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THE EFFECTS OF SAMPLE FAT VALUE MANIPULATION ON RAW COW MILK COMPOSITION AND INDICATORS

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Abstract

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Values of milk indicators (MIs) can be influenced by sampling errors and milk manipulation. This paper estimated the freezing point depression (FPD) and other MIs drifts which can cause fat movement. That is important for: – preparation of reference milk samples (MSs) for proficiency testing and instrument calibrations; – estimation of the impact of milk treatment as centrifugation in dairy plants on FPD. Five MSs (A = original milk; milk with modified fat (F) content; B = less F, C = low F, D = more F, E = high F) were created (gravitation F separation at 4 °C for 12 hours) with the same milk matrix 12× per year. F averages increased by 4.80% (122.1%) from 1.68 to 6.48% due to manipulation. It increased variability of MIs especially for SNF (solids non fat), L (lactose) and CP (crude protein). SCC (somatic cell count) averages increased by 803 (196.8%) from 9 to 812 thousand.ml^{-1}. Correlation (r) F × SCC was 0.85 ($P < 0.001$). SNF, L and CP averages decreased by 0.47% (5.3%), 0.31% (6.3%) and 0.17% (5.0%). Correlations were –0.78, –0.75 and –0.64 ($P < 0.001$). Urea decreased along with F increase by 1.05 mg.100ml^{-1} (2.9%) but with r –0.13 ($P > 0.05$). Acetone increased by 1.37 mg.l^{-1} (47.6%) with r 0.21 ($P > 0.05$). Electrical conductivity decreased by 0.23 mS.cm^{-1} (6.0%) with r –0.15 ($P > 0.05$). Alcohol stability was reduced by 0.14 ml (23.3%) with r –0.15 ($P > 0.05$). FPD, titration and actual acidity were not influenced.

milk, sample, fat manipulation, milk freezing point, somatic cell count, milk indicators

The quality of milk as composition and properties depend in the first place on primary milk production technology and the nutritional and health state of dairy cows. However, milk quality assesssment also depends on sampling accuracy and milk sample manipulation apart from the reliability of the analysis. In particular the fat (F) content, somatic cell count, free fatty acid content (Hanuš *et al.*, 2008 b) and total mesophilic bacteria count (Cempírková, 2002, 2007) may be influenced by these factors as they are most sensitive to sampling accuracy. This is relevant to the price of milk according to quality.

The freezing point depression (FPD) is a very important physical property of raw and treated (pasteurized) drinking milk. FPD is investigated along the dairy chain as part of milk quality control in the dairy developed countries quite regularly (Crombrugge, 2003). The original raw milk freezing point is influenced in particular by the milk chemical composition and by the other milk physical properties (Brouwer, 1981; Walstra and Jenness, 1984; Koops *et al.*, 1989; Wiedemann *et al.*, 1993; Chládek and Čejna, 2005) as well. Of course, there are also secondary technological effects which influence the raw milk FPD such as the incidental foreign water addition during milking (Buchberger, 1990 a, b, 1994; Crombrugge, 2003) or next milk manipulations via collecting, transport and other treatments such as pasteurization too (Rohm *et al.*, 1991; Janštová *et al.*, 2007). The main part of the original

milk FPD (Demott, 1969; Brouwer, 1981; Walstra and Jenness, 1984; Koops *et al.*, 1989) is linked to the lactose content (53.8%), with macroelement concentrations (K^+ 12.7%, Cl^- 10.5%, Na^+ 7.2%), citrates 4.3%, urea 1.9% and other components 6.9% (fat, protein et cetera). Other authors (Freeman and Bucy, 1967; Eisses and Zee, 1980; Buchberger, 1990 a, b, 1994; Kološta, 2003; Kirchnerová and Foltys, 2005) investigated and partly explained all the other effects on FPD such as biological, biochemical (dairy cow feeding and dairy cow mammary gland health state) and technological (milking, collecting, transport and pasteurization). Milk watering owing to foreign water penetration is connected with these technological steps. Also milk sampling and treatment (manipulation) can influence FPD.

Fat is the milk component that is most changed by various technological factors in the milk processing chain and in the case of both raw unpasteurized and pasteurized milk, during mixing, cooling, storage, transport, preparation and treatment (centrifugation). All this can simultaneously influence the FPD (as drifts) and affect other milk component proportions and properties as well (Hanuš *et al.*, 2003).

For these reasons the aim of this paper was to explain the FPD and other milk component and property value drifts which may be caused by incidental fat content changes. There is a dearth of relevant information on the three main reasons for this investigation: 1) the information acquired could be important for explaining possible effects of milk sampling errors and sample manipulations on milk composition and properties; 2) the methodological data is significant for milk reference laboratories and dairy analytical technologies in the preparation of milk standard or reference samples for interlaboratory proficiency testing and instrument calibrations for measurement of various milk indicators; 3) this estimation is essential for determinating the impact of basic milk treatment such as centrifugation in dairy plants on milk freezing point. The second reason is the importance of reference sets of milk samples (MSs) today at a time of rapid dissemination of new effective milk analytical methods like NIR–FT and MIR–FT, near and mid infra–red spectrophotometry with Fourier transformations, which are able to measure simultaneously a large number of milk indicators and must be calibrated regularly according to reference method results and using reliable methodical procedures (Tsenkova *et al.*, 2000; Kukačková *et al.*, 2000; Jankovská and Šustová, 2003; Šustová *et al.*, 2007; Hanuš *et al.*, 2008 a; Hering *et al.*, 2008).

MATERIAL AND METHODS

Animals and bulk milk samples

Bulk milk samples (MSs) from a commercial dairy farm store tank were used for the analyses in this study. These originated from both milked cattle breeds in the country, that is Czech Fleckvieh and Holstein dairy cows which were kept in one herd in the ratio 1:1. Cows were milked twice a day in a milking parlour. The milk was sampled over the whole year each month one MS. In this way the sample material covered all feeding seasons.

Experimental milk fat content manipulations

Five MSs (A = original milk, normal fat (F); B, C, D, E = milk sub–samples with modified (manipulation) fat content; B = less fat, C = low fat, D = more F, E = high F) were created on the basis of each bulk milk sample by the relevant modification (according to Hanuš *et al.*, 2003). Milk fat was withdrawn from sub–samples B and C and the same fat milk was added to sub-samples D and E by regulated hydromechanical gravitation fat separation (at 4 °C for 12 hours) and by the back homogenization mixing of the relevant portions as well. This ensured that all sub–samples B, C, D and E had the same milk matrix of original sample A.

Chemical, physical and microbiological analyses

All MSs were analysed in the accredited laboratory and National reference laboratory for raw milk of Agrovýzkum Rapotín. The investigated milk indicators (MIs) were as follows: fat (F) content (in $g.100g^{-1}$, %); crude protein (CP) content (in $g.100g^{-1}$, %); lactose (L) content (in $g.100g^{-1}$ of monohydrate, %); content of solids non fat (SNF, in $g.100g^{-1}$, %); total solids content (TS, in $g.100g^{-1}$, %).

All mentioned MIs were measured using MilkoScan 133B (Foss Electric, Denmark) equipment which was regularly calibrated (Hanuš *et al.*, 1995 a) according to reference method results (standard CSN 57 0536 by the Gerber's method for fat content, Kjeldahl's method for crude protein content and polarimetric and gravimetric methods for lactose and SNF contents, according to standard CSN 57 0530).

The somatic cell count (SCC, in $thousand.ml^{-1}$) was determined using a Fossomatic 90 instrument (Foss Electric, Denmark) according to standard CSN EN ISO 13366–2. Both instruments are used regularly in the relevant national proficiency testing with good results.

The milk urea (U, in $mg.100ml^{-1}$) concentration was determined by spectrophotometry at 420 nm wavelength. The specific reaction solution was prepared as sour mixture with the p–dimethylaminobenzaldehyde (Hering *et al.*, 2008; Hanuš *et al.*, 1995 b, 2008 a). The Spekol 11 instrument (Carl Zeiss Jena, Germany) was calibrated using six samples in a scale with the increased urea concentrations from 6 to 60 $mg.100ml^{-1}$.

The milk acetone (AC, in $mg.l^{-1}$) concentration was investigated by spectrophotometry at 485 nm wavelength. The AC was absorbed into alkali solution of KCl with the salicylaldehyde by 24 hours microdiffusion (Vojtíšek *et al.*, 1991; Janů *et al.*, 2007) in special vessels (at 20 °C in the darkness). The Spekol 11 instrument (Carl Zeiss Jena, Germany) was cali-

brated by five points on the scale with the increased AC concentration from 1 to 20 mg.l^{-1}.

The milk electrical conductivity (EC) was measured using OK 102/1 (Radelkis, Hungary) conductometer at 20 °C (in mS.cm^{-1}) with the help of the geometrically exactly defined bell glass electrode with ring platinum contacts. The instrument was calibrated by the relevant salt (KCl) solution (10.2 mS.cm^{-1}) at the each MS set measurement.

The active (pH) acidity was measured using pH–meter CyberScan 510 (EUTECH INSTRUMENTS) at 20 °C. This instrument is regularly calibrated by the standard buffer solutions (pH 4.0 and 7.0 Hamilton Duracal Buffer, Switzerland) at the each MS set measurement.

The milk freezing point depression (FPD, in °C) was measured by the reference cryoscopic method with the Cryo–Star automatic instrument (Funke–Gerber, Germany). This instrument was regularly calibrated (Bauch *et al*., 1993; Buchberger and Klostermeyer, 1995; Tomáška *et al*., 2005) by standard NaCl solutions (Funke–Gerber) and used in the national proficiency testing with regularly successful results.

The titration acidity (TA) was measured using the milk titration by the alkaline solution to the light pink colour of the mixture (in ml 0.25 mol.l^{-1} NaOH solution, which was used to the titration of 100 ml of milk). The method was performed according to standard CSN 57 0530 (the Soxhlet–Henkel method).

The total mesophilic bacteria count (TMBC) was investigated (Cempírková, 2002, 2007) using calculation of the colony forming units (CFU) and traditional plate cultivation methode (at 30 °C for 72 hours) with GTK M (Milcom Tábor) agar or agar with the glucose monohydrate, triptone–peptone, dehydrated yeast extract and skim milk powder, according to standard CSN ISO 6610 (in thousands of CFU.ml^{-1}).

The alcohol stability (AS) was determined with the help of the milk titration (5 ml) by 96% ethanol to the formation of the first visible milk protein flakes (in ml of used alcohol).

Design of statistical treatment

The main statistical characteristics as arithmetical mean (x) and standard deviation (sd) of milk indicators (MIs) were calculated separately for original milk samples (MSs; n = 12) and all original and manipulated MSs (n = 60) together. SCC, CPM and AC values were logarithmically transformed on decimal basis (log) because of non–normal distribution in most cases (Ali and Shook, 1980; Raubertas and Shook, 1982; Shook, 1982; Reneau, 1986; Reneau *et al*., 1988; Meloun and Militký, 1994; Hanuš *et al*., 2001). This was followed by geometric means. Correlations between MIs were calculated separately for original MSs and all original and manipulated MSs together. The Excel programme was used for the statistical evaluation. Because of the overstriking of fat manipulation effect the original and modified groups (5 groups × 12 samples) of MSs were displayed by box graphs in terms of data frequency distributions.

I: *Main statistical parameters of milk indicators for original milk samples (A)*

	n	x	sd	min.	max.
F	12	3.93	0.262	3.48	4.40
CP	12	3.40	0.076	3.20	3.50
L	12	4.96	0.121	4.74	5.19
SNF	12	8.91	0.163	8.65	9.19
TS	12	12.83	0.198	12.41	13.23
SCC	12	408	181	275	940
log SCC	12	2.5799	0.1496	2.4393	2.9731
FPD	12	–0.5234	0.0085	–0.5321	–0.5054
TMBC	11	243,364	447,172	19,000	1,600,000
log TMBC	11	4.9008	0.5982	4.2788	6.2041
U	12	36.76	10.56	10.56	50.93
AC	12	2.88	2.14	0.79	8.40
log AC	12	0.3551	0.2955	–0.1048	0.9245
AS	12	0.60	0.185	0.40	0.90
TA	12	7.66	0.320	7.19	7.99
EC	12	3.86	0.600	2.85	4.57
pH	12	6.67	0.108	6.57	6.90

n number of cases; x arithmetical mean; sd standard deviation; min. minimum; max. maximum; F fat (%); CP crude protein (%); L lactose (%); SNF solids non fat (%); TS total solids (%); SCC somatic cell count (thousand.ml^{-1}); FPD freezing point depression (°C); TMBC total mesophilic bacteria count (thousands of CFU.ml^{-1}); U urea (mg.100ml^{-1}); AC acetone (mg.l^{-1}); AS alcohol stability (ml of alcohol); TA titration acidity (ml 0.25 mol.l^{-1} NaOH solution); EC electrical conductivity (mS.cm^{-1}); pH active acidity

RESULTS AND DISCUSSION

Variability in milk indicators via fat content manipulation

The main statistical characteristics of MIs of original MSs are shown in Tab I and all MSs including fat manipulated samples are in Tab. II. The methodical and technological changes in milk fat content or changes that could be caused by milk sampling errors, can influence the results of the other measurements (Fig. 1, F and other MIs). As the tables show, the variability (sd and variability range) of MIs was marked often in both directions, due to fat manipulation in SCC and also in other main milk components as the results for identical MIs as these in Tab. I are compared to Tab. II.

Effect of fat content manipulation on hygienic milk indicators

The change trends of MIs depending on F manipulations in identical milk matrix are clearly visible in Fig. 1. The natural F variation range was from 3.48 to 4.40% (Tab. I; Fig. 1), after manipulation it was from 1.52 to 7.47% (Tab. II). F group averages for MSs (C, B, A, D, E) increased regularly (Fig. 1) from 1.68 to 6.48% or by 4.80% (by 122.1% relatively). The same SCC values varied from 275 to 940 thousand.ml^{-1} (Tab. I; Fig. 1) and from 4 to 1,876 thousand.ml^{-1} (Tab. II). Also SCC group averages for MSs (C, B, A, D, E) increased consistently in relation to F manipulations (Fig. 1) from 9 to 812 thousand.ml^{-1}. On average it was by 803 thousand.ml^{-1} (by 196.8%) along experimental F increasing at significant ($P < 0.001$) correlation coefficients (F × SCC and F × log SCC 0.85 and 0.84; Tab. IV; F × log SCC nonlinear 0.93; Fig. 2). This phenomenon can be explained by adhesion of somatic cells to fat globules which have larger diameter and lower specific weight than other cells and the water phase of milk and tend to increase towards milk level together with adherent somatic cells. A similar trend in relation to F changes but of course not as marked has been observed for TMBC too as an important hygienic indicator (Cempírková, 2002, 2007).

Effect of fat content modification on other major milk components

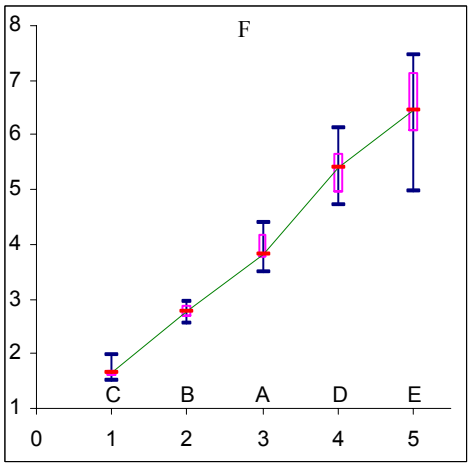
In contrast, weaker but clear trends were observed for main milk components in decreasing order: SNF, L and CP. In these cases group averages (C, B, A, D, E) decreased by 0.47% for SNF, 0.31% for L and 0.17% for CP or by 5.3?%, 6.3% and 5.0% relatively along with increase with milk fat (Fig. 1). Correlations were statistically significant (Tab. IV; $P < 0.001$; –0.78, –0.75 and –0.64). These results are in good accord with our preliminary paper (Hanuš *et al.*, 2003). Certainly the TS results were expected where the trend was logically and markedly in agreementt with F (Fig. 1). These facts are explainable by the mutual movements of proportions of specific weights in milk components during F manipulation which for fat is lower and for other main components higher than in the water phase.

Effect of fat content manipulation on minor milk components and health indicators

From the same mentioned reasons too, minor milk component a U (nutrition milk indicator with relation to fertility and production traits of cows; Zhai *et al.*, 2006; Jílek *et al.*, 2006; Řehák *et al.*, 2009) decreased a little along with F increase (Fig. 1). On average this was by 1.05 mg.100ml^{-1} (by 2.9%) but with a correlation coefficient of –0.13 (Tab. IV; $P >$

II: *Main statistical parameters of milk indicators for all, original and modified milk samples (A, B, C, D and E)*

	n	x	sd	min.	max.
F	60	4.04	1.773	1.52	7.47
CP	60	3.40	0.097	3.11	3.61
L	60	4.95	0.169	4.52	5.30
SNF	60	8.90	0.241	8.33	9.36
TS	60	12.94	1.591	10.43	16.10
SCC	60	416	366	4	1,876
log SCC	60	2.2935	0.7187	0.6021	3.2732
FPD	60	–0.5228	0.0080	–0.5321	–0.5051
TMBC	55	368,344	1,412,256	11,000	9,920,000
log TMBC	55	4.8202	0.6105	4.0414	6.9965
U	60	36.48	10.67	8.78	51.34
AC	60	3.41	2.26	0.66	9.14
log AC	60	0.4396	0.2914	–0.1791	0.9611
AS	60	0.55	0.164	0.30	0.90
TA	60	7.46	0.370	6.79	8.39
EC	60	3.98	0.571	2.85	4.82
pH	60	6.70	0.106	6.55	6.95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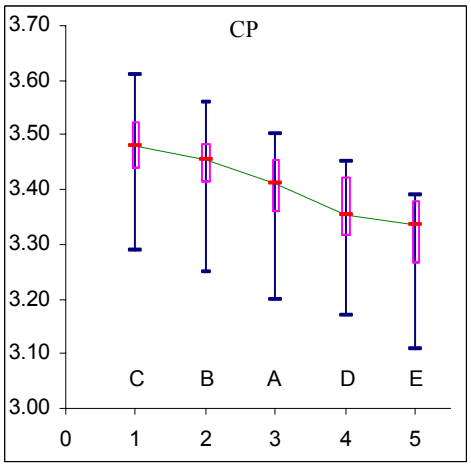
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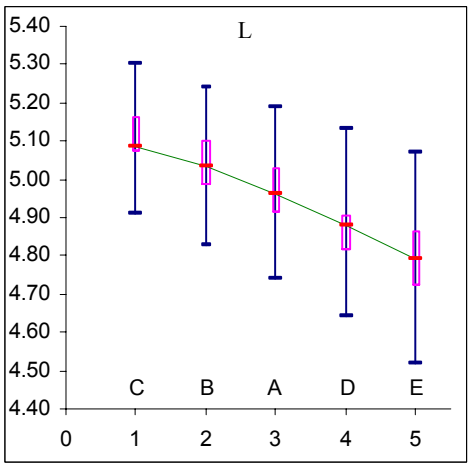
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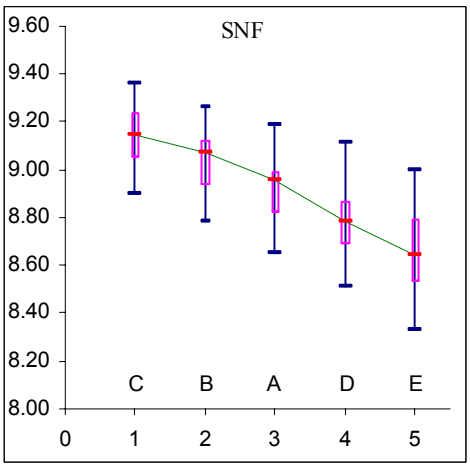
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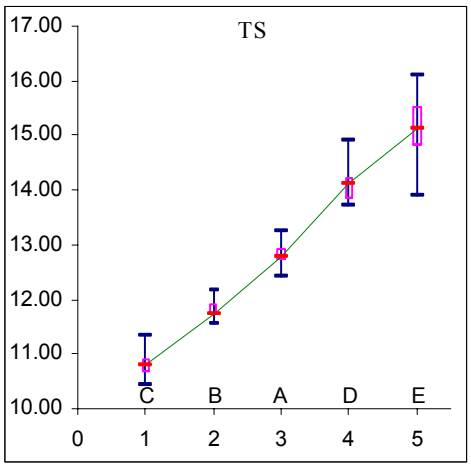
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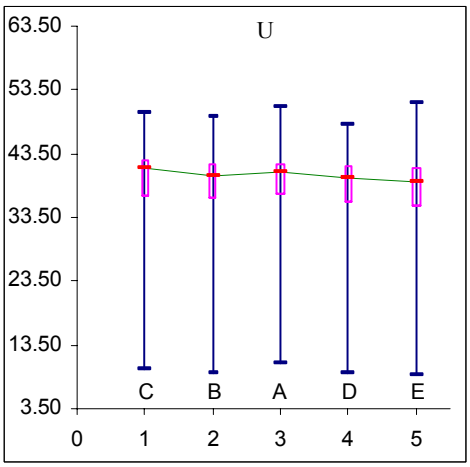
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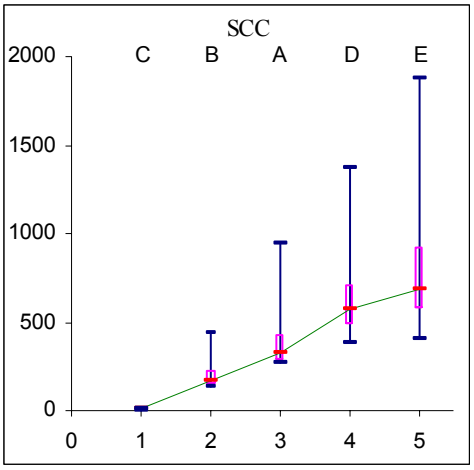
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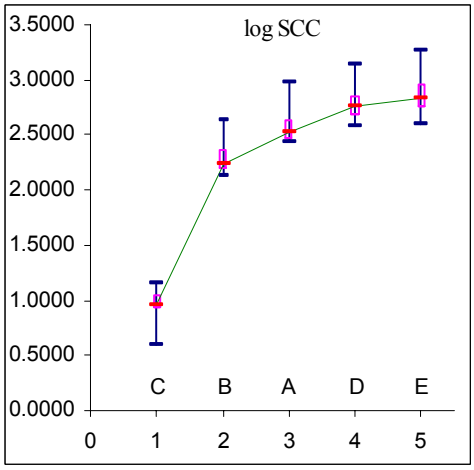
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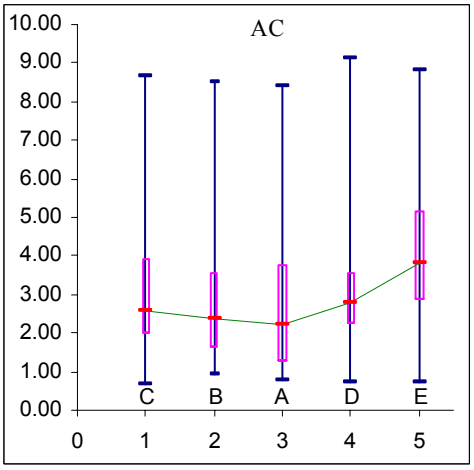
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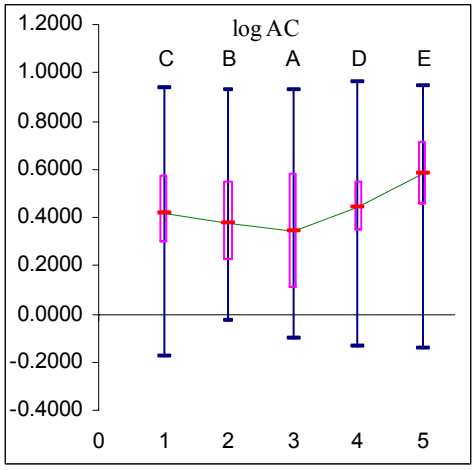
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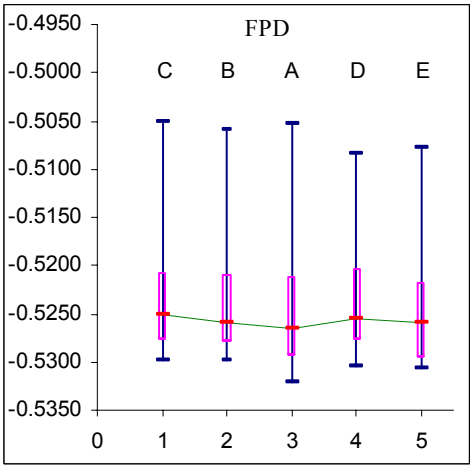
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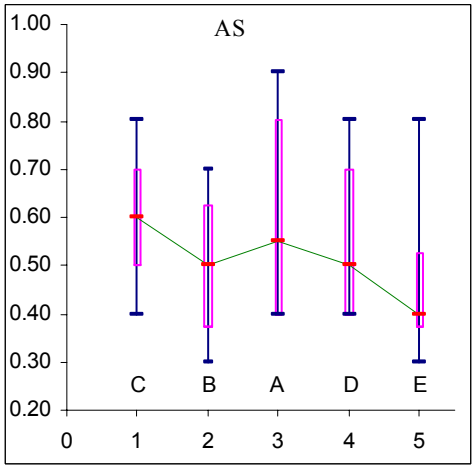
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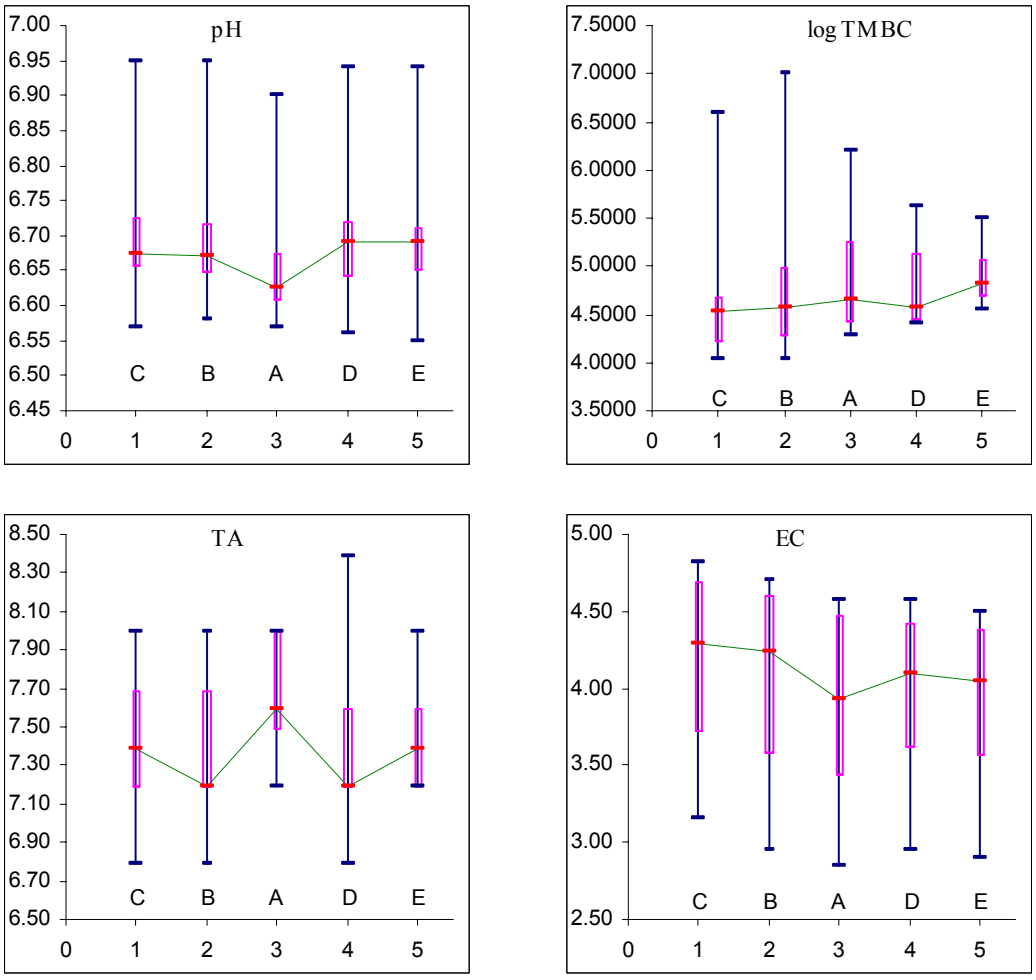


1: *Data frequency distributions of milk indicators for original (A) and modified groups (C, B, D and E) of raw cow bulk milk samples* (Box graph: median (the central short horizontal line); top edge of 1st and 3rd quartile (the tetragon); variation range, maximum – minimum (the vertical line))

0.05). That is in agreement with our preliminary results (Hanuš *et al.*, 2003). In contrast to this, however, the next minor milk component AC (cow health and nutrition milk indicator; Vojtíšek *et al.* 1991; Janů *et al.*, 2007) increased by 1.37 mg.l^{-1} (by 47.6%; Fig. 1) along with increase in experimental F with a correlation coefficient 0.21 (Tab. IV; $P > 0.05$). This phenomenon confirms a closer link of AC to milk fat fraction. An impact trend was investigated for EC as this health indicator decreased by 0.23 mS.cm^{-1} (by 6.0%) along with F increase (Fig. 1). However this effect was also insignificant (correlation –0.15; $P > 0.05$; Tab. IV).

Effect of fat content modification on some milk physical and technological properties

In agreement with assumption, the FPD was only minimally affected (Fig. 1) due to milk F manipulation with very low correlation (0.03; $P > 0.05$; Tab. IV). It is in good accordance with estimations of the possible impact of fat content on FPD in previous papers by Demott (1969), Brouwer (1981), Walstra and Jenness (1984) and Koops *et al.* (1989). That is one reason why possible milk sampling errors and milk technological centrifugation should not be a source of FPD deterioration in terms of quality change on milk market as it has been often mistakenly done in practice. Titration acidity and actual acidity were likewise affected insignificantly without visible trends (Fig. 1; Tab. IV) by F changes. An impact trend was observed for alcohol stability (Fig. 1). AS was reduced via F increase by 0.14 ml (by 23.3%). The correlation was –0.15 ($P > 0.05$; Tab. IV).

Changes of milk indicator relations via fat content manipulation

The comparison of mutual relations (correlations) between MIs in natural and all MSs including F modified MSs is interesting (Tab. III and Tab. IV). Some relationships were changed very markedly by F value modification. Some even changed the dependence under experimental conditions. This means the development of quite a new kind of relationship and strong effect using the F content manipulation. There are more significant correlations in Tab. IV than in Tab. III. This may be due to a larger

III: *Correlations coefficients between milk indicators in group of native milk samples (A; n = 12, TMBC 11)*

	F	CP	L	SNF	TS	SCC	log SCC	FPD	U	AC	log AC	AS	TA	EC	pH	TMBC
F			–0.733*	–0.657	0.782*	0.610	0.709	0.712*	–0.580							
CP	–0.251			0.721*		–0.851*	–0.818*								–0.626	
L		0.361		0.906*			–0.593		0.654	–0.778*	–0.778*					0.649
SNF						–0.745*	–0.808*	–0.618	0.690	–0.693	–0.694				–0.609	
TS		0.263	–0.223	–0.044												
SCC			–0.489		0.192			0.761*							0.659	
log SCC					0.272			0.771*	–0.595						0.634	
FPD		–0.566	–0.493		0.432				–0.859*			0.635			0.764*	
U		0.455			–0.198	–0.557									–0.805*	
AC	0.399	–0.244			–0.045	0.108	0.220	0.279	–0.505							
log AC	0.250	–0.246			–0.243	0.065	0.169	0.077	–0.365					0.701		
AS	0.456	–0.330	–0.190	–0.289	0.365	0.416	0.430		–0.388	0.255	0.031					
TA	0.326	0.410	–0.022	0.168	0.570	–0.245	–0.163	0.121	–0.023	0.213	0.032	0.033				
EC	–0.253	0.029	–0.307	–0.218	–0.514	–0.254	–0.218	–0.499	0.288	0.523		–0.188	–0.169			
pH	0.368		–0.448		–0.015					0.363	0.228	0.406	–0.090	–0.145		
TMBC	–0.296	0.117		0.525	0.065	–0.204	–0.244	–0.134	0.471	–0.233	–0.378	0.439	0.320	0.004	–0.182	
log TMBC	–0.435	–0.101	0.537	0.337	–0.249	–0.100	–0.151	–0.123	0.420	–0.143	–0.170	0.344	0.149	0.173	–0.179	

Insignificant coefficients (P > 0.05) below diagonale. Significant coefficients above diagonale: P ≤ 0.05 without sign; P ≤ 0.01 with*.

IV: *Correlations coefficients between milk indicators in groups of original and modified milk samples (A, B, C, D and E; n = 60, TMBC 55)*

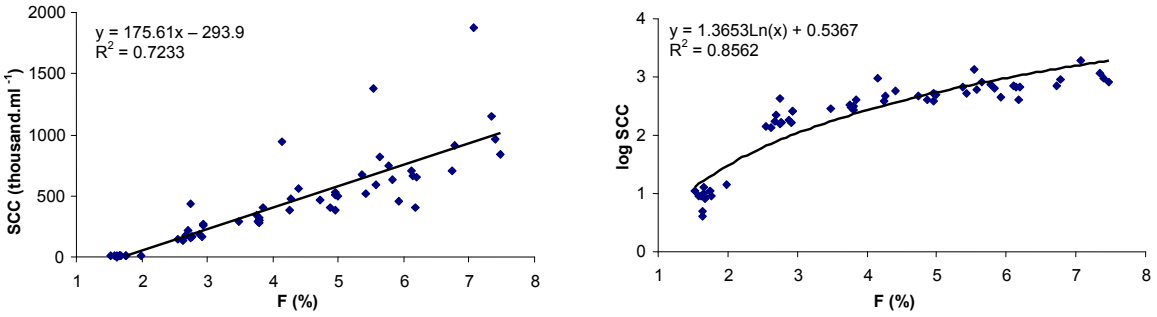
	F	CP	L	SNF	TS	SCC	log SCC	FPD	U	AC	log AC	AS	TA	EC	pH
F		–0.640*	–0.751*	–0.783*	0.996*	0.851*	0.844*								
CP			0.616*	0.835*	–0.586*	–0.821*	–0.606*	–0.377*	0.384*				0.333		–0.397*
L				0.948*	–0.694*	–0.724*	–0.637*	–0.322	0.495*	–0.663*	–0.655*		0.290		
SNF					–0.721*	–0.836*	–0.688*	–0.377*	0.502*	–0.546*	–0.537*		0.339		
TS						0.821*	0.836*								
SCC								0.299	–0.296						
log SCC															
FPD	0.031				–0.022		0.072		–0.870*					–0.480*	0.721*
U	–0.128				–0.067		–0.134			–0.482*	–0.374*		0.289		–0.722*
AC	0.213	–0.207			0.154	0.136	0.074	0.229					–0.291	0.499*	
log AC	0.207	–0.195			0.149	0.114	0.056	0.063					–0.389*	0.598*	
AS	–0.150	–0.064	0.113	0.053	–0.159	0.002	–0.129	0.247	–0.113	–0.155	–0.212				
TA	–0.023				0.026	–0.125	0.009	–0.193				0.022			
EC	–0.154	0.095	–0.147	–0.063	–0.181	–0.245	–0.203		0.258			–0.049	–0.253		–0.293
pH	0.003		–0.146	–0.262	–0.037	0.258	0.047			0.139	0.032	0.158	–0.264		
TMBC	–0.153	0.095	0.215	0.189	–0.142	–0.125	–0.077	–0.065	0.126	–0.115	–0.094	–0.040	0.261	–0.033	–0.087
log TMBC	0.073	–0.169	0.023	–0.055	0.073	0.104	0.110	–0.113	0.163	–0.099	–0.010	0.048	0.097	0.121	–0.223

number of observations but it is partly due to F manipulations as well. Therefore, some of correlations coefficients between F and other manipulation influenced milk indicators (Tab. III and Tab. IV) approach more closely (for instance for CP, SNF, TS, SCC) and some changed their dependence (for instance for AS or F manipulation had no marked influence on TA as can bee seen in the group means, Fig. 1). On the other hand, the uninfluenced indicator FPD lost its original positive correlation (Tab. IV) with F manipulation which means deterioration in FPD with F increase (0.71; P < 0.01; Tab. III). The correlation coefficients between MIs and experimental F manipulations mostly confirmed the findings based on the MI group means in a logical way.

CONCLUSION

The dynamics of milk indicator changes through fat content manipulation are described. The technological and methodical milk fat content changes or changes caused by milk sampling errors, can in-

fluence the results of the other measurements. The main impacts were identified on somatic cell count, solids non fat, total solids, lactose and protein content. Other milk indicators were less influenced. These data can be practically used in the methodical and technological procedures of milk laboratories for reference sample preparation and in dairy plants for technology milk processing and milk market information.



2: *Regression relationships of fat manipulations to somatic cell count in raw cow milk*
Sample groups A, B, C, D and E, n = 60, correlation 0.85 and 0.93.

SUMMARY

A number of milk indicators (MIs) affecting the economic impact of milk quality can also be influenced by sampling accuracy and milk manipulation. The goal of this paper was to examine and quantify the freezing point depression (FPD) and other milk component and property drifts which could be caused by fat movement. Explanations for the possible effects of sampling errors and sample and milk manipulations on milk component and property changes are important for: – reference laboratories for the preparation of reference milk samples for proficiency testing and instrument calibrations; – estimation of the impact of milk treatment as centrifugation in dairy plants on FPD. Five milk samples (A = original milk; milk with modified fat (F) content; B = less F, C = low F, D = more F, E = high F) were created (gravitation F separation at 4 °C for 12 hours) with the same milk matrix 12× per year. F averages increased by 4.80% (122.1%) from 1.68 to 6.48% due to manipulation. It increased variability of MIs especially for SNF (solids non fat), L (lactose) and CP (crude protein). SCC (somatic cell count) averages increased by 803 (196.8%) from 9 to 812 thousand.ml^{-1}. Correlation (r) F × SCC was 0.85 ($P < 0.001$). SNF, L and CP averages decreased by 0.47% (5.3%), 0.31% (6.3%) and 0.17% (5.0%). Correlations were –0.78, –0.75 and –0.64 ($P < 0.001$). Urea decreased along with F increase by 1.05 mg.100ml^{-1} (2.9%) but with r –0.13 ($P > 0.05$). Acetone increased by 1.37 mg.l^{-1} (47.6%) with r 0.21 ($P > 0.05$). Electrical conductivity decreased by 0.23 mS.cm^{-1} (6.0%) with r –0.15 ($P > 0.05$). Alcohol stability was reduced by 0.14 ml (23.3%) with r –0.15 ($P > 0.05$). FPD, titration and actual acidity were not influenced. The results can be used for various estimations at methodical (laboratories) and technological (dairy factories) procedures.

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