ABSTRACT SUBMISSION

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Text Abstract

This study aims to investigate the potential of red and white whole grain sorghum flour to develope gluten-free bread (GFB) with sensory accepted properties.

Red (BRS332) and white (BRS501R) sorghum grain, produced by Embrapa Milho e Sorgo, were milled to produce fine flour. A 22 factorial design with two repetitions of the central point was used to study sorghum flour (SF) and water (W) levels in GFB acceptability. Experimental breads were prepared based on a single formulation made with SF and composite formulations prepared with 50 and 75% SF combined with potato starch. The W levels ranged from 100 to 140% (flour basis). Fifty-two consumers evaluated the sensory acceptability of the breads. They had no gluten-related disease, but they were aware that they were tasting GFBs. Consumers scored the appearance, colour, aroma, texture, taste and overall acceptability of the formulations on a 10-cm hybrid hedonic scale.

All the GFB formulations containing red SF were well-accepted (scores ranging from 7.4 to 8.5). No significant differences were observed between the acceptability scores of single and composite formulations for all evaluated sensory attributes. The red SF and water levels had no effect on GFB acceptability. Composite formulations prepared with 50 and 75% white SF and potato starch were also well-accepted (scores ranging from 7.6 to 8.8). Increasing water levels is required in single formulation to increase the scores for texture (from 6.3 to 7.3) and global acceptability (from 6.9 to 7.6). The internal preference mapping for overall acceptability showed preference to formulations with 50%SF/140%W and 75%SF/120%W. These GFB presented 9.5 and 15.4g of whole grain per 50g serving, respectively.

This research highlights the great potential of red and white SF for producing nutrient-dense and acceptable GFB, which is important for consumers with gluten-related disorders since GFB often lack nutrition content and acceptability.

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Approval Confirm

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Potential of red and white whole grain sorghum flour in gluten-free breadmaking: A study on consumer acceptability

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INTRODUCTION

More research and development are required to increase the variety of better-tasting and healthy gluten-free bread (GFB).

This can be done by incorporating raw materials rich in nutrients and bioactive compounds, such sorghum (*Sorghum bicolor*), into the formulations [1].

This study aims to investigate the potential of red and white whole grain sorghum flour to develop GFB with sensory accepted properties.

MATERIALS AND METHODS

Experimental design and gluten-free bread preparation

Figure 1 - Representative images of gluten-free bread formulations prepared with a 2^2 factorial design with 2 centre points to study the effects of white and red sorghum flour (WSF and RFS) and water (W) levels on a flour basis.

Sensory acceptability test and preference mapping

Fifty-two consumers scored the appearance, colour, aroma, texture, flavour and overall acceptability of the formulations on a 10-cm hybrid hedonic scale [3].

The internal preference mapping was evaluated in relation to overall acceptability. First, cluster analysis was applied to the samples. After this, the resultant matrix was subjected to multidimensional scaling analysis.

RESULTS AND DISCUSSION

Table 1 - Acceptability scores of gluten-free bread formulations prepared with a factorial design to study the effects of white sorghum flour (WSF) and water levels on a flour basis

Coded factors (Uncoded - flour basis)			Acceptability scores on a 10 cm scale					
Trial	WSF	Water	Appearance	Colour	Aroma	Texture	Flavour	Overall
1	-1 (50%)	-1 (100%)	8.50 ^{a} ± 1.59	8.44 ^{a} ± 1.65	8.75 ^{a} ± 1.45	7.90 ^{ab} ± 1.73	8.10 ^{ab} ± 1.55	8.13 ^{ab} ± 1.47
2	+1 (100%)	-1 (100%)	7.94 ^{a} ± 1.83	7.73 ^{a} ± 1.89	7.58 ^{b} ± 1.85	6.29 ^{c} ± 2.11	6.74 ^{c} ± 2.33	6.86 ^{c} ± 1.94
3	-1 (50%)	+1 (140%)	8.46 ^{a} ± 1.39	8.58 ^{a} ± 1.36	8.61 ^{a} ± 1.59	8.41 ^{a} ± 1.61	8.74 ^{a} ± 1.33	8.89 ^{a} ± 1.39
4	+1 (100%)	+1 (140%)	8.21 ^{a} ± 1.56	7.99 ^{a} ± 1.72	8.01 ^{ab} ± 1.63	7.17 ^{bc} ± 2.35	7.69 ^{bc} ± 1.71	7.60 ^{bc} ± 1.75
5	0 (75%)	0 (120%)	8.29 ^{a} ± 1.72	8.24 ^{a} ± 1.74	8.49 ^{a} ± 1.66	7.61 ^{ab} ± 1.90	8.15 ^{ab} ± 1.82	8.15 ^{ab} ± 1.55
6	0 (75%)	0 (120%)	8.26 ^{a} ± 1.72	8.10 ^{a} ± 1.75	8.63 ^{a} ± 1.48	7.56 ^{ab} ± 1.98	8.00 ^{ab} ± 2.10	8.21 ^{ab} ± 1.57

Values are mean ± standard deviation (n=52). The values followed by a different letter in each row are significantly different ($P < 0.05$).

Composite formulations prepared with 50 and 75% WSF and potato starch were well-accepted (scores ranging from 7.6 to 8.8)

Increasing water levels is required in single WSF formulation to increase the scores for texture (from 6.3 to 7.3) and global acceptability (from 6.9 to 7.6).

Table 2 - Acceptability scores of gluten-free bread formulations prepared with a factorial design to study the effects of red sorghum flour (RSF) and water levels on a flour basis.

Coded factors (Uncoded - flour basis)			Acceptability scores on a 10 cm scale					
Trial	RSF	Water	Appearance	Colour	Aroma	Texture	Flavour	Overall
1	-1 (50%)	-1 (100%)	8.05 ^{a} ± 1.76	8.03 ^{a} ± 1.69	8.45 ^{a} ± 1.96	7.65 ^{a} ± 2.03	8.33 ^{ab} ± 1.79	8.18 ^{a} ± 1.62
2	+1 (100%)	-1 (100%)	8.33 ^{a} ± 1.76	8.33 ^{a} ± 1.64	8.33 ^{a} ± 2.03	7.43 ^{a} ± 1.93	7.51 ^{b} ± 2.15	7.72 ^{a} ± 1.80
3	-1 (50%)	+1 (140%)	7.77 ^{a} ± 1.90	7.56 ^{a} ± 2.05	8.50 ^{a} ± 1.65	8.40 ^{a} ± 1.83	8.65 ^{a} ± 1.71	8.48 ^{a} ± 1.61
4	+1 (100%)	+1 (140%)	8.36 ^{a} ± 1.72	8.30 ^{a} ± 1.88	8.46 ^{a} ± 1.53	8.16 ^{a} ± 1.99	8.08 ^{ab} ± 1.86	8.20 ^{a} ± 1.62
5	0 (75%)	0 (120%)	7.91 ^{a} ± 1.91	7.97 ^{a} ± 1.88	8.49 ^{a} ± 1.64	7.88 ^{a} ± 2.02	8.50 ^{ab} ± 1.50	8.38 ^{a} ± 1.42
6	0 (75%)	0 (120%)	7.63 ^{a} ± 1.84	7.52 ^{a} ± 1.84	8.50 ^{a} ± 1.75	7.77 ^{a} ± 1.89	8.06 ^{ab} ± 1.86	7.99 ^{a} ± 1.54

Values are mean ± standard deviation (n=52). The values followed by a different letter in each row are significantly different ($P < 0.05$).

All the GFB formulations containing RSF were well-accepted (scores ranging from 7.4 to 8.5).

No significant differences were observed between the acceptability scores of single and composite formulations for all evaluated sensory attributes. The red SF and water levels had no effect on GFB acceptability.

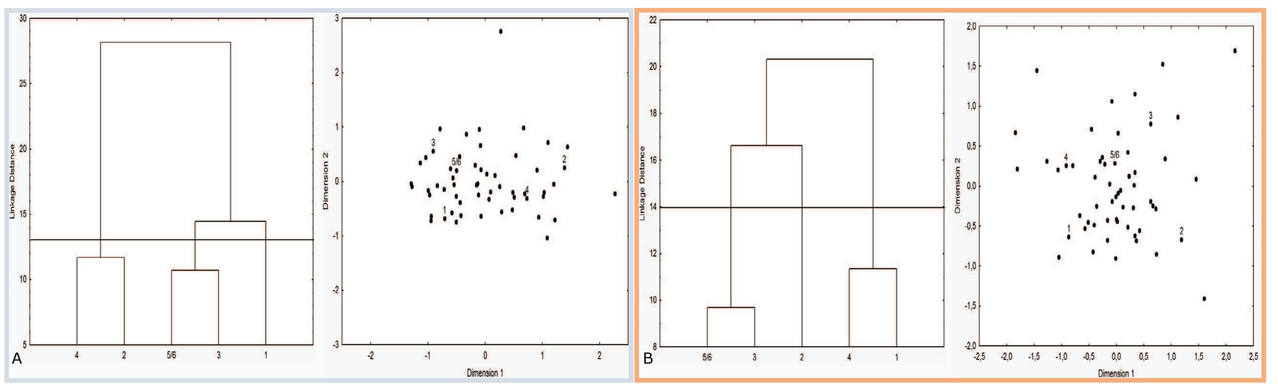


Figure 2 - Euclidean distances diagram and preference mapping for gluten-free bread formulations prepared with different combinations of white sorghum flour and water (A) and red sorghum flour and water (B) levels.
Legend – sorghum flour (SF) and water (W) levels in each trial: 1 (50% SF, 100% W); 2 (100% SF, 100% W); 3 (50% SF, 140% W); 4 (100% SF, 140% W) ; 5-6 (75% SF, 120% W).

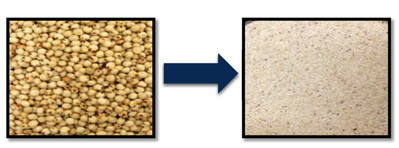
The GFBs were divided into three groups as a function of consumer preference, based on Euclidean distances diagram.

The multidimensional scaling presents the spatial dispersion of the consumers in relation to their preference for the GFBs. Each consumer was represented as a point and individuals with similar preferences were close to each other. The number of consumers around a sample indicated how much this one was preferred over others. Furthermore, there were some consumers who did not prefer any GFB, given that some points were distant from all the samples.

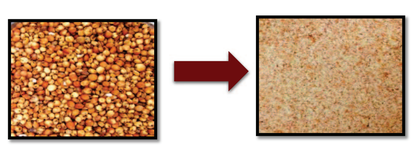
The internal preference mapping for overall acceptability showed preference to formulations with 50%SF/140%W and 75%SF/120%W. These GFB presented 9.5 and 15.4g of whole grain per 50g serving, respectively.

CONCLUSION

This research highlights the great potential of red and white SF for producing nutrient-dense and acceptable GFB, which is important for consumers with gluten-related disorders since GFB often lack nutrition content and acceptability.



White (BRS501) sorghum grain and resulted fine flour.



Red (BRS332) sorghum grain and resulted fine flour.

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