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THE INFLUENCE OF TEXTURE IMPROVER TYPE AND ITS ADDITION LEVEL ON RHEOLOGICAL PROPERTIES OF GOAT'S MILK YOGHURT**

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** Original scientific paper

Abstract: Set yoghurt from goat's milk with addition of two texture improvers DSE 6693 and DSE 6694 from NZMP New Zealand, added in the amount of 1, 2and 3% and control yoghurt without addition of texture improvers were produced. In yoghurt determined sensory quality, pH, apparent viscosity and rheological properties. Flow curves obtained for produced yoghurts were described by three rheological models: Ostwald de Waele, Herschel-Bulkley (H-B) and Casson. Addition of texture improver caused an increase in total solids and total protein content of milk for yoghurt. Yoghurt with texture improvers gave better sensory quality than control yoghurt. The yogurt with 1% addition of DSE 6693 and with 2% addition of DSE 6694 had the best sensory quality. The increase in addition level of texture improvers caused an increase in apparent viscosity, consistency coefficient K, yield stress (except H-B model) and deviation from Newtonian flow (decrease of flow index n). Effect of type of improver was rather negligible, whereas its level addition considerably influenced the evaluated rheological parameters.

Key words: goat's milk yoghurt, rheological properties, texture improver

Introduction and literature review

The main problem in the production of goat's milk yoghurt is to obtain a product with as good a curd tension or viscosity after stirring as in cow's milk yoghurt. In comparison with a common quality standard for cow's milk yoghurt, after stirring the goat's milk yoghurt has usually too low curd tension or viscosity (*Abrahamsen* 1986, *Tamime and Robinson* 199). In order to improve the consistency and viscosity of the product, the

total solids of processing milk is increased in the way of: skim milk powder addition, vacuum evaporation or membrane processes such like ultrafiltration or reverse osmosis One of the new method permitted to obtain preferable consistency of goat's milk yoghurt is modification of processing milk by addition of special supplement called texture improver. The base components of these additives are milk proteins in the amount 51-85%. Texture improvers can replace addition of milk powder or stabilizers, improving viscosity, texture, mouth feel of the yoghurt and reduce syneresis (*Elferink* 1998*, Tamime and Robinson* 1999*)*.

The aim of this study was to determine the influence the type of texture improver used and its level addition on rheological properties of yoghurt produced from goat's milk.

Materials and methods

Raw milk for production of set-yoghurts obtained from an Improved Polish White breed of goat's during the middle-lactation period was pasteurised at 85°C for 15 min, cooled down to incubation temperature and inoculated with starter culture YC-180 obtained from Chr. Hansen, Denmark. The culture was added in 2% quantity converted into the batch starter culture (5 u [unit] for 25 litter of milk). The yoghurts were incubated at 44°C until the pH of 4,8 was reached. Then the products were cooled down to 5-8°C. At this temperature products were stored for 14 h and than analysed. Three type of yoghurts were produced: control (without addition of texture improver), with addition of texture improver DSE 6693 in the amount of 1, 2 and 3% and with addition of texture improver DSE 6694 at the same level (1, 2 and 3%).

Table 1. The basic composition of texture improvers

Component	Type of texture improvers	
	DSE 6693	DSE 6694
Water [%]	5,2	5,0
Total protein [%]	80,4	76,0
Total protein in dry matter [%]	84,8	80,0
Lactose [%]	6,5	11,7
Fat [%]	2,5	2,9
Ash [%]	4,4	4,5

The texture improvers came from NZMP New Zealand, and were added into the milk before pasteurisation. The basic composition of used texture improvers are presented in table 1.

In the milk for yoghurts the following characteristics were analysed: total solids, total protein, fat, lactose, and mineral compounds, density, potential acidity and pH (*AOAC,1995, PN-68/A-86122)*. In yoghurt the following characteristics were analysed: sensory evaluation in 5-point scale performed by trained panel of 5 judges of verified sensory acuity, pH, apparent viscosity and flow curves using rotary viscometer Rheotest RV2 (VEB MLW Medingen, Germany). Obtained flow curves were described by three rheological models: Ostwald de Waele, Herschel-Bulkley and Casson.

Results of investigations and discussion

Basic chemical composition and physicochemical properties of processing milk for yoghurts were as follow: total solids 11,84 ± 0,07%, total protein 3,23 ± 0,04%, fat 3,5 ± 0,1%, lactose 4,56 ± 0,20%, ash 0,70 ± 0,14%, density 1,0277 ± 0,0007 g/cm^3, acidity 7,13 ± 0,24°SH and pH 6,58 ± 0,01. *Guo et al.* (2001) have stated a similar composition of goat's milk in the middle lactation period for collecting milk from different breeds of goats. According to *Pełczyńska* (1995) the total solids content in goat's milk ranged from 11,50 to 13,63 %, a total protein content from 2,9 to 3,76%. According to *Kudełka* (1997) the mean total solids content in goat's milk is 12,06% and protein content 3,2%. Addition of texture improvers caused increase in total solids and total protein contents. Changes in content of these components are presented in the table 2.

Table 2. Changes in total solids and total protein contents after addition of texture improvers in relation to contents of these components in control milk

Components		Total solids [%]	Total protein [%]
Control milk		11,84	3,27
Type of improver	Addition level[%]		
DSE 6693	1	12,56	4,09
	2	13,10	4,73
	3	13,82	5,50
DSE 6694	1	12,50	3,99
	2	13,49	4,61
	3	13,83	5,20

On figure 1 are presented the results of sensory evaluation, pH and apparent viscosity of yoghurts produced from goat's milk with two types of texture improver in comparison to these characteristics for control yoghurt.

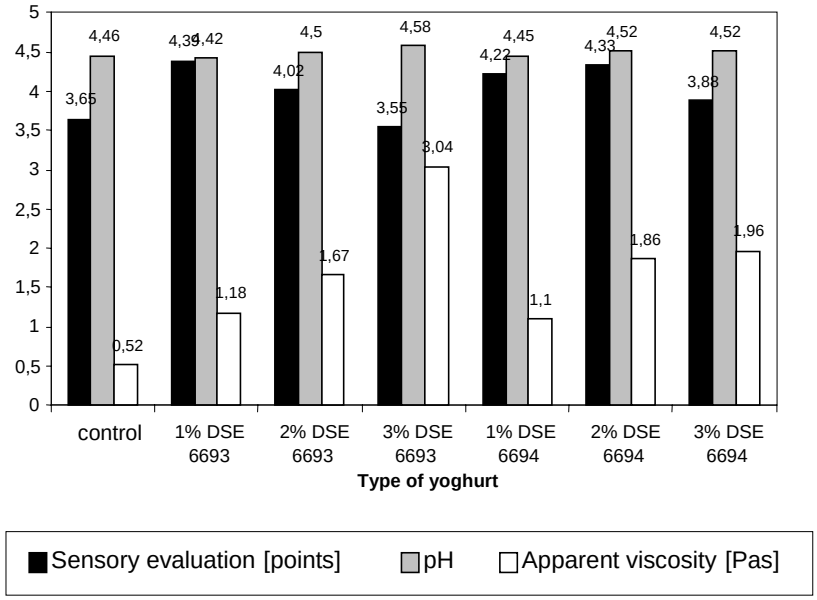


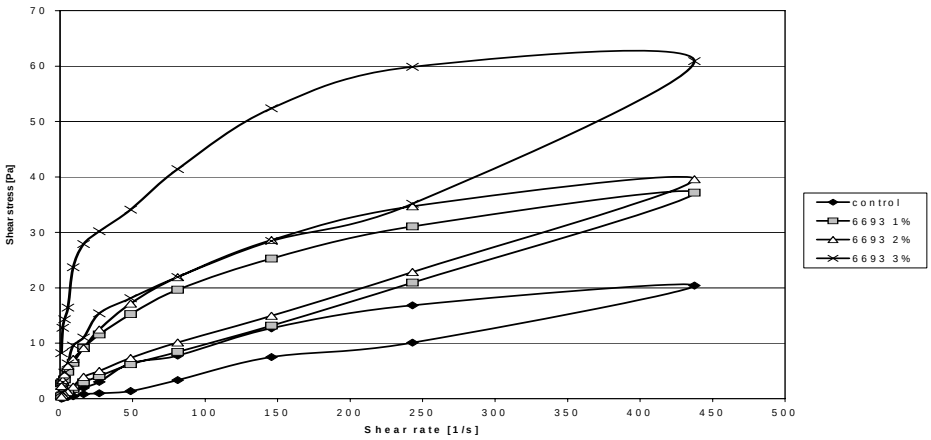
Figure 1. Results of sensory evaluation, pH and apparent viscosity of goat's milk yoghurts produced with texture improvers

Yoghurts with addition of texture improvers had better sensory quality than control yoghurt. The best sensory quality characterise yoghurt with 1% addition of texture improver DSE 6693 and with 2% of DSE 6694. Apparent viscosity of yoghurts with addition of texture improvers were larger than in control yoghurt and have increased with increase of texture improver addition level. The pH of all produced yoghurts were similar. *Elferink* (1998) have found a positive effect of texture improver on the structure, viscosity and stability of yoghurt. According to *Tamime and Robinson* (1999) texture improvers play a positive role in formation of proper viscosity, texture,

mouth feel of yoghurts.

On figure 2 are presented flow curves of yoghurts produced with texture improvers and control yoghurt. The curves have a shape of hysteresis loop.

Yoghurts with texture improver 6693



Yoghurts with texture improvers 6694

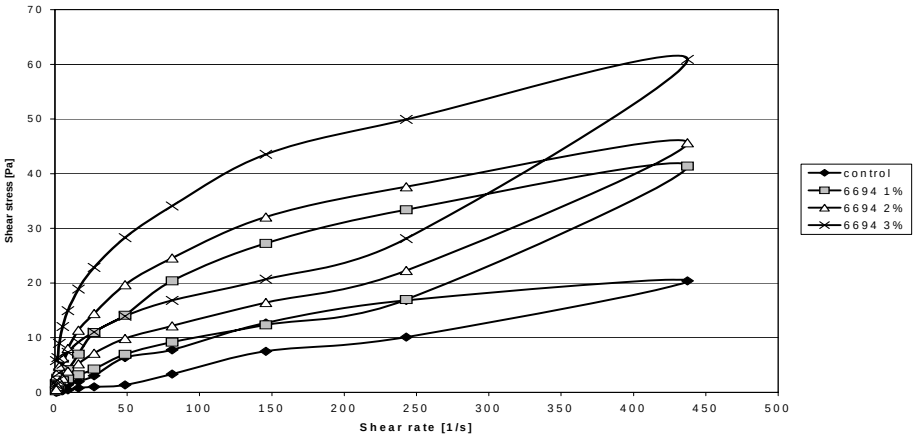


Figure 2. Flow curves of yoghurts with texture improvers and of control yoghurt

In comparison to control yoghurt, flow curves of yoghurts produced with addition of both texture improvers have a higher slant angle and higher values of shear stress for the same value of shear rate. These yoghurts were more resistant to action of shear forces (*Jaros et al.,* 2002*)*. An increase in addition level of texture improver caused increase in slant angle, shear stress value for the same shear rate and in hysteresis loop area of flow curves. Hysteresis loop area is a measure of energy, which is needed for destruction of yoghurt gel (*Schramm* 1998*)*.

In table 3 are presented the values of rheological parameters of analyzed yoghurts, calculated from models used for describing of study products.

Table 3. Values of rheological parameters of yoghurt from goat's milk with texture improvers and control yoghurt, calculated from models used for describing of study products

Type of yoghurt	Model									
	of Ostwald de Waele			of Herschel-Bulkley				of Casson		
	K [Pas^n]	n [-]	R^2	τ_0 [Pa]	K [Pas^n]	n [-]	R^2	τ_0 [Pa]	η [mPas]	R^2
Control	1,26	0,61	0,9868	0,12	1,17	0,62	0,9861	0,90	120,70	0,8785
1% DSE 6693	3,88	0,47	0,9913	0,38	3,58	0,48	0,9903	3,75	128,96	0,8914
2% DSE 6693	6,91	0,37	0,9929	0,00	8,74	0,33	0,9953	7,38	92,52	0,8922
3% DSE 6693	14,93	0,25	0,9878	0,00	33,25	0,16	0,9956	16,90	54,81	0,8758
1% DSE 6694	3,52	0,48	0,9881	0,00	3,96	0,46	0,9910	3,31	124,76	0,8733
2% DSE 6694	7,13	0,38	0,9788	0,00	9,29	0,34	0,9851	7,64	105,30	0,8535
3% DSE 6694	4,71	0,45	0,9390	0,00	13,71	0,27	0,9813	3,57	138,31	0,8869

The values of consistency coefficient for yoghurt produced from milk with addition of texture improvers, calculated from Ostwald de Waele and Herschel-Bulkley models and yield stress calculated from Cassons model were higher in comparison with the values of these parameters for control yoghurt. An increase in addition level of texture improver caused an increase in the values of these parameters. An opposite changes were found for flow index n. Yoghurts with texture improvers caused a higher deviation from Newtonian flow (lower values of flow index n) than control yoghurt.

Changes in Cassons viscosity were irregular. Obtained data have a good fit to rheological models of Ostwald de Waele and Herschel-Bulkey and a little worse to Cassons model.

Conclusions

1. Addition of texture improver increased total solids and total protein content in milk for yoghurt.
2. Yoghurts with texture improvers had better sensory quality than control yoghurt. The best sensory quality had yoghurt with 1% addition of texture improver DSE 6693 and with 2% addtion of texture improver DSE 6694.
3. The increase in addition level of texture improvers caused generally an increase in apparent viscosity, consistency coefficient K, yield stress (except H-B model) and deviation from Newtonian flow (decrease of flow index n).
4. Effect of type of improver was rather negligible, whereas its level addition considerably influenced the evaluated rheological parameters.

UTICAJ TIPA POSPEŠIVAČA STRUKTURE I NIVOA NJEGOVOG DODAVANJA NA REOLOŠKE OSOBINE KOZIJEG MLEČNOG JOGURTA

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Rezime

Jedna od novih metoda koje su dozvoljene u dobijanju željene konzistencije kozijeg mlečnog jogurta je modifikacija prerade mleka dodavanjem specijalnog dodatka koji se naziva pospešivač strukture. Osnovne komponente ovih aditiva su mlečni proteini u količini od 51-85%. Pospešivači strukture mogu zameniti dodavanje mleka u prahu ili stabilizatora, poboljšavajući viskoznost, strukturu, ukus u ustima jogurta i smanjuju sinerezu. Cilj ovog ispitivanja je bio određivanje uticaja tipa pospešivača strukture koji se koristi i nivoa dodavanja na renološke osobine jogurta proizvedenog od kozijeg mleka. Proizveden je jogurt od kozijeg

mleka uz dodavanje dva pospešivača strukture DSE 6693 i DSE 6694 od NZMP sa Novog Zelanda, koji su dodati u količini od 1, 2 i 3% i kontrolni jogurt bez dodavanja pospešivača strukture. Određivani su senzorni kvalitet, pH, očigledna viskoznost i reološke osobine. Krive dobijene za proizveden jogurte su opisane korišćenjem tri reološka modela : Ostwald de Waele, Herschel-Bulkley (H-B) i Casson. Dodavanje pospešivača strukture je izazvalo povećanje sadržaja ukupnih čvrstih materija i ukupnih proteina u mleku za jogurt. Jogurt sa pospešivačima strukture je imao bolji senzorni kvalitet nego kontrolni jogurt. Jogurt u koji je dodato 1% DSE 6693 i 2% DSE 6694 je imao najbolji senzorni kvalitet. Povećanje nivoa dodavanja pospešivača strukture je izazvalo povećanje u očiglednoj viskoznosti, koeficijentu konzistencije K, stresu prinosa (osim modela H-B) i devijaciju od Newtonian toka (smanjenje indeksta toka n). Uticaj tipa posepšivača je bio zanemarljiv, dok je njegov nivo bio pod značajnim uticajem ocenjivanih reoloških parametara.

References

ABRAHAMSEN R.K. (1986): Yoghurt from ultrafiltered goat's milk. Bulletin IDF, 202, 171-174.

AOAC (1995): Official methods of analysis, Washington DC.

ELFERINK E. (1998): Domovictus – functionality of whey based texture improvers for yoghurt. In: Texture of fermented milk products and dairy desserts. IDF Special Issue, 9802, 197-202.

GUO M.R., DIXON P.H., PARK Y.W., GILMORE J.A., KINDSTED P.S. (2001): Seasonal changes in the chemical composition of commingled goat milk. Journal of Dairy Science 84, E. Suppl., 79-83.

JAROS D., HAQUE A., KNEIFEL W., ROHM H. (2002): Influence of starter culture on the relationship between dry matter content and physical properties of stirred yoghurt. Milchwissenschaft, 57, 8, 447-450.

KUDEŁKA W. (1997): Zawartość podstawowych składników mleka koziego w czasie pełnej laktacji. Przegląd Mleczarski, 12, 384-387.

PEŁCZYŃSKA E. (1995): Mleko kóz. Medycyna Weterynaryjna, 51, 2, 67-70.

PN-68/A-86122 Mleko. Metody badań.

SCHRAMM G. (1998): Reologia. Podstawy i zastosowania. Ośrodek Wydawnictw Naukowych PAN, Poznań.

TAMIME A.Y., ROBINSON R.K. (1999): Yoghurt. Science and Technology. Woodhead Publishing, Cambridge.