



SORGHUM STARCH AS FOOD INGREDIENT: PASTING AND THERMAL PROPERTIES

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ABSTRACT: Sorghum is a cereal that can be an alternative source of starch, of interesting properties following the demand for non-chemically modified starches, which is current market trend. Therefore, this study evaluated the pasting and thermal properties of sorghum starches extracted from three cultivars: BRS305, BRS308 and CMSXS180 that were compared to commercial maize starch. Sorghum starches showed higher peak viscosity and lower enthalpy of gelatinization than maize. The most interesting property presented by sorghum starch was the high retrogradation viscosity which is responsible for gels of outstanding viscosity during cooling, which would be interesting to preparation of high viscosity gels.

Keywords: apparent viscosity, gelling agent, retrogradation.

INTRODUCTION

Starches from traditional sources such as maize, wheat and cassava have been widely studied and used, however for the rational use of different botanical species, non commercially explored starch sources are also gaining attention for having unique properties (WANG; GUO, 2020).

Sorghum is a gluten-free cereal already used as an alternative to wheat for human consumption, due to its low production cost and its starch extraction similar to maize, that may encourage its use for supplying the increasing demand for non-chemically modified starches, especially as an ingredient in industrial food products (SINGH; SODHI; SINGH, 2010, REBELLATO et al., 2020).

This work aimed to evaluate pasting and thermal properties of starch extracted from varied sorghum genotypes compared to commercial maize starch.



MATERIALS AND METHODS

Materials

Sorghum starches were extracted from BRS305, BRS308 and CMSXS180 genotypes (brown, red and white pericarp, respectively) kindly donated by Embrapa Milho e Sorgo (Sete Lagoas, Brazil) and compared with commercial maize starch, obtained in local market (Rio de Janeiro, Brazil). Sorghum and maize starches at $7 \pm 1\%$ moisture content were analyzed.

Methods

Paste viscosity profile

The paste viscosity of the starches was determined using a RVA Series 4 (Newport Scientific, Warriewood, NSW, Australia) and the data was analyzed using the ThermoLine software for Windows (Newport Scientific Pty Ltd., Warriewood, Australia), using the profile Standard 1 (RVA manual provided) and Table III of the method 76-21.01 of American Association of Cereal Chemists - AACC (1999).

Starch thermal properties

The starch gelatinization temperature was studied using a DSC Q200 (TA Instruments, New Castle, USA). The degree of starch gelatinization was determined using the software Universal Analysis 2000 version 4.5A (TA Instruments, New Castle, USA). From the heating curve profile was used onset (T_o), peak (T_p) and conclusion (T_c) temperatures and calorimetric enthalpy (ΔH) according to the methodology described by Bernardo et al. (2018).

RESULTS AND DISCUSSION

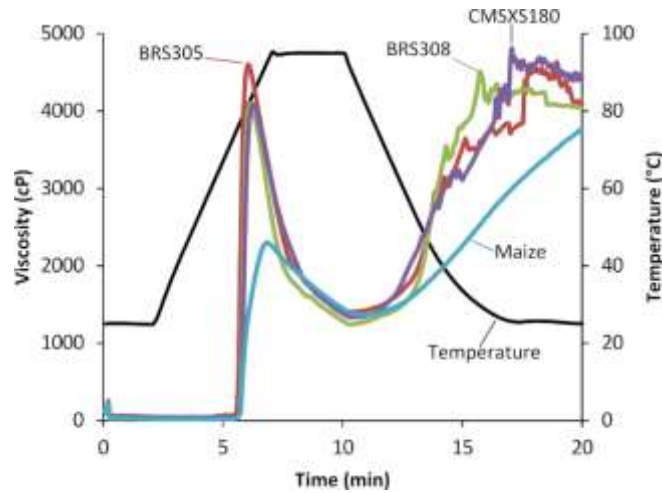
Paste viscosity profile

The paste viscosity behavior of sorghum starches and maize is displayed in Figure 1. Sorghum genotypes presented similar paste temperature do maize, but sorghum starches presented sharp increase in granule swollen observed as sharp peak viscosity, particularly for BR305 genotype, showing very low resistance to shear, whereas maize starch showed slight higher granular resistance to heat and shear. The retrogradation viscosity of sorghum starches were very high with formation and breakdown of gel strength, not seen in maize starch. This is an indication of high association of



amylose molecules during cooling down, which would be interesting when high gel strength is desired in a food product associated with high viscosity during heat.

Figure 1 – Paste viscosity of sorghum starches extracted from BRS305, BRS308, CMSXS180 genotypes and commercial maize starch.



Starch thermal properties

The thermal properties of starches were analyzed and the results were presented in Table 1.

Table 1 - Thermal properties of different genotypes of sorghum and maize starch.

Thermal properties	BRS305	BRS308	CMSXS180	Maize
To (°C)	59.63	67.17	66.37	64.53
Tp (°C)	68.26	74.58	73.95	72.74
Tc (°C)	76.90	83.97	83.47	81.78
ΔH (J/g)	10.53	9.00	9.64	11.80

Although, the paste viscosity of sorghum genotypes and maize were not distinct, by using DSC, it was possible to identify that BRS305 presented the lowest onset temperature To (59.63°C), Tp (68.26°C) and Tc (76.90°C) indicating that its melting in excess of water was more pronounceable than other starch granules, thus easier to cook even when compared to maize (64.53, 72.4 and 81.78°C, respectively), with the highest ΔH of gelatinization (11.80 J/g).



CONCLUSION

Sorghum starch provides quite interesting pasting properties that could be applied in products requiring high viscosity when heated and in gels of high strength.

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REFERENCES

AACC. Approved Methods of Analysis, 11th Ed. Method 76-21,01. General pasting method for starch using the rapid visco analyser. Approved November 3, 1999. Cereals & Grains Association, St. Paul, MN, U.S.A. 1999.

BERNARDO, C. O.; ASCHERI, J. L. R.; CHÁVEZ, D. W. H.; CARVALHO, C. W. P. Ultrasound assisted extraction of yam (*Dioscorea bulbifera*) starch: effect on morphology and functional properties. **Starch-Stärke**, 70, n. 5-6, p. 1700185, 2018. <https://doi.org/10.1002/star.201700185>.

REBELLATO, A. P.; ORLANDO, E. A.; THEODOROPOULOS, V. C. T.; GREINER, R. et al. Effect of phytase treatment of sorghum flour, an alternative for gluten free foods and bioaccessibility of essential minerals. **Journal of Food Science and Technology**, p. 1-8, 2020. <https://doi.org/10.1007/s13197-020-04382-w>.

SINGH, H., SODHI, N. S., SINGH, N., Characterisation of starches separated from sorghum cultivars grown in India. **Food Chemistry**, 119, 95-100, 2010. <https://doi.org/10.1016/j.foodchem.2009.05.086>.

WANG, S.; GUO, P. Botanical sources of starch. *In: Starch Structure, Functionality and Application in Foods*: Springer, 2020. p. 9-27. https://doi.org/10.1007/978-981-15-0622-2_2.