted twenty genotypes per session and evaluated them according to their training. Each genotype was tasted in two separate sessions for a total of eight evaluations per genotype. Following collection of sensory ratings of the diversity panel, the data was analyzed using the MIXED procedure in SAS, with genotype as a fixed effect. Random effects included rep, reviewer, session, reviewer*seed type, and session*seed type. Seed type was also evaluated as a fixed effect with the random effect genotype(seed type) included in the model.

RESULTS AND DISCUSSION

The genotypes and seed types investigated in this panel exhibited a diversity of cooking times and sensory characteristics (Table 2). The cooking times ranged from 16.7 to 68.9 minutes across the for the 2015 harvest. The distribution of cooking times by seed type covered a narrower range, but cooking time differences among seed types are still apparent. ANOVAs at the genotype and seed type levels revealed significantly different cooking times among genotypes and seed types at $\alpha = 0.05$.

For sensory characteristics, the genotype level showed statistical significance at $\alpha = 0.05$ for all traits but beany, cooked, and earthy. This reflects a range of sensory characteristics present in the ADP and provides information regarding which beans may perform well as ingredients, as

extremes for future sensory evaluations, or even as potential breeding material. As the seed type level showed statistical significance in few sensory characteristics, it appears that a range of sensory characteristics exist within each seed type. This suggests that currently, seed type does not define the flavor or texture of a dry bean, but presents an opportunity to target consistent, desirable sensory profiles when breeding dry beans for current and new market classes.

Future work involves a second year of data collection and association mapping to reveal genomic loci that influence cooking time and sensory traits. This information can enable breeders to target faster cooking times and specific sensory profiles and allow for improvement of agronomic traits without sacrificing desirable cooking time and sensory quality.

Table 1: 5-point hedonic scales used by reviewers for evaluation of sensory characteristics.

5-Point Hedonic Sensory Evaluation Scales	
Flavor Intensity	1-5, bland to strongly flavored
Beany	1-5, no/very little bean flavor to very bean flavored
Cooked	1-5, very raw flavor to very cooked flavor
Vegetative	1-5, no vegetative flavor to very strong vegetative flavor
Earthy	1-5, no earthy flavor to very strong earthy flavor
Starchy	1-5, no starchy flavor to very strong starchy flavor
Sweet	1-5, no sweetness to very sweet
Bitter	1-5, no bitter flavor to very bitter
Seed Coat	1-5, no perceptible seed coat to very tough seed coat
Texture	1-5: mushy (1), smooth (2), grainy (3), thicker grainy quality (4), or chunky (5)

Table 2: Cooking time and sensory data for the ADP 2015 harvest. Number of genotypes (N), or seed types for "Cook Time (S)", mean, median, range, and p-values from the analyses of variance of the cooking time and sensory evaluation data of the diversity panel.

	N	**Min**	**Median**	**Mean**	**Max**	**St. Dev**	**CV%**	**P-value**
Cook Time	398	16.70	30.30	31.48	68.88	7.14	10.37	<.0001
Cook Time (S)	26	23.05	30.69	30.87	39.77	3.23	8.14	<.0001
Flavor Intensity	388	1.75	2.88	2.87	3.88	0.44	15.28	<.0001
Beany	388	1.75	2.75	2.78	4.00	0.41	14.71	0.1731
Cooked	388	3.63	4.50	4.50	5.00	0.30	6.56	0.0814
Vegetative	388	1.13	2.00	2.02	3.38	0.38	18.99	<.0001
Earthy	388	1.13	1.88	1.97	3.14	0.34	17.49	0.1808
Starchy	388	1.88	3.13	3.10	4.38	0.37	12.07	<.0001
Sweet	388	1.00	1.63	1.65	3.25	0.39	23.55	<.0001
Bitter	388	1.00	1.63	1.69	3.88	0.37	21.99	<.0001
Seed Coat	388	1.75	3.00	2.97	8.38	0.48	16.13	<.0001
Texture	388	1.25	2.63	2.61	4.00	0.42	16.24	<.0001

REFERENCES:

1. Mkanda, A. V., Minnaar, A. & De Kock, H. L. Relating consumer preferences to sensory and physicochemical properties of dry beans (Phaseolus vulgaris). *J. Sci. Food Agric.* **87,** 2868–2879 (2007). **2.** Cichy, K. A. *et al.* A Phaseolus vulgaris diversity panel for andean bean improvement. *Crop Sci.* **55,** 2149–2160 (2015). **3.** Wang, N., Daun, J. K. & Malcolmson, L. J. Relationship between physicochemical and cooking properties, and effects of cooking on antinutrients, of yellow field peas (Pisum sativum). *J. Sci. Food Agric.* **83,** 1228–1237 (2003).