RHEOLOGICAL PROPERTIES OF YOGURT WITH GERMINATEDSORIZFLOUR

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Absract: Yoghurt with and without the addition of germinated soriz flour and Danisco stabilizer has a behavior similar to that of rheological pseudoplastic nenewtoniene fluids. Soriz yogurt supplementation with germinated soriz flour and Danisco stabilizer changes the network structure and the permeability of curd, reduce essentially the process of synereses and increases viscosity. The viscosity modification of yogurt supplemented with germinated soriz flour is determined by the weak interactions (hydrogen, hydrophobic, Van der Waals....) of yogurt with the flour proteins, which causes the rearrangement of solids structure of yogurt, particularly in large proportions of flour.
Keywords: *yogurt, germinated soriz flour, synereses, dynamic viscosity, apparent viscosity.*

Introduction

The rheological properties are important indicators of the quality of food from the raw material during processing (for choosing the optimal scheme of work) and for consumer.

Structure and rheological properties of fermented dairy products are influenced by a number of factors: the quality of milk, pH, the nature of bacterial cultures, temperature, mechanical processing, fermentation time, additions.*(Mullineux, 2008)*

In the present paper as filler was used germinated soriz flour. Germinated soriz flour is a natural product and increases essential amino acid content in yogurt, vitamins (especially those from groups B and PP), vegetable fats, easily assimilated carbohydrates, dietary fibre, improves the nutritional and organoleptic properties of enriched dairy products. The flour can also serve as a replacement of some part of the yogurt stabilizers, which ensures the microstructure formation of the finished product. The price of germinated soriz flour is lower than that of the imported stabilizers.

Materials and methods

In studies conducted have used the following raw materials: standard cow's milk (2.5%), skimmed powder milk, sugar-candy, GRINDSTED-stabilizer SB258A (contains native E1422 acetylated diamidon adipate and gelatin), starter bacteria (Danisco, Dania), *germinated soriz flour*.

Preparation of yogurt was made by the conventional technology of production, with small changes: *germinated soriz flour* with granulary (particle size) 140 µ was mixed with a normalized part of milk at the rate of 1:10. Then flour and milk suspension was thermostated at a temperature of 60± 2°C, for 30 minutes, filtered, and then administered in the mass of balanced milk caps along with other components of the recipe.

The study of rheological properties of yogurt were carried out at different concentrations of flour and stabilizer. Experimental variants are shown in Table 1.

Table 1. Experimental variants of recipes used to determine rheological properties of yogurt (2.5% fat)

	Product code	Filler content, %	
		Stabilizer	*Germinated* sориz*flour*
1	I+S0	-	-
2	I+S1	0,1	-
3	I+S2	0,2	-
4	I+S3	0,3	-
5	I+F0,5+S0	-	0,5
6	I+F0,5+S1	0,1	0,5
7	I+F0,5+S2	0,2	0,5
8	I+F0,5+S3	0,3	0,5
9	I+F1,5+S0	-	1,5
10	I+F1,5+S1	0,1	1,5
11	I+F1,5+S2	0,2	1,5
12	I+F1,5+S3	0,3	1,5
13	I+F2,5+S0	-	2.5
14	I+F2,5+S1	0,1	2.5
15	I+F2,5+S2	0,2	2.5
16	I+F2,5+S3	0,3	2.5

Yogurt viscosity has been determined by viscometric REOTEST RV. Tension shear of yogurt was calculated according to the formula:

$$\tau = \alpha \times Z, \qquad (1)$$

where: τ- *tension shear, Pa;*
α – viscometric data on screen;
Z – constant cylinder, (Z= 1,19)

On the basis of the results obtained was calculated Dynamics viscosity (apparent) η,

$$\eta = \tau / \gamma \times 100, \qquad (2)$$

where: *η- dynamics viscosity, Pa·s;*
γ- shear rate, s^{-1}.

Determination of *synereses index* of yogurt included the separation and dosing the quantity of the exudate whey. For this yogurt samples (10g) were placed in centrifuge tubes and centrifuged for 5 minutes at the speed of 1000 revs/min. *(Н. Г. Меркулова, 2009)*
Index of *synereses* has been determined from the relation:

$$S = m_z / m_p \times \cdot 100, \qquad (4)$$

where: *m_z – quantity of exudate whey, g;*
m_p- the sample of yogurt, g;

Results and discussions

Yogurt synereses

Fermented dairy products are structured disperse systems as gels. Their chemical composition does not reflect their physico-chemical properties than at the level of constituent subunits distributed in ensembles with varying degrees of order.

S*ynereses* is a biochemical phenomenon and physico-chemical complex, still unknown and represents a thermodynamic property which consists of reducing the volume of the gel due to expulsion of vast quantities of solvent with its aging. *Syneresis* is actually a continuation of the clotting reaction to the maturing coagulation, which leads to increasing the cross-linking density of links in the contracting gel and the expulsion of solvent.

S*ynereses* intensity and depth of yogurt depends largelyon the internal surface of the solid phase, porosity (spaces occupied by whey) and permeability of gel. Gel porosity depends on the size and nature of association of the solid gel and the permeability of solid elements is dependent on the size, shape and pore size. In coagulants formed by acidifying lactic pores have a micellar character (not alveolar, as in the case of curd formed by rennet). In this case during synereses curdis relatively slow contracting (absence of forces which create forces of contracting), porosity continuously decreases, but remains relatively high permeability throughout the whole process thanks to the fact that the network is made up of demineralised casein. *(Mahaut M., Jeantet R., Brule, 2000)*

Supplement of yogurt with germinated soriz flour and stabilizer can change both the network structure and permeability of the curd and may affect the process of s*ynereses*.

The results characterizing the values of s*ynereses indexes* yogurt samples analyzed are shown in Figure 1.

Thus the value of s*ynereses* for plain yoghurt is 23,6%, and the flour with the addition of germinated soriz flour ranges from 8.2 to 14.1% and decreases with the increasing of admixture content. This indicates that the starch (and debatably protein) flour changes the structure and permeability of the gel network.

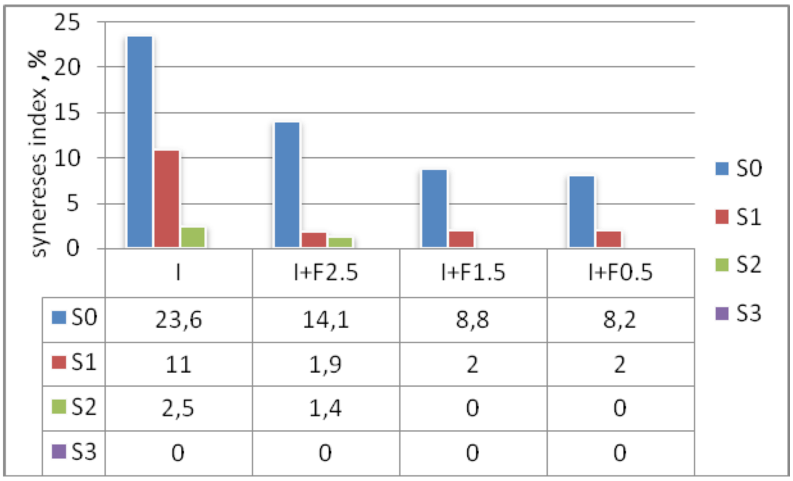
As for DANISCO stabilizer is a mixture of acetylated distarch adipate (obtained by crosslinking starch with adipic acid and acetic anhydride) and gelatin and is widely used in food industry as an artificial thickening agent, stabilizer, loading agent. Stabilizer in lower concentrations do not form gels, but it moisturizes and increases essentially viscosity and water retention in yogurt curd structure Therefore, adding up to 0.3% of Danisco reduces the coefficient of s*ynereses* up to 0. Combining stabilizer with germinated soriz flour produces a synergistic effect and reduces the amount of stabilizer used from 0.3to 0.2% and in some cases even up to 0.1%.

The ability to move through the pores of the whey is directly influenced by the viscosity of the liquid phase.

Viscosity of yogurt

Viscosity is an important index for technological process but also for the consumer.

Yoghurt is a fluid, i.e. possess a viscous fluid and elastic properties of a solid. The rheological behavior of yogurt is like that of a nenewtonien fluid.



	I	I+F2.5	I+F1.5	I+F0.5
S0	23,6	14,1	8,8	8,2
S1	11	1,9	2	2
S2	2,5	1,4	0	0
S3	0	0	0	0

Fig. 1. Variation in the *synereses* index (volume of exudate from *synereses*) of yogurt samples depending on the amount of stabilizer (S) and added germinated soriz flour (F)

In this respect the viscosity of product depends on the velocity of exerted shear. In the case of yogurt the viscosity decreases with the increasing shear rate, and the viscosity is characterized by the so-called apparent viscosity at a given shear velocity.

The most common technique used for food rheological fluid is viscometers, which measures the resistance to shear, expressed as the coefficient of viscosity. (*Skiver A.,1995*).

Analysis of reograms allows the appreciation of the product flow properties in a wide range of shear velocities and the viscometric characterization of the complete product.

Figure 2 shows the change in dynamic viscosity (η, Pa·s) depending on shear velocity (γ^{-1}) yogurt samples 9 to 12 in Table 1. The analog results were obtained and for other types of recipes.

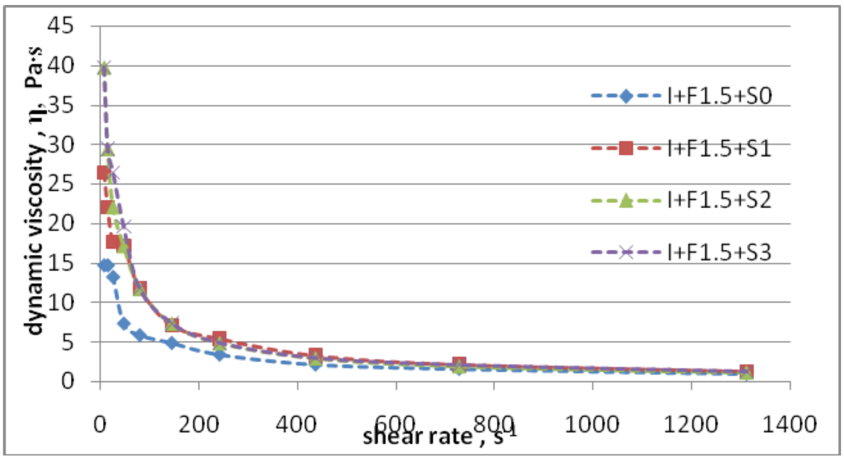


Fig. 2. Variation of dynamic viscosity depending on shear rate for yogurt samples with added flour 1.5% and stabilizer from 0.1 to 0.3%

For all samples of yogurt has found that they have a rheological behavior similar to that of rheological nenewtoniene fluids, independent of time, that is a pseudoplastic behaviour. Characteristic for a fluid with such behavior is lowering resistance to flow as a result of the increase in the velocity of fluid shear. Values of apparent viscosity tovelocity shear 243000 s^{-1} are shown in Figure 3.

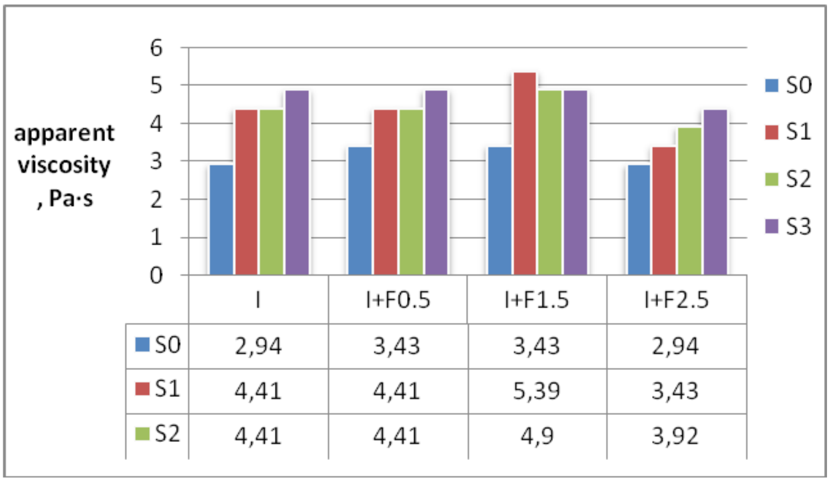


Fig. 3.Variation of apparent viscosity of yogurt samples at shear rate of 243000s^{-1}

The value of the apparent viscosity of yogurt samples range from 2.94 Pa·s for flour and yogurt without added stabilizer up to 5.39 Pa·s for yogurt with addedflour1.5%and 0.1% stabilizer. The addition of 0.5% flour did not change the apparent viscosity of yogurt, except for the sample without stabilizer. To the addition of flour at the rate of 1.5% is an increase in the viscosity of yogurt. The viscosity of yogurt with 0.2% stabilizer and flour is equivalent to 0.3% sample of yogurt stabilizer (without flour).

Yogurt samples with 2.5% flour have a lower value of apparent viscosity compared to the control sample. The value of the apparent viscosity of yogurt samples range from 2.94Pa·s for flour and yogurt without added stabilizer up to 5.39Pa·s for yogurt with added flour 1.5% and 0.1% stabilizer. The addition of 0.5% flour did not change the apparent viscosity of yogurt, except for the sample without stabilizer. To the addition of flour at the rate of 1.5% is observed an increase in viscosity yogurt. The viscosity of yogurt with 0.2% stabilizer and flour is equivalent to 0.3% sample of yogurt stabilizer (without flour). Yogurt samples with 2.5% flour have a lower value of apparent viscosity compared to the control sample.

This variation of yogurt viscosity of can be explained primarily by the presence and quantity of stabilizer with specific hydrophilic properties.

As for the influence of the addition of germinated soriz flour up to 1.5- 2.0%, this is probably due to the fact that the molecules of starch gelatinized flour acts as active molecules that connect water in the casein recipe pores and increase the network of yogurt viscosity. There are probable and weak interactions (hydrogen, hydrophobic, Van der Waals....) of yogurt proteins with those of the flour, which causes strong structural rearrangement of yogurt, especially in large proportions of flour. At higher concentrations of starch in the flour forms a network of its own, incompatible (due to the thermodynamic incompatibility) with that of casein. As a result casein network is compact and leads to lower viscosity of yogurt.

Therefore the supplementation with fish flour over 2.0 to 2.5% is contraindicated because it causes reduction of viscosity and stability of yogurt. At the same time it leads to the increase content in yogurt and fermenting substances that reduce the duration of fermentation, which also lowers the stability of curd gel.

Conclusions

1. Supplementation of yogurt with germinated soriz flour and Danisco stabilizer changes both the network structure and permeability of curd and essentially reduces the process of s*ynereses*.

2. Value of the apparent viscosity of yogurt samples range from 2.94 Pa·s flour and yogurt without the addition of stabilizer and flour up to 5.39Pa·s for yogurt with added flour 1.5% and 0.1% stabilizer.

3. Changing of the viscosity and s*ynereses* coefficient of supplemented yogurt with germinated soriz flouris determined by weak interactions (hydrogen, hydrophobic, Van der Waals....) of yogurt proteins with those of the flour, which causes strong structural rearrangement of yogurt, especially in large proportions of flour.

References

1. Mahaut M., Jeantet R., Brule G., 2000. Initiation a la technologie fromagere. Tec & Doc, Paris,France. 1-21.
2. Mullineux G., Simmon M.J.H., Influence of rheological model on the processing of yoghurt, Journal of Food Engineering, 84: 2008, 250-257.
3. Skiver A., Characterization of stirred yoghurt by rheology, microscopy and sensory analysis, Ph.D. Thesis, The Royal Veterinary and Agricultureal University, Copenhagen, Danemark, 1995, 133 p.
4. Н. Г. Меркулова и др. Производственный контроль в молочной промышленности, Практическое руководство, Санкт-Петербург, Издательство Профессия, 2009, 653 стр.