RHEOLOGICAL CHARACTERIZATION OF SUSPENSIONS OF CASSAVA STARCH AND MAIZE STARCH WITH PURIFIED CASHEW TREE GUM

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ABSTRACT

Aqueous suspensions of cassava and maize starches with addition of purified cashew gum (5% starch + gum 1% w/v) were analysed at 25°C in a rotational rheometer, at shear rate ranging from 0 to $100s^{-1}$. The experimental data were fitted to Ostwald de Waale, Casson and Herschel-Buckley rheological model, in order to classify the studied fluids. The results showed that Ostwald de Waal (Power Law) model presented the best fit showing a pseudoplastic flow behavior.

1. INTRODUCTION

The use of natural polymers has been increasing by a large number of industries working with food and non food application to of varied makes the rheological behavior study of these materials very important. These polysaccharides have some characteristics such as biocompatibility and biodegradability. Moreover, they modify the characteristics of aqueous solutions acting as thickeners, emulsifiers and stabilizers and they are still able to form gels, films and membranes (LAPASIL, 2005; PRICL, 1995). These properties involve different mechanisms of association between chains, which depend on the individual characteristics of each polymer (TONELI, MURR & PARK, 2005).
Among the most widely used industrial polysaccharides are starch and derivatives, gums of microbial origin and plant origin (seed mucilage and gum exudates.
The gum exuded from the cashew (Anacardiun occidentale L) is a branched heteropolysaccharide (acidic arabinogalactan) made up of units of galactose, arabinose, glucose, uronic acid, mannose and xylose, which can vary according to geographic region. The cashew is a xerophytic plant, native of tropical America found between N 27th parallel, Southeast Florida, and S 28th, South Africa (FLEET & PARENTE, 1995). In Brazil it is grown in the Northeast and Amazon regions.
The polysaccharides exudates are produced as a defense mechanism of plants against stress by physical injury or microbial attack. The exudation may be spontaneous or incisions in the trunk (MENESTRINA, 1998). The production of gum in Brazil can reach to 50,000 ton/year showing great commercial possibility (EMBRAPA-CNPCA, 1991).
Starch is a storage polysaccharide, abundant in cereals and tubers, and much used as food, which is composed of amylose and amylopectin. Amylose is a polysaccharide composed of units of α $(1 \rightarrow 4)$ D-glucose together in long chains predominantly linear. While amylopectin is a branched polymer, due to the presence of links α $(1 \rightarrow 6)$ between the chains of glucose. Among the cereals and tubers, mostly used in the manufacture of starch are maize and cassava.
The aim of this study was rheological characterization suspensions of maize and cassava starch with addition of purified cashew gum.

2. METHODOLOGY

Crude cashew gum was donated by Embrapa (Fortaleza, CE). The gum was crushed in a ball mill MLW-KM. Later, it was purified by the method of Rinaudo and Milas. Then were formulated aqueous suspensions of cassava and maize starches with the addition of cashew gum (5% starch + 1% gum w/v). The samples were analysed at 25 ° C in a Thermo Haake Mars rotational rheometer with geometry plate/plate (35 mm diameter) with a range of shear rate from 0 to $100s^{-1}$. Different aliquots of samples were evaluated in triplicate. Subsequently were plotted the flow (τ x γ) and viscosity (η x γ) curves. In order to classify the rheological behavior fluids, the experimental data were fitted to the Ostwald de Waal, Casson and Herschel-Buckley rheological models.

3. RESULTS AND DISCUSSION

The Table 1 shows the fitting coefficients for log σ x log τ, where σ is the tension strain and γ is the shear rate. The linear variation indicates that the aqueous suspensions of maize and cassava starches containing purified cashew gum followed the power law model (Eq. 1). The slope value n is always less than 1, when the fluid is pseudoplastic.

$$\sigma = \kappa\gamma^n \quad \text{(Eq. 1)}$$

Where k is the consistency index and n is the flow behavior index.

TABELA 1. Adjustment coefficient Ostwald Waale model

Sample	n	K	R^2
CAS5	0.622 ±0.084	2.525 ± 0.286	0.988 ± 0.014
CAS5C1	0.605 ±0.015	2.664 ±0.060	0.994 ±0.002
MAS5	0.528 ±0.075	3.165 ±0.460	0.978 ±0.017
MAS5C1	0.782 ±0.099	2.039 ±0.306	0.946 ±0.034
C1	0.566 ±0.132	2.848 ±0.541	0.973 ±0.012

CAS5- Cassava starch 5%, CAS5C1- Cassava starch 5% +Cashew gum 1%, MAS5 - Maize starch 5%, MAS5C1 – Maize starch 5% + Cashew gum 1%, C1- Cashew gum 1%, n- flow behavior index, K- consistency index, R^2- linear regression coefficient

The addition of gum favored the reduction of viscosity in the maize starch slurry, whereas the formulation of cassava starch increased viscosity (Figure 1). These different behaviors could be related to the different interactions between the gum and the cassava and maize starches. The presence of gum may have reduced the mobility of cassava starch molecules in suspension hence increasing the viscosity. Furthermore, one should consider the different sedimentation times of each starch type and its morphology (grain size and contact surface) (TESTER, 2004) that also influence the viscosity.

4. CONCLUSION

Both maize and cassava starches in presence of cashew tree gum presented pseudoplastic behavior. The effect of cashew tree gum was not the same depending on the source of starch granule.

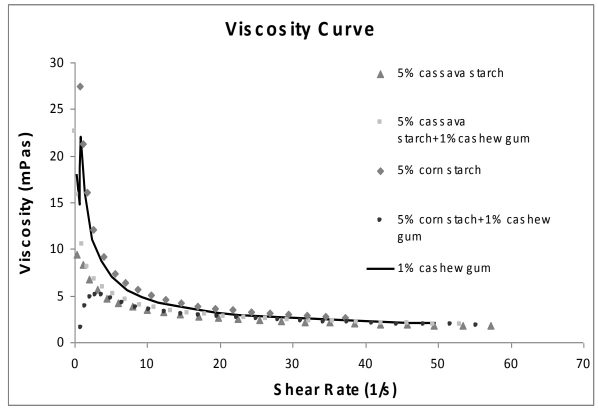

FIGURE 1. Effect of the addition of cashew gum in the viscosity

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