Rheological properties of fermented beverage from barley flour

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ABSTRACT

Introduction. Increased awareness of the relationship between diet and health has led to increased demand for foods rich in biologically active substances. It must be found the opportunities to replace wheat flour with other species. Actual solution to the problem is use of barley flour for producing a traditional fermented beverage "Boza", which is prepared from wheat, millet, corn, rice, barley, oats and other flour. The objective of present study is to determine the influence of fermentation and brewing time on the rheological properties of the beverage "Boza" from barley flour.

Materials and methods. It is used analytical standard method about viscosity with rotary viscometer „Reotest 2.1" and method for production of beverage "boza" which is developed in University of Food Technologies. It is prepared 12 samples of fermented beverage from barley flour according to fermentation (12, 24, 36 h) and brewing time (15, 30, 45, 60 min).

Results. The comparative analysis has shown that with increasing velocity gradient, the viscosity of all the samples decreased. All the fermented beverages from barley flour have a pseudo plastic behavior. By increasing the brewing time the viscosity increases and the consistence becomes denser. The fermentation time had no significant effect upon the viscosity of fermented beverage from barley flour. The results of studies can be used to determine the fermentation and brewing time and to obtain a technology for barley flour beverage.

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Реологічні властивості ферментованого напою з ячмінного борошна

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Introduction

Increased awareness of the relationship between diet and health has led to increased demand for foods rich in biologically active substances. It must be found the opportunities to replace wheat flour with other species. Actual solution to the problem is use of barley

flour for producing a fermented beverage "type Boza". The beverage named "Boza" is traditional fermented beverage which is prepared from wheat, millet, corn, rice, barley, oats and other flour.

The beverage named "Boza" is traditional fermented beverage which is prepared from wheat, millet, corn, rice, barley, oats and other flour [5, 7, 8, 9]. It is a viscous liquid with a pale yellow color and sweet or sour taste [2]. It is widely consumed in Bulgaria, Turkey and some other countries of the Balkan Peninsula due to its pleasant taste, flavor and its nutritional properties [1, 6, 11].

A lot of processes in food industry are related to the processing of dispersed systems, suspensions, colloids, visco-plastic and viscoelastic products [5, 9]. In these processes it is exhibit different physical properties, such as strength, plasticity, hardness, elasticity, viscosity etc. These properties characterize the assignment of the product in the application of a certain voltage, which leads to a corresponding deformation. They are called the structural-mechanical properties [9].

Viscosity is one of the most important rheological properties of beverages [7]. It is a resistance measure of the fluid against the removal of some layers to the other. It is perceived as a "thickness", or the pouring resistance. It's belongs to a group of the rheological properties of fluids.

Din (2009) creates a fermentation beverage from barley flour. It is showed that the beverage viscosity is improved significantly with the increasing of β-glucans (in the recipe). A highest viscosity was obtained by 1 % β-glucans, while the lowest by without β-glucans [4].

The objective of the present work was to study the effect of fermentation and brewing time upon the rheological properties of fermented beverage (type Boza) from barley flour.

Materials and methods

Raw materials:

Barley flour – from "TIT-Tenio Tenev", Kameno, sertificate № 37 for safety and quality of barley flour, DT № 37 from 12.11.2008 г., with ash content 1.93 % (d.b.), moisture content 12.52 % and acidity 5.25 °H;

Potable water, EN 806-1:2003;

Sugar, BDS 390-79;

Boza „Bomax" – Haskovo, DT 01-01-2006.

Basic method for production of beverage "boza" (developed in University of Food Technologies):

1. *Recipe:* table 1.

Table 1: Beverage recipe "type Boza"

Ingredients	Quantity, %
Barley flour	9
Water potable	61
Sugar	12
Boza	18

2. *Technology:*

The technology for the preparation of fermented beverage from barley flour (Table 1) is characterized by some special particularities. Barley flour is baked until his color

becomes light - brown, with a little smell of nuts. It is suspended in water and it boiled. After boiling and cooling, it was added the sugar. After the slurry cooled (T ≈ 30 °C), it was added "Boza" like yeast. The beverage was allowed to ferment. Fermentation beverage is filtered and cooled [3].

Method for fermented beverage according to fermentation and brewing time (developed in University of Food Technologies). It is prepared 12 samples (table 2) of fermented beverage from barley flour according to fermentation (12, 24, 36 h) and brewing time (15, 30, 45, 60 min). The quantities of raw materials for preparation of 12 samples of fermented beverage (type "Boza") were similar, defer to Table 1. Toasting time (10.0 min), boiling temperature (97.8 °C) and final cooling temperature (34.8 ° C), before yeast adding, were constant for all samples.

Table 2. Beverage samples according to fermentation and brewing time

Brewing time, min.	Samples (A, B, C, D) according to fermentation time (h)		
	12	**24**	**36**
15	A 1	A 2	A 3
30	B 1	B 2	B 3
45	C 1	C 2	C 3
60	D 1	D 2	D 3

Analytical methods:

Determination of viscosity with rotary viscometer „Reotest 2.1". The rotary viscometer "Reotest 2.1" can determine a viscosity of the fermentation beverage from barley flour. Configuration used in measuring cylinders is S/ S3. The viscosity measurement was carried out according to the following formula:

$$\eta = \frac{\tau}{D},$$

τ – tangential pressure, Pa;
D – velocity gradient, s^{-1};
The tangential pressure is measured by the formula:

$$\tau = \frac{az}{10}$$

α – results from the indicator, scale marks;
z – constant of internal measuring cylinder;
z = 7.65 for scale I;
z = 73.60 for scale II.
The values of the velocity gradient depending on the system used for measuring cylinders were reported at a frequency of electric current 50 Hz [10].

Results and discussion

Fig. 1 shows the results on the viscosity of the fermented beverage from barley flour at different brewing times (15, 30, 45, 60 min) for the same fermentation time – 12 h.

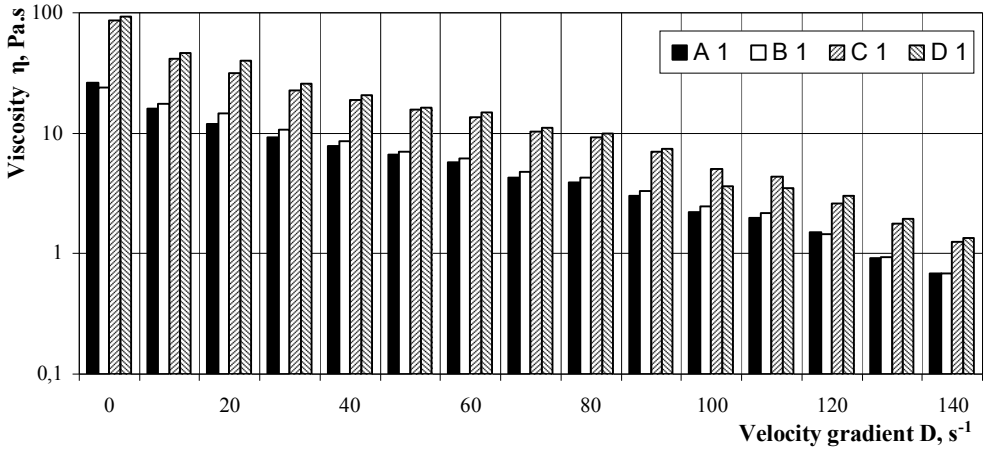

Fig. 1. Viscosity of fermented beverage with different brewing time (15, 30, 45, 60 min) and fermentation time – 12 h.

On 15 and 30 min of brewing the viscosity was a value respectively 26.26 and 23.95 Pa.s, whereas on 45 and 60 min the viscosity increased almost with 3.0 ÷ 3.5 times at the beginning of study. By increasing the velocity gradient in all samples it was found that the viscosity decreases. This behavior is inherent for pseudo plastic fluids. With increasing a brewing time, the viscosity increases too, respectively, the consistence becomes denser.

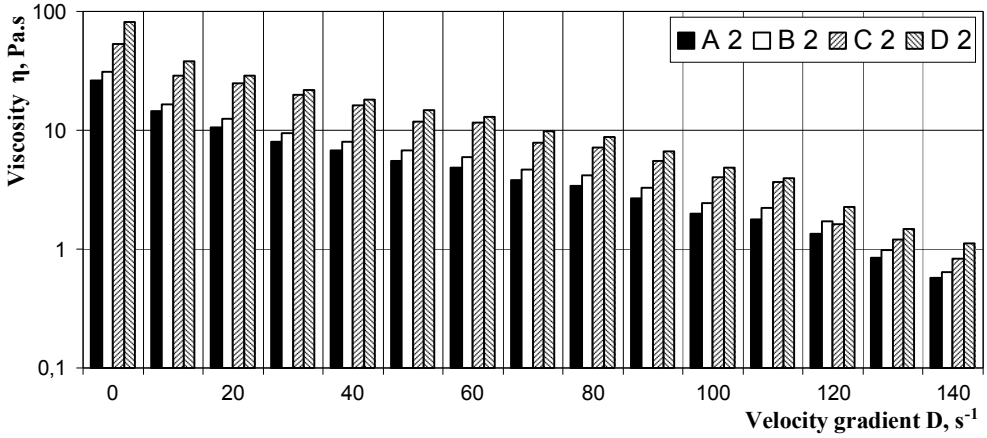

Fig. 2. Viscosity of fermented beverage with different brewing time (15, 30, 45, 60 min) and fermentation time – 24 h.

Figure 2 shows the samples with different brewing time (15, 30, 45, 60 min) and the fermentation time – 24 h. It was found that the results obtained from figure 1 are the same. It may be concluded that with increasing the velocity gradient, the viscosity of the samples decreased. On 15 and 30 min brewing time viscosity initials values increased slightly, while on 45 and 60 min the increasing is significantly.

Figure 3 follow the same relationship as in figure 1 and 2.

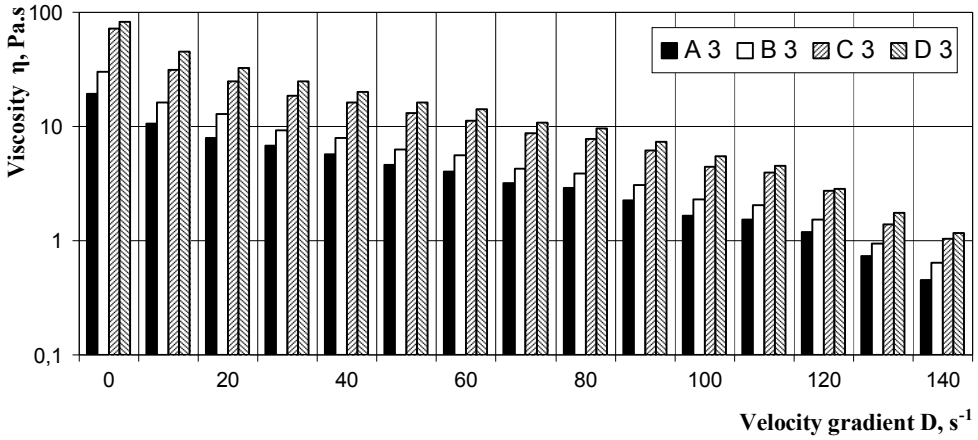

Fig. 3. Viscosity of fermented beverage with different brewing time (15, 30, 45, 60 min) and fermentation time – 36 h.

From the three figures (1, 2 and 3) it can be concluded that with increasing velocity gradient, the viscosity decreases. Therefore developed samples of fermented beverage from barley flour have a pseudo plastic behavior. With increasing the brewing time, the viscosity increases also. It can be concluded that the consistence was dense.

The results in figures 4, 5, 6, 7 also show the viscosity change of fermented beverage (type boza) at different fermentation times.

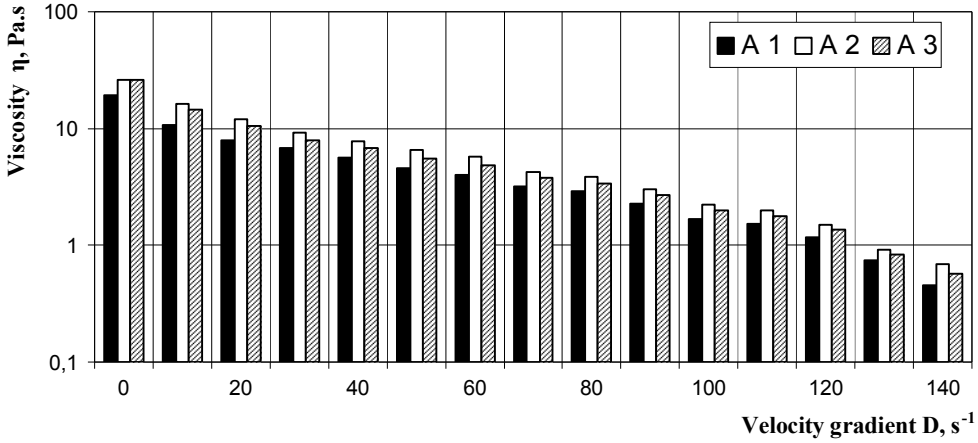

Fig. 4. Viscosity of fermented beverage, brewing 15 min (sample A) at different fermentation time (12, 24, 36 h).

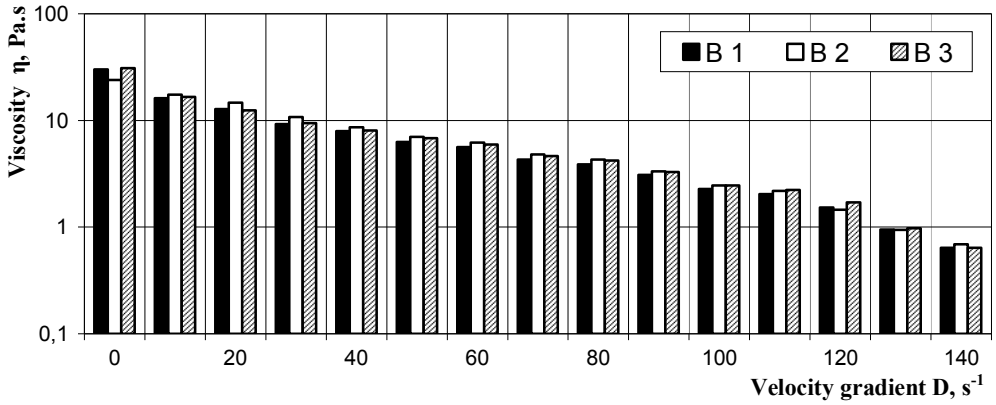

Fig. 5. Viscosity of fermented beverage, brewing 30 min (sample B) at different fermentation time (12, 24, 36 h).

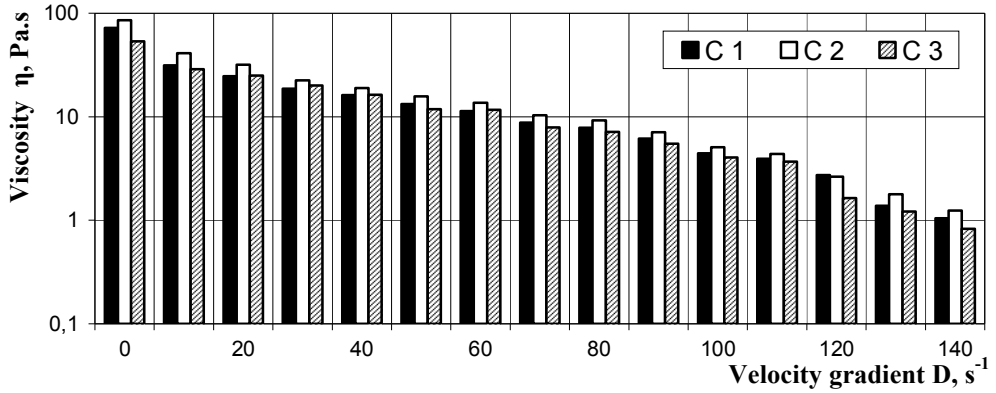

Fig. 6. Viscosity of fermented beverage, brewing 45 min (sample C) at different fermentation time (12, 24, 36 h).

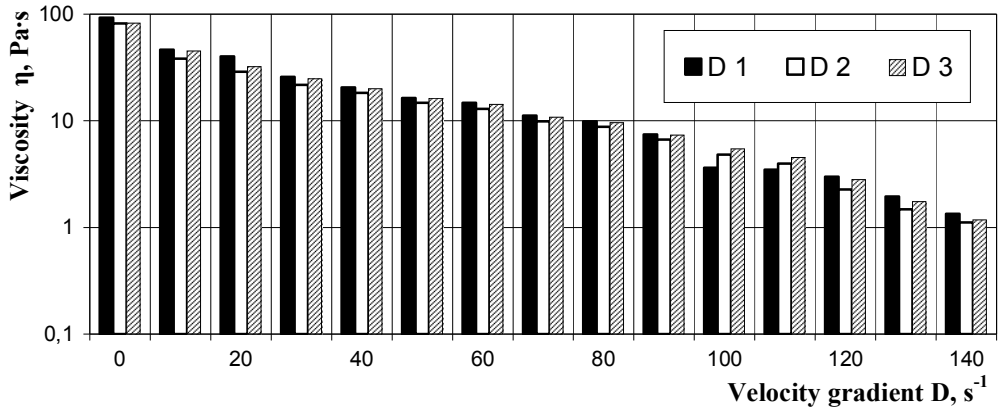

Fig. 7. Viscosity of fermented beverage, brewing 60 min (sample D) at different fermentation time (12, 24, 36 h).

Figures 4 and 5 show a decrease in viscosity with increasing the velocity gradient. The difference between the samples of the viscosity at different fermentation is very small.

The results in figures 6 and 7 also show that the viscosity does not change significantly. From these results it can be concluded that the fermentation time did not significantly influenced on viscosity of the fermented beverage.

Conclusions

The results from experiments indicated that with increasing velocity gradient, the viscosity of all samples decreased. Fermented beverages from barley flour have pseudo plastic behavior. By increasing brewing time the viscosity increases and their consistence becomes denser. Fermentation time had no significant effect on the viscosity of fermented beverage from barley flour.

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