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An Experimental Study on Rheological Properties of Pestil Blends

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Abstract: The rheological and sensory properties kind (apricot, grape and mulberry molasses) blends were studied pestil (rollband) syrup of apricot, mulberry and grape at 25, 40, 50 and 70°C, rheological properties kind of pestil syrup (untreatment and treatment with sulphurapricot molasses) blends were studied using sugar concentrations of 0%, 5% and 10%. The empirical power law model fitted the apparent viscosityrotational speed data. All blends exhibited pseudoplasticbehavior. The syrup content and temperature influenced the flow behavior and consistency index values. Temperature sensitivity of the consistency index was assessed by applying an Arrhenius-type equation. E_a values ranged from 326,65 to 175,86 J mol s^{-1} as syrup content varied from apricot, grape to mulberry, respectively. Arrhenius constant, k, however, correlated with mouthcoating.

Keywords: Rheology, Pestil, Apricot

1. Introduction

Malatya where is famous its apricotsis not only the most important apricot production center in Turkey but also all the world's apricot production center. An analysis of data related to the world of dried apricot exports, ranks first with about 80-85% share of Turkey in the export of these products [1]. Apricot is widely grown in Malatya Province in Turkey where the fruit can be consumed both fresh fruit and dried fruits fruit such aspestil, fruit puree, jam, marmalade or as fruit juice [2].

Fruits are one of the oldest methods of long-term preservation of intact factor is to make the pestil. Pestil is a foodstuff which is made of fruits such as grape, mulberry, plum and apricot. Pestil is made from thin sheet of sun-dried the fruit pulp. This fruit leather is also called roll band. Roll band is a traditional popular food containing sugar in Turkey and other East Asian and Middle Eastern countries. Pestil on the other hand, can be obtained either from grape, mulberry or apricot and requires minimum processing. It has remarkable flour and sugar stability and resistance to oxidative deterioration. The process is known as a mixture which is gathered from the separation of the peel and sediment of fruits like grapes, apricots, plums, or other sweet and sour fruits, that are concentrated, dried in the sun and formed into plates.

It is generally known as pestil, and it is a healthy and natural product. It is contains molasses and starch so it is a good source of carbohydrate. For this reason pestil is consumed mainly for energy. Pestil which has a high energy value became an important foodstuff in terms of nutrition sources. It has vitamins which is insoluble in water and vitamins. Beside this, pestil contains a great amount of minerals like K, Ca, S, P, Mg, Cu, Zn, 1 and Cl. Pestil blend can be considered as a typical example of aflour, sugar and mashed fruit. In many food systems, protein and lipids commonly interact and thus the ability of protein to form a stable blend is important and may help enhance sensory properties. Optical properties such as color, appearance, taste, smell and texture are important features in the selection and valuation of food materials [3-6]. A better understanding of the parameters that influence the sensory properties of food will enable food manufacturers to better design and control the properties of food products. For example, consumer acceptance of such products depends on their ability to spread on another material and has a direct relationship with viscosity and flow behavior [5, 7-8]. In the food industry, viscosity is one of the most important parameters required in the design of a technological process.

On the other hand, viscosity is also an important factor that determines the overall quality and stability of a food system. High protein, high mineral and vitamin content of pestilmight offer a promising nutritious and healthy alternative to consumers. Rheology properties of food are one of the most important indicators of their quality. Furthermore, rheological or flow properties of process streams directly affect the design and operation of process. Therefore, rheological characterization of samples, taken in some critical steps in production, provides crucial insight into product quality control and process economics. Therefore, the objectives of this study were to prepare pestil blends from fruit syrup, rheological properties of the blends.

2. Materials and Methods

2.1. Preparation of Pestil Blends

The fruit syrups of grape, mulberry and apricot were used. Pestil with a carbohydrate content of 65.2%, protein content of 0.84% and fat content of 0.25% was used (composition given by the supplier). The fruits juices is taken out by fruits have been subjected to an the fruits pressure for ejecting intensively sugar and other materials in washed the fruits. Fruits are separated from rotten ones and they are washed. It is boiled the fruits pulp make from products such as pestil blends which is obtained after filtering fruits. The flour which is made by sieving the flour is added with sugar, is mixed in the boiler by adding the pestil blends. The pestil blends is prepare after warmed.

2.2. Experimental Methods

Model mixes were prepared in accordance with the traditional pestil mixture composition, which is sugar, flour and mashed fruit. Apricot pestil blends were prepared untreatment and treatment with sulphur apricot. Apricots have a long time storage that sun dried after pretreatment with sulfur dioxide to prevent spoilage and to slow down enzymatic and non-enzymatic reactions. However, by adding sugar to pestil syrup of untreatment apricot to give the concentration of 0%, 5%, 10% (w/w) and mixing evenly with a spatula. The levels of the sugar in pestil were selected to represent acceptable range for consumers. Grape and mulberry pestil blends were prepared by adding flour. The temperature was gradually increased with vigorous stirring until boiling which was maintained for 15 min. The prepared mixes were cooled to room temperature. Blends were directly subjected to analysis.

2.3. Viscosity Measurement

The viscosity (Pa. s) of blends were determined at 25, 40, 50 and 70°C using a Brookfield rotational viscometer (Model RVDV++, Brookfield Engineering Laboratories, Stoughton, MA) equipped with spindle 3, 4, 5 at the speed of 0.5, 2, 5, 10, 30and 60 rpm. Enough sample in a 400 ml beaker was used to immerse the groove on the spindle with guard leg [9]. Temperature was maintained using a thermostatically controlled water bath. Flow behavior was described by the power law model.

$$\eta_A = k\ \gamma^{(n-1)} \qquad (1)$$

where η_A is the apparent viscosity (Pa s), γ is the rotational speed (s^{-1}), k is the consistency index (Pa s^n) and n is the flow behavior index (dimensionless).

3. Results and Discussion

The flow behavior index (n) and consistency index (k) values, obtained by fitting the rotational speed versus apparent viscosity data to a power law model (Eq. 1), are presented in Table 1 and 2. [10] reported that fundamental rheological information could be achieved from viscosity-rotational speed data of Brookfield viscometers. The values of flow behavior index, n, ranged from 0.117 to 0.608 and the consistency index, k, ranged between 2.998 and 18.20Pa s. The R^2 values from fitting ranged from 0.950 to 0.999 for all samples. This model was able to represent the experimental data reasonably well with the R^2 value, which is a measure of the goodness of fit, higher than 0.950. The model parameters obtained for each pestil blends are displayed in Table 1-3.

Table 1. *The consistency index (k) and flow behavior index (n) of apricot pestil blends at different sugar concentration.*

Percentage of sugar	Apricot Pestil		
	k	***n***	***R^2***
0 (Dried apricot)	14,054	0,243	0,955
0 (Fresh apricot)	14,174	0,263	0,990
5	15,094	0,216	0,992
10	13,588	0,216	0,988
Treatment with sulphur	18,078	0,231	0,999

* *k* (Pas^n) and *n* (dimensionless) indices were obtained by fitting rotational data to power law model, $\eta = k\ \gamma^{n-1}$, where η is apparent viscosity, *k* is consistency index and *n* is flow behavior index

Table 2. *Power law parameters.*

Kind of Pestil Blends		T (°C)			
		25	**40**	**50**	**70**
	n	0,20	0,19	0,26	0,23
Apricot	*k*	14,71	13,61	13,87	18,20
	R^2	0,993	0,987	0,992	0,999
	n	0,567	0,604	0,608	0,568
Grape	*k*	2,998	3,723	4,972	9,126
	R^2	0,950	0,967	0,979	0,994
	n	0,117	0,288	0,339	0,305
Mulberry	*k*	3,041	4,528	5,112	7,867
	R^2	0,997	0,995	0,997	0,992

* *k* (Pas^n) and *n* (dimensionless) indices were obtained by fitting rotational data to power law model, $\eta = k\ \gamma^{n-1}$, where η is apparent viscosity, *k* is consistency index and *n* is flow behavior index

The smaller the n values the greater the departure from Newtonian behavior. Viscosity of apricot pestil in the treatment with sulphur is higher (higher k value) than untreatment apricot pestil and the consistency index decreased. The increase in sugar concentration resulted in lower viscosity (lower k values) for all temperatures tested and the consistency index decreased with increasing temperature in the treatment apricot pestil. The higher solid contents generally cause an increase in the viscosity resulting from mainly molecular movements and interfacial film formation [11-13]. The addition of sugar may also lead to a decrease in viscosity as in the case for semi-liquid maize dough [13].

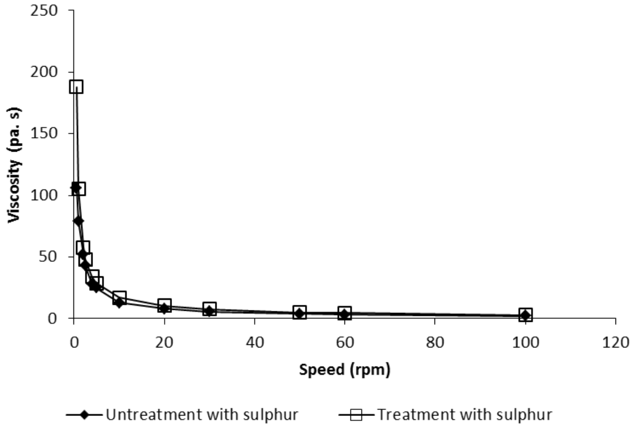

Figure 1. *The rheological behavior of treatment and untreatment with sulphur apricot pestil blend.*

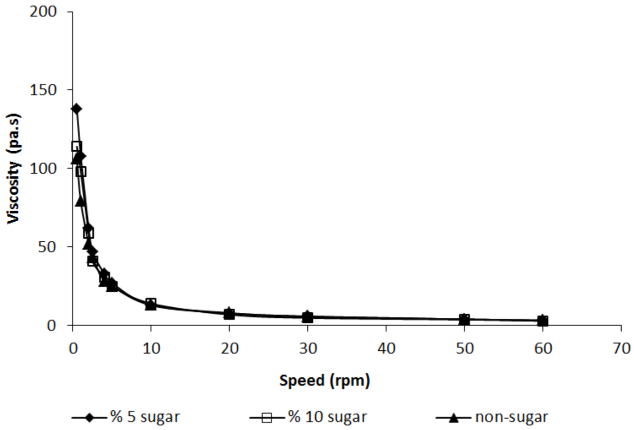

Figure 2. *The rheological behavior of sugar and non-sugar apricot pestil blend.*

Most fluid foods do not have the simple Newtonian rheological model and more complex models is need for describe their rheological behavior. Their viscosities regard as shear stress, shear rate and temperature. The rheological model most often used to describe to Power Law model for rheological behaviour of fruit pulps, juices, and puree. The power law model used to the flow behavior of pseudoplastic foods [5]. From Table 2, it can be observed the value of n is smaller than 1 in all cases, concluding that all pestil blends present pseudoplastic characteristics. Table 2 show that the experimental data are in agreement with the power law models it can be noted that the models present high R^2values. Models were proposed to correlate the dependency of the rheological parameters with the temperature.

From typical curves could be seen that all pestil blends had a non-newtonian and pseudoplastic behaviour. A change in the rheological behaviour of all pestil blends with increasing the temperature was observed (Figs. 3-5). The apparent viscosity decreases with the temperature in all cases.

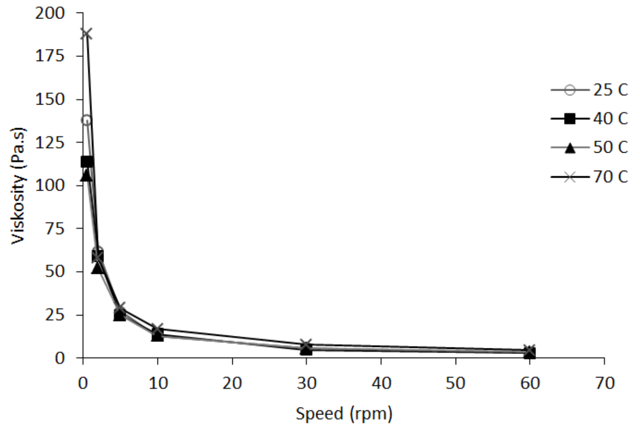

Figure 3. *The rheological behavior of apricot pestil blend at different temperatures.*

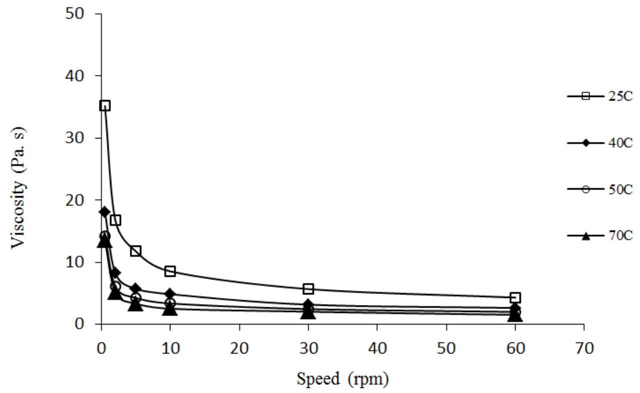

Figure 4. *The rheological behavior of grape pestil blend at different temperatures.*

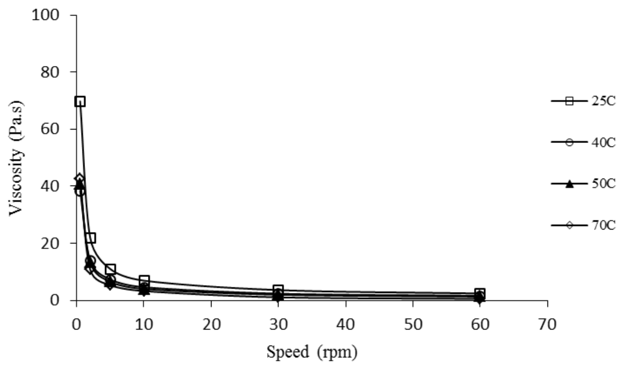

Figure 5. *The rheological behavior of mulberry pestil blend at different temperatures.*

The flow behavior index (n) of blends at 50°C indicated that they were more pseudoplastic (lower n values) than blends prepared at 25, 40, 50 and 70°C for all concentrations. Heating may rupture molecular entanglement and bonds may stabilize the molecular structure and reduce the effective molecular volume in protein and sugars resulting in a decrease in viscosity. All blends showed pseudoplastic flow behavior irrespective of temperatures (Figures 1-5).

Table 3. *Arrhenius-type equation parameters for pestil.*

Kind of Pestil Blends	k_0(Pas^n)	E_a(Jmol^{-1})	R^2
Grape pestil	7,055447	326,6487	0,9693
Mulberry pestil	27,47015	175,8577	0,7186
Apricot pestil	70,1148	190,2204	0,9830

k_0(Pa s^n) and E_a (J mol^{-1}) parameter were obtained from Arrhenius type equation;
$\ln k=\ln k_0+E_a/R_gT_a$, where k_0 is the Arrhenius constant, E_a is the activation energy,
R_g is the universal gas constant and T_a is the absolute temperature.

The decrease in viscosity as the speed (shear rate) was increased has been related to the increased alignment of constituent molecules of the tested system [14]. Temperature sensitivity of the consistency index was assessed by applying an Arrhenius-type equation. The parameters are shown in Table 3. E_a values ranged from 326,65 to 175,86 J mol s^{-1} as grape, mulberry and apricot pestil, respectively.

4. Conclusion

This study developed blends from grape, mulberry and apricot pestil such as energetic food and healthy alternative product to the consumers. The empirical power law model fitted the apparent viscosity rotational speed data. Pestils made all blends from grape, mulberry and apricot showed pseudoplastic flow behavior on the temperatures. The rheological parameters of the grape, apricot and mulberry pestil blends at different temperatures may have useful implications for design and processing in the food industry.

References

[1] Özler A., Karakus E., Pekyardimci S., Purification and Biochemical Characteristics of Pectinesterase from Malatya Apricot (Prunusarmeniaca L.), Preparative Biochemistry and Biotechnology, 2008, 38: 4.

[2] Elmacı Y., Altug T., Pazir F., Quality Changes In Unsulfured Sun Dried Apricots During Storage, International Journal of Food Properties, 2008, 11: 146–157.

[3] Lawless, H. T., Heymann. H., Sensory Evaluation of Food: Principles and Practices. New York: Chapman & Hall, 1998.

[4] Lawless H. T., Heymann H., Sensory Evaluation of Food: Principles and Practices, Springer, 2010.

[5] Rohm, M., Strobl, H., Jaros, D., Butter colour affects sensory perception of spreadability, European Food Research and Technology., 1997, 205: 2, 108-110.

[6] Yazıcı F., Çakır D. K., Kara S., Ayaz S., Keylan H., İncekara B., Pestil, OndokuzMayıs University Faculty of Engineering Deparment of Food Engineering, 2012, Samsun.

[7] Kokini, J. L., and Dickie, A., A Model of Food Spreadability from Fluid Mechanics. Journal of Texture Studies, 1982, 13: 211-227.

[8] Álvarez E., Cancela M. A., Maceiras R., Comparison of Rheological Behaviour of Salad Sauces, International Journal of Food Properties, 2006, 9: 907–915.

[9] Álvarez E., Cancela M. A., Maceiras R., Effect of Temperature on Rheologıcal Propertıes of Dıfferent Jams, International Journal of Food Properties, 2006, 9: 135–146.

[10] Chinnan, M. S., K. H. McWatters, and V. N. M. Rao., Rheological characterization of grain legume pastes and effect of hydration time and water level on apparent viscosity. J. Food Sci. 1985, 50: 4, 1167-1171.

[11] Bhattacharya, S., Bhat, K. K., Raghuver, K. G., Rheology of bengal gram cicerarictinum flour suspensions, Journal of Food Engineering, 1992, 17, 83-96.

[12] Maskan, M. and Gögüş, F., Effect of sugar on the rheological properties of sunflower oil-water emulsions, Journal of Food Engineering, 2000, 43: 3, 173-177.

[13] Sopade P. A., Filibus T. E., The influence of solid and sugar contents on rheological characteristics of akamu, a semi-liquid maize food, Journal of Food Engineering - J Food Eng, 1995, 24: 2, 197-211.

[14] Rhas, C. K. Theory, Determinationa and Control of Physical Properties of Food Materials. Dordrecht, Holland: D. Reidel Publishing Company, 1975.