Synergistic interaction of Balangu seed gum with selected food hydrocolloids: the rheological investigation

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Balangu (*Lallemantia royleana (Walla) Benth*) is belonged to the family of *Labiatae* and grown extensively in different regions of European and Middle East countries. This seed is a feasible source of mucilaginous gum and can produce a sticky, turbid and tasteless gum. In the present study, the effects of different substitution levels of Xanthan gum (XG), Locust bean gum (LBG) and Guar gum (GG) with Balangu seed gum (BSG) were studied in the mixing ratios of 1:1, 1:3 and 3:1 at the total concentration of 1% at 25°C. All the solutions and the control ones behaved as shear thinning fluids, which could be well described by the power law model. By substituting the control solutions with different levels of BSG, the consistency coefficient (k) values showed decrease, but it was not statistically significant for LBG: BSG and GG: BSG ratios of 3:1. In addition, there was no significant difference between the k mean values of XG solution and XG: BSG mixed systems 3:1 and 1:1. Higher substitution levels resulted in higher flow behavior index (n) mean values for Xanthan solutions. However, it did not alter monotonically with increasing the BSG for other mixtures.

Keywords: Synergistic effect; Balangu; Xanthan; Locust bean; Guar

1 INTRODUCTION

Food Hydrocolloids are widely used in food industry because of their physical and functional properties. They can improve the rheological and textural characteristics of foods [3]. In fact, the selection of the particular hydrocolloids for a specific purpose is the task of the food fabricator. Therefore, having a deep understanding of the rheology of hydrocolloids will be so important and helpful in their technology.

Lallemantia royleana with vernacular name of Balangu is a mucilaginous endemic plant which is widely grown in different places of European and Middle Eastern countries especially Turkey, Iran and India [5]. Because of high mucilage content, its seeds adsorb water quickly by the hydration process and produce a sticky, turbid and tasteless liquid, which can be used as novel food hydrocolloid in food formulations [4].

The use of two or more gums in the formulation of a single food is a common practice in the industry for the synergistic effect of the combining use. The texture and the rheological characteristics of food products can be improved by the synergism effects and economical benefit may be gained [1].

Hence, the objective of this study was to investigate the behavior of selected hydrocolloids at different substitution levels of Balangu seed gum.

2 MATERIALS AND METHODS

2.1 Materials and solution preparation

Balangu seed extract and its dispersion at 1% concentration was prepared according to Mohammad Amini method [2] and by dispersing the crude extract powder of Balangu seed in deionized water for 30 min at room temperature. Xanthan and Guar were dissolved in deionized water under vigorous agitation for 1 h which resulted clear solution at 1%. Locust bean dispersion was prepared by dispersing the powders in deionized water using a high speed mixer for 15 min at room temperature followed by heating at 90°C for 10 min. The effects of different substitution levels of Locust bean, Xanthan and Guar by Balangu seed extract on the rheological characteristics was studied at 25%, 50%, 0.75% and 100% levels.

2.2 Rheological measurements

Rheological evaluations were performed using a rotational viscometer (Bohlin Model Visco 88, Bohlin Instruments, UK) and C30 measuring spindle. Flow behavior was described by the fitting of the experimental data (apparent viscosity – shear rate) with the power low model:

$$\eta = K\dot{\gamma}^{n-1} \quad (1)$$

Where, η is the apparent viscosity (Pa.s), $\dot{\gamma}$ is the shear rate (s^{-1}), K is the consistency coefficient ($pa.s^n$) and n is the flow behavior index (dimensionless).

3 RESULTS AND DISCUSSION

Figs. 1-3 shows the apparent viscosity values of solutions prepared with Balangu seed extract and guar, Locust bean gum and Xanthan solutions. All solutions showed a non-Newtonian shear thinning behavior. It is obvious that the apparent viscosity of Balangu extract is lower than all the studied hydrocolloids.

To demonstrate the synergism effects the rheological parameters, a statistical analysis was performed on the data obtained for K and n values. The analysis of variance (ANOVA) results showed

that there was no significant difference between the K values of the three hydrocolloids and the 25% substitution level by Balangu seed extract.

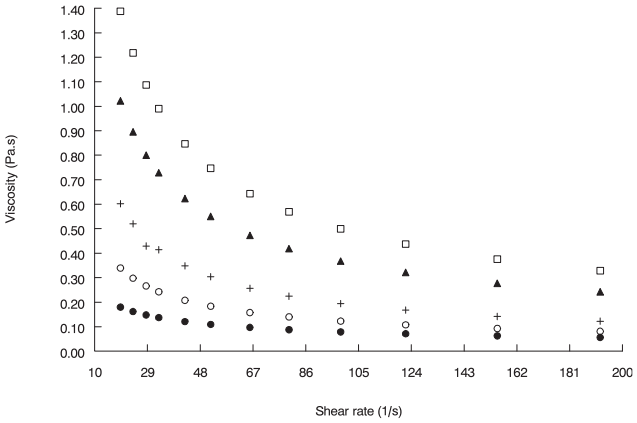

Fig. 1. Viscosity of Balangu and Guar their mixtures against shear rate in water at 25°C. Balangu: Guar ratio: (+) Balnagu, (□) Guar, (▲) 1:3, (●) 1:1, (○) 3:1.

As it is shown in Fig. 3, there is no difference between the viscosity of the Xanthan solution and the solutions with 25% and 50% substitution levels. The flow behavior index showed no particular trend for the studied samples.

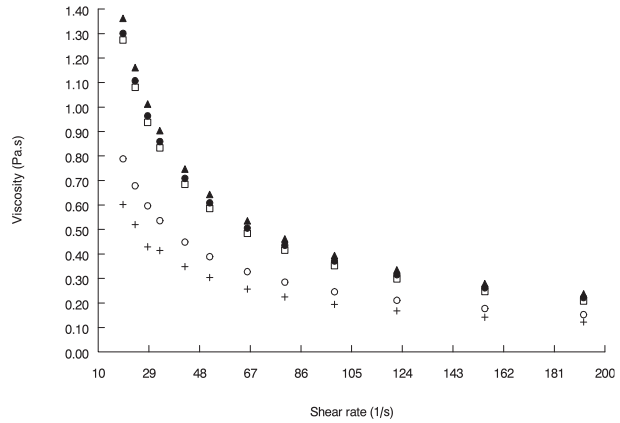

Fig. 2. Viscosity of Balangu and Locust bean gum their mixtures against shear rate in water at 25°C. Balangu: Locust bean gum ratio: (+) Balnagu, (□) Locust bean gum, (▲) 1:3, (●) 1:1, (○) 3:1.

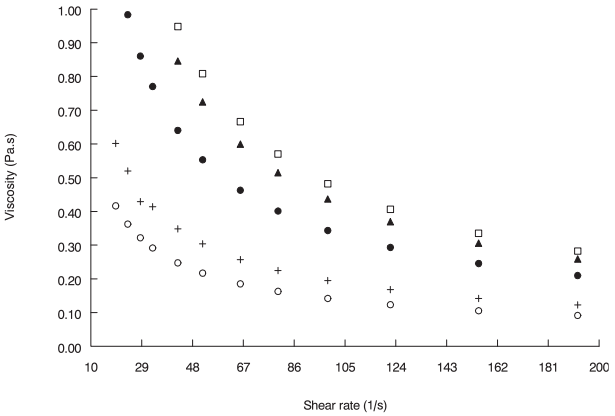

Fig. 3. Viscosity of Balangu and Xanthan their mixtures against shear rate in water at 25°C. Balangu: Xanthan ratio: (+) Balnagu, (□) Xanthan, (▲) 1:3, (●) 1:1, (○) 3:1.

4 CONCLUSION

Since the 25% substitution level of the studied hydrocolloids by Balangu seed extract resulted in desired consistency, the combined use of the studied hydrocolloids and Balangu extract can be recommended in different food formulations.

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