BEAN QUALITY ACCESSED BY DIFFERENT SOAKING AND COOKING METHODS.

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Common bean is the most important staple foods for Brazilian population and also an important source of protein, carbohydrate and fiber. Among the bean quality parameters grain appearance (size, color and shape) is the most decisive that leads the consumer to buy the product, followed by cooking time and taste. More than 80% of Brazilian population live in the cities and bean consumption is diminishing due to long cooking time. The bean industries try to capture bigger market share by offering canned bean, but the majority of the commercial cultivars do not have the appropriate canning quality.

The cooking time of large grains such as WAF 69, SUG 33 and DRK 18 (from CIAT), and small grains as BRS Radiante, Pérola and BRS Valente (from Embrapa Rice and Beans) were evaluated by Mattson method after soaking at different salt solutions. Two concentrations (0,5% and 1%) of NaCl, KCl, Urea, K_2SO_4 and distilled water were applied and compared to potash water (extracted from upland rice straw) in full strength and 50% diluted in water. The beans were evaluated for cooking time and the content of soluble solids in broth. Another experiment was to evaluate the cooking time of BRS Horizonte (carioca) and BRS Grafite (black), both are Embrapa Rice and Beans cultivars, with variable soaking time and water:grain ratio, in presto cooker and conventional cooking pan on common gas stove with high and low heat.

The greatest reduction of cooking time was observed when beans were soaked in potash water (Table 1). Soaking in KCl at 0,5 % did not shorten the cooking time, but reduced the cooking time by 4 minutes when soaked in 1.0% solution. At 0.5 % concentration, the SO_4^- anions were more efficient in reducing the cooking time than the Cl^-. The cooking time for beans in K_2SO_4 at 0.5 and 1.0% was almost the same, whereas urea at 0,5% showed shorter cooking time than in 1.0% solution. There was a positive correlation between cooking time and soluble solids content for beans. The grains soaked in full strength potash water gave the second highest soluble solids content and the highest tegument cracking, what lead to cooking time reduction. The high potassium content (4,3%) found in potash water might cause this cooking time reduction. Potassium derived from KCl or K_2SO_4 did not show the same efficiency as potash water in reducing cooking time, hence other chemical components in potash water may be involved in this process, which deserves further studies. Large grain size, such as SUG 33 and WAF 69, needed longer cooking time and gave lower content of soluble solids in the broth. Large seeded DRK 18 showed good canning properties with the shortest cooking time, it has an intermediary soluble solids content and higher percentage of non cracked seed coat. Medium grain size such as BRS Radiante had shorter cooking time when compared to small seeded Pérola or BRS Valente at all salt concentrations for soaking. The best grain:water ratio for cooking beans with presto cooker was 1:3 (w/v) and 1:5 (w/v) with and without previous grains soaking, respectively. For conventional pan, the satisfactory ratio was obtained at 1:4,5 (w/v) and 1:6,5 (w/v) with and without grain soaking, respectively (Table 2). Suitable appearance was obtained, when beans were presoaked or not, and cooked either by presto cooker or conventional pan with beans:water ratio of 1:7,5 (w/v) and at low heat for 20 minutes (as previously determined by Mattson method) (Table 2).

It can be concluded that the canning quality depends on bean cultivars, seed size and presoaking in salt solutions. The potash water gave overall positive effects on some grain quality parameters, hence it deserves further research to identify the factors that are related to beans cooking time reduction. When beans are cooked in presto cooker after soaking, a better appearance and less cooking time can be achieved. This method showed better correlation to Mattson cooking test.

Table 1[(*)]. Bean quality of different cultivars of common beans submitted to different soaking solutions at variable chemical concentrations.

Cooking time (min.)

| Identification | \multicolumn{5}{}{0,50%} | 50% | | \multicolumn{5}{}{1,00%} | 100% | |
	H_2O	NaCl	KCl	Urea	K_2SO_4	Potash	Average	H_2O	NaCl	KCl	Urea	K_2SO_4	Potash	Average
WAF 69	39,5	30,5	34,0	26,0	29,5	26,5	31,0a	39,5	24,5	26,5	29,5	28,5	21,5	26,9a
SUG 33	37,0	32,0	32,0	32,0	24,5	26,0	30,6a	37,0	28,5	21,5	33,0	25,5	21,0	26,7a
DRK 18	21,0	21,5	21,0	20,5	18,5	18,5	20,2c	21,0	17,0	22,0	20,5	16,0	14,0	18,3d
BRS Radiante	19,5	18,5	17,5	17,0	20,5	16,5	18,3d	19,5	18,0	19,5	21,5	22,5	16,0	19,3c
Pérola	23,5	22,0	22,5	19,0	23,5	19,0	21,6b	23,5	19,5	21,5	23,5	24,5	16,5	21,2b
BRS Valente	22,5	21,5	23,5	17,5	19,5	16,5	20,2c	22,5	18,0	19,5	23,5	20,5	14,0	19,3c
Average	27,2a	24,3b	25,1b	22,0c	22,7c	20,5d		27,2a	20,9d	21,8d	25,3b	22,9c	17,2e	

Soluble Solids (%)

Identification	H_2O	NaCl	KCl	Urea	K_2SO_4	Potash	Average	H_2O	NaCl	KCl	Urea	K_2SO_4	Potash	Average
WAF 69	7,6	5,4	6,2	7,6	6,8	7,8	6,9c	7,6	7,6	5,7	7,9	7,0	7,7	7,1e
SUG 33	6,5	4,3	5,0	7,3	7,0	7,4	6,3d	6,5	6,9	5,0	7,2	6,6	7,2	6,5f
DRK 18	7,7	5,9	7,6	8,2	7,9	8,0	7,6b	7,7	7,9	7,9	10,3	7,5	7,5	8,1c
BRS Radiante	6,3	5,9	7,1	9,3	8,5	8,6	7,6b	6,3	8,1	5,9	9,4	8,7	8,2	8,0d
Pérola	6,2	7,8	8,8	10,9	10,5	10,9	9,2a	6,2	10,2	9,1	11,1	10,1	9,6	9,9b
BRS Valente	6,3	9,0	9,3	11,0	10,5	10,5	9,4a	6,3	11,0	9,7	12,0	10,5	9,5	10,4a
Average	6,8d	6,4e	7,3c	9,1a	8,5b	8,9ab			8,6b	7,2d	9,7a	8,4bc	8,3c	

Whole Grains after Cooking (%)

Identification	H_2O	NaCl	KCl	Urea	K_2SO_4	Potash	Average	H_2O	NaCl	KCl	Urea	K_2SO_4	Potash	Average
WAF 69	76	63	93	99	72	79	80d	76	93	93	94	81	86	88d
SUG 33	97	88	99	94	97	96	95bc	97	90	97	96	97	81	93bc
DRK 18	99	100	99	98	99	89	97a	99	96	98	97	99	86	96a
BRS Radiante	100	94	96	97	87	87	94c	100	96	98	98	90	81	93ab
Pérola	96	95	93	98	97	89	95c	96	93	94	98	92	87	93ab
BRS Valente	99	90	98	98	96	93	96ab	99	88	92	86	91	87	90c
Average	95b	88cd	96ab	97a	91c	89d		95a	92ab	93a	93a	92b	92c	

[*]Values followed by the same letters are not different at 5% probability.

Table 2. Effects of different cooking methods on common beans appearance.

Bean Identification	Cooking Method	\multicolumn{5}{}{*Presto cooker}					\multicolumn{5}{}{*Conventional}				
		\multicolumn{2}{}{Presoaked grains}		\multicolumn{3}{}{Non presoaked grains}			\multicolumn{3}{}{Presoaked grains}			\multicolumn{3}{}{Non presoaked grains}		
		Cooking time (min.)/ Grain:water ratio (w/v)										
		10	20	20	30	35	20	40	45	20	60	65
		1:3		1:7,5	1:5		1:7,5	1:4,5		1:7,5	1:6,5	
BRS Horizonte (carioca)	Low fire	S	S	S	VS	VS	B	S	VS	VB	LS	VS
	High fire	Nd	nd	LS	nd	nd	VS	Nd	nd	VB	nd	Nd
BRS Grafite (black)	Low fire	S	VS	S	S	VS	B	S	VS	B	LS	VS
	High fire	nd	nd	S	nd	nd	S	Nd	nd	B	nd	Nd

*nd: not determined; S: Satisfactory (Whole cooked grains); VS: Very Satisfactory (Whole grains very cooked); B: Bad (Whole hard grains); LS: Less Satisfactory (Cooked split grains); VB: Very Bad (Hard and split grains).