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ANALYSE OF THE RELATIONSHIP BETWEEN MILK COMPONENTS AND REPRODUCTION IN THE CZECH FLECKVIEH FIRST-CALF COWS

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Abstract

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The aim of our study was to evaluate the relationship between reproduction and milk traits in cows of the Czech Fleckvieh. In the period of 90–180 days after calving milk of each dairy cow was analysed for constituent milk components and milk features (40 analyses in total for each sample). The database contained data concerning to the origin and reproduction traits (service period, services per conception and interval between calving and first insemination) for every single cow.
When the calculated correlations were evaluated the milk yield reached significant (* $p < 0.05$) to very significant (** $p < 0.01$) negative correlation to content of some milk components: fat (–0.253**); rough protein (–0.256**); casein (–0.197**); pure protein (–0.247**); and also to content of some macroelements as: phosphorus (–0.245**); sodium (–0.261**); magnesium (–0.151*).
Relation of milk yield (in kg) and reproduction traits (number of inseminations and length of service period) shows non–significant positive correlations. With increasing of milk yield, there are a higher number of services per conception and longer service period. It confirms a general tendency of deterioration of reproduction with an increasing milk yield.
We have found out that when the concentration of urea, acetone, number of somatic cells and percentage of fat in milk of Czech Fleckvieh cows was increased, reproduction traits worsened (number of inseminations, length of service period). The differences were not statistically significant. This negative relation was not proven to an interval (number of days between calving and the first insemination), where a company management may have a significant influence.

Czech Fleckvieh, milk production, reproduction, milk components

Abbreviation key:
SCC = Somatic Cell Count, SP – service period, SC = services per conception; CFI = days between calving and first insemination, ČSN = Czech state norm

An important condition for successful breeding of the Czech Fleckvieh breed is a good reproduction and good state of health of the cows. On the other hand, increasing milk yield is connected with generally known negative correlations – concerning mainly reproduction features. It brings higher demands mainly on timely monitoring of possible reproduction and health problems. Analysis of milk, which is a very important and also easily obtainable bodily fluid, may substantially contribute to an early diagnosis of reproduction and health problems. In this study we focused on monitoring of relations between reproduction indicators and basic indicators of state of health of the cows (acetone concentration, urea concentration, somatic cell count) and also to other (45 in total) indicators of milk analyses. In case of some milk components we focused also on increased – above-average concentrations that often indicate reproduction problems.

A basic condition for good milk yield and reproduction of cows is a good nutrition.

Patton, J. et al. (2007) found that energy balance during early lactation was associated positively with conception rate to first insemination. In addition, a more positive energy balance was associated with a greater likelihood of earlier presumption of cyclicity and earlier conception. Buckley, F. et al., 2003 published a positive relationship between dairy cow reproductive performance (likelihood of submission and pregnancy) and milk production in a pasture-based system when adjustments include breeding value for milk yield and proportion of Holstein-Friesian genes. Seasonal pasture-based system of milk production is necessary to maintain body condition score at 2.75 or greater during the breeding season. Loss of body condition between calving and first service should be restricted to 0.5 body condition score unit to avoid a detrimental effect on reproductive performance. The results of this study show also that milk protein and lactose content, and body weight gain postbreeding are important tools to identify cows at risk of poor reproductive performance.

Baker, L. D. et al., (1995) found that high concentrations of urea in bodily fluids of the cows reduce metabolic effectiveness of milk production, influence negatively health and reproduction and contribute to environmental contamination, because more than 95% of endogenous urea is excreted in urine. Concentration of urea in milk is a better indicator of an average concentration of urea in blood plasma than the urea in blood plasma itself. Gustafsson, A. H. and Palmquist, D. L. (1993) proved that the content of milk urea may be used as a tool indicating the state of nutrition in case the main sources of variance are eliminated. Urea in milk has been proven to be a suitable indicator of state of nutrition of cows in many works: Oltner, R. and Wiktorsson, H. (1983); Gustafsson, A. H. and Emanuelson, U. (1993); Hanuš et al. (1993); Homolka, P. and Vencl, B. (1993); Piatkowski et al. (1981). Fertility and milk yield (in kg) and also milk components are important conditions of good economy of cow breeding. That is why many authors deal with their mutual relations. Hanuš, O. et al. (1993) found out that prolonging service period to more than 90 days is connected with higher content of urea in milk. Conception rate after the 1st insemination and an insemination index were not in a statistically significant relation to content of urea and out of this they deduced higher frequency of silent heat. Also Říha, J. a Hanuš, O. (1999a) came to similar conclusions. They proved that the higher concentration of urea, i.e. supposed higher nitrogen stress of the organism, the worse important practical indicators of cow fertility are – mainly the length of service period, insemination interval and getting pregnant after the 1st insemination. Concerning the insemination index the relation was non-evidential. Ferguson, J. D. and Chalupa, W. (1989) and Ferguson, J D. (1991) stated that milk production and fertility of cows are influenced by using a protein got to rumen micro-organisms and tissues of the ruminant (saturation of two metabolic systems). When there were various diets, pregnancy rate went from 52% – when the level of plasma urea nitrogen was 1.67 mmol/l – to 35% and the level of 4.17 mmol/l.

Butler, W. R. et al. (1996) found, that PUN (plasma urea nitrogen) and MUN (milk urea nitrogen) concentrations > 19 mg/dL were associated with approximately a 20 percentage point decrease in pregnancy rate after AI in lactating dairy cattle. Ferguson, J. D. et al. (1993) published that likelihood ratio test indicates conception rate decreases with serum urea N of >14.9 mg/dl, but dichotomized test suggests that the decrease does not occur until serum urea N is >20 mg/dl.

A good indicator of energetic metabolism is a concentration of acetone in milk (various authors: Gustafsson, A. H. and Emanuelson, U. (1993); Hanuš, O. and Ticháček, A. (1997); Gravert, H. O. et al. (1986); Hlásný, J. (1997), e.g.. Gustafsson, A. H. and Palmquist, D. L. (1993) observed a negative influence of ketonuria on reproduction accompanied by an obvious nitrogenous overload of the organism of the cows. Říha, J. a Hanuš, O., (1999b) proved a continuous deterioration of reproduction indicators (service period by 19 days, where $p < 0.05$; number of inseminations by 0.27, where $p < 0.08$) when the concentration of acetone in milk was gradually increased. It is important to consider also a quality of fodder in different seasons. Levels of ketones are higher in winter (compared to summer) because of feeding higher doses of ketogen feed (Rauramaa, A. and Rajamáki, S., 1988; Hanuš, O. et al., 1993).

MATERIAL AND METHODS

Collection of data including data on reproduction indicators of breeding-cows, their origin and milk components content comes from five farms of the Czech Fleckvieh cows. In the period of 90–180 days after calving milk of each dairy cow was analysed for constituent milk components and milk features (40 analyses in total for each sample). The analyses carried on, including abbreviations and units of measurement were as follows:

Daily milk yield (kg.day^{-1})
F = Fat content (g.100g^{-1}; %)
L = lactose (monohydrate, g 100g^{-1}, %)
SNF = solid non fat (g 100g^{-1}, %)
DM = dry matter (g 100g^{-1}, %)
SCC = somatic cell count (thousand ml^{-1})
log SCC
U = urea concentration (mg.100 ml^{-1})
Ac = acetone concentration (mg l^{-1})
log Ac
AS = alcohol stability (ml, consumption of 96% ethanol to protein coagulation in 5 ml of milk
TA = titration acidity according to Soxhlet–Henkel (ml 0.25 mol.l^{-1} NaOH solution for the titration 100 ml of milk)
EC = electrical conductivity (mS cm^{-1})
pH = actual milk acidity
MFP = milk freezing point (°C)
RCT = rennet coagulation time (second)
CQ = subjective estimation of curds cake quality determined by the aspection and touch from 1st (excellent) to 4th (poor) class

CF = cheese curd firmness = depth of the penetration of the corpuscle falling into curd cake in the standard way, value expresses the opposite relationship to firmness (mm)
WV = whey volume (in ml; whey, which was ejected during rennet curds cake creation for 60 minutes)
CP = crude protein content (Kjeldahl, total N×6.38, g $100g^{-1}$, %)
CAS = casein content (Kjeldahl, casein N×6.38, g $100g^{-1}$, %)
TP = true protein content (Kjeldahl, protein N×6.38, g $100g^{-1}$, %)
WP = whey protein content (Kjeldahl, difference TP–CAS, g $100g^{-1}$, %)
NPN = non protein nitrogen matters (Kjeldahl, CP nitrogen–TP nitrogen×6.38, g $100g^{-1}$, %)
UNR = urea nitrogen ratio on non protein nitrogen in %
F/CP = fat/crude protein ratio the casein numbers were calculated on the basis of CP and TP = CAS–CP and CAS–TP in %
CA = citric acid concentration (mmol l^{-1} or %)
macroelements Ca, P, Na, Mg, K (in mg kg^{-1})
microelements I (in µg l^{-1})
FAM–T = fermentation ability of milk, it means an yoghourt test with microbial culture (by the titration acidity of yoghurt in ml of 0.25 mol.l^{-1} NaOH.100ml^{-1})
FAM–pH (by the actual acidity of yoghurt pH)
FAM–CL (lactobacilli in CFU.ml^{-1})
log Lacto
FAM–CS (streptococci in CFU.ml^{-1})
log FAM–CS
FAM–TCM (fermenting noble microorganisms in CFU. ml^{-1})
log FAM–TCM
FAM–RSL (ratio streptococci/lactobacilli), all the previous parameters at FAM were measured after the yoghurt test fermentation

The analytical procedures were in the case of milk components and physical-chemical features of milk carried on according to the following milk processing analytical procedures:

F, L and SNF indicators were measured by the instrument MilkoScan 133B (Foss Electric, Denmark), which was regularly calibrated according to the reference method results (standard ČSN 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 ČSN 57 0530). The instrument was included into proficiency testing with regularly successful results. The wide-spreaded result uncertainties were: ± 2.77% for fat (± 0.101 for original unit), ± 2.59% for protein (± 0.085) and ± 2.77% for lactose (± 0.115).

MFP values were analysed by the top cryoscopic instrument Cryo-Star automatic Funke-Gerber (Germany). The selected measurement mood was Plateau Search (with parameters: interval = 23 second and delta t = 0.4 m°C). The instrument was under regular calibration by the standard NaCl solutions (Funke-Gerber) and included into proficiency testing with successful results regularly. The wide-spreaded result uncertainty of measurement (1.96 times the combined uncertainty as standard deviation with probability level 95%) was ± 0.00608 °C, it means ± 1.18%.

The SCC was determined by Fossomatic 90 instrument (Foss Electric, Denmark) according to ČSN EN ISO 13366–3. Apparatus was included into proficiency testing with the good results regularly. The wide-spreaded result uncertainty was ± 9.3% for SCC $\leq$ 900 thousands.ml^{-1}.

The protein fractions CP, TP and CAS were determined by the reference Kjeldahl´s method on the instrument line Tecator with Kjeltec Auto Distillation unit 2 200 (Foss–Tecator AB, Sweden) according to ČSN 57 0530. The instrument was included in the international proficiency testing (APLAC and ICAR-CECALAIT) regularly with mostly successful results.

The U was determined by spectrophotometric method at the 420 nm of the wave length. The specific reaction solution was prepared as sour mixture with the p-dimethylaminobenzaldehyde. Spekol 11 instrument (Carl Zeiss Jena, Germany) was calibrated by six samples in the scale with the U increase from 6 to 60 mg.100 ml^{-1}.

The A was investigated by the spectrophotometric measurement at 485 nm of the wavelength. The A was absorbed into alkali solution of KCl with the salicylaldehyde due to 24 hours microdiffusion in the special vessels (at 20 °C in the darkness). Spekol 11 was calibrated by the five points on the scale with the A increase from 1 to 20 mg.l^{-1}.

The CA was determined by the spectrophotometric measurement at 428 nm of the wavelength. Milk was coagulated by the trichloracetic acid and after it the adventitious filtrate reacted with the pyridin and acetanhydride (30 minutes at 32 °C). The citric acid generates with the pyridin a yellow-coloured complex in acetanhydride medium. The Specol 11 was calibrated by seven points of the concentrations from 1.5 to 20.0 mmol.l^{-1}, it means from 0.03 to 0.36%.

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

Active acidity (pH) was measured by the pH-meter CyberScan 510 (Eutech Instruments) at 20 °C. The mentioned instrument was regularly calibrated by the standard buffer solutions (pH 4.0 and 7.0 Hamilton Duracal Buffer, Switzerland) at the measurement of each milk sample set.

The TA was measured with the milk titration (100 ml) by the alcaline solution up to the light pink colour of the mixture (in ml of the 0.25 mol.l^{-1} NaOH.100ml^{-1}). The method was performed according to the standard ČSN 57 0530.

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

The macro- and microelement milk contents were investigated by the atom absorption spectrophotometry on the equipment Spectrometer SOLAAR S4

and 6F S97 Thermo Elemental (England) according to standard operation procedures of the accredited laboratory. The instrument was included into proficiency testing with mostly successful results.

The FAM-TCMs (carried out according to standard ON 57 0534 by the slightly modified procedure with thermophilic yoghourt culture YC–180–40–FLEX = *Streptococcus thermophilus*, *Lactobacillus delbrueckii* subsp. *lactis* and *L. d.* subsp. *bulgaricus*) were investigated by the calculation of the colony forming units (CFU) at the classical plate cultivation method (at 30 °C for 72 hours) with GTK M (Milcom Tábor) agar with the glucose monohydrate, triptone-peptone, dehydrated yeast extract and skim milk powder, according to standard ČSN ISO 6610.

Statistical procedure of evaluation of results of the experiment

1. The collections of data with results of milk components (fat, proteins, lactose) were clear of outliers on the level of probability of confidence interval 99% (arithmetic mean x ± standard deviation $s_x \times 2.58$). For the collection of results of SCC we used a similar method with logarithmically transformed results to approximate the collection of data to a normal frequency distribution. In this case of purifying the data we also used a method of a qualified guess (the value of measurement < 3 000 thousand/ml).
2. Results of SCC were for all the calculations applied in their original values thousands/ml and also in their logarithmically transformed form (log) and sequentially in geometric means (g).
3. Concerning the component features (fat and protein) we computed in kg of fat and protein (T kg and B kg) produced in the morning, in the evening and during the whole day. Calculations were based on established daily milk yield.
4. The statistical calculations were made using SPSS 15.0 program for Windows®, release 15.0.0 (6 Sep 2006).

RESULTS AND DISCUSSION

Basic statistical parameters of examined milk indicators and reproduction are shown in table No. I Tables No. II, III and IV show correlation relations between the features of milk yield and reproduction, stating the number of examined animals at the same time. In some cases the calculated correlations may not be absolutely relevant. These are the cases where deterioration of a feature is conditioned by getting out of the physiological range – i.e. in case of very low or on the contrary very high values (for example in case of urea concentration). Table No. V hence shows the relations of reproduction and chosen features of milk yield when the feature is represented by its mean (presented in the form of $\bar{x} \pm 1s$) and when its values were raised (above $\bar{x} \pm 1s$).

Milk yield (kg)

Table No. I clearly shows relatively high average milk yield in the examined group of dairy cows (7 047.42 kg of milk s_x = 1 508.11 kg) and a corresponding high maximal lactation (10 715 kg). This higher milk production is connected to corresponding reproduction traits, which correspond with the yield. An average length of service period (102.3 days; s_x = 49.71 days) and the number of inseminations (1.93; s_x = 1.26) were influenced by several animals with extremely deteriorated reproduction, which corresponds to the values of variability (s_x) and a maximal reached value (324 days; 8 inseminations).

When the calculated correlations were evaluated (tables No. II, III, IV) the milk yield reached significant (* $p < 0.05$) to very significant (** $p < 0.01$) negative correlation to content of some milk components: fat (–0.253**); rough protein (–0.256**); casein (–0.197**); pure protein (–0.247**); and also to content of some macroelements as: phosphorus (–0.245**); sodium (–0.261**); magnesium (–0.151*). A negative correlation to the total content of dry matter (–0.247**) follows these data. Very significant negative correlation appeared also in the feature freezing point of milk (–0.167**), which decreases as the production increases (mean = –0.5281 °C.). On the other hand lactose showed a positive correlation (+0.258**) – tables No. II, III, IV.

Relation of milk yield (in kg) and reproduction traits (number of inseminations and length of service period) shows non-significant positive correlations (tables No. II, III, IV). It confirms a general tendency of deterioration of reproduction with an increasing milk yield. It is evident also when the reproduction traits on the middle level of production (presented in a form of $\bar{x} \pm 1s$) are compared to an above-average milk production ($> \bar{x} + 1s$) – table No. V. In this comparison of average and high producing cows the length of service period reached 102.32 and 112.98 days; number of insemination was 1.9 and 2.0. Even though these differences are non-significant, a deterioration of reproduction of high producing cows is evident. This tendency is also evident from figure 1, which shows a correlation dependence of milk production after a finished 305–day lactation and the length of service period.

Content of fat (%) and protein (%)

Even though a high milk production has been reached in the examined herd, this yield is connected also to a good fat content of milk (average = 3.9%; s_x = 0.629) and a percentage of rough protein (average = 3.43%; s_x = 0.251%) – table No. I. It also corresponds to an average content of casein (2.75%; s_x = 0.24%) and pure protein (3.24%; s_x = 0.246 %). All the examined protein components showed a low variability of values, expressed by a form of (s_x and V_x).

Content of fat (in %) and rough protein (in %) show very similar tendencies that are a consequence of their mutual very significant correlation (fat – rough protein +0.269**). This relation is also evident in a mutual cor-

relation of fat – casein (+0.276**) and fat – pure protein (+0.248**). Both these milk components at the same time show the already mentioned negative correlation to a level of milk production (–0.253**; –0.256**). A higher content of fat and rough protein when the milk yield was lower is evident also from table No. V. This table clearly shows that cows with a higher fat content (above $\bar{x} \pm 1s$), reached a lower milk production by 956 kg (7114.18 – 6155.12) and similarly, cows with a higher content of protein showed a lower production by 508.70 kg (7021.00 – 6512.3).

When the reproduction traits were observed, we noticed their deterioration in case of a higher content of fat (in %). When the content of protein was higher, this deterioration did not appear. Even though the differences in reproduction of cows with an average fattiness (number of inseminations = 1.9; SP = 101.0) and with a markedly above-average fattiness (number of inseminations = 2.00; SP = 105.32) are statistically non-significant, they may be related to a lipomobilisation (a syndrome of a pre-calving fattening) of cows.

Content of lactose (%)

We have noticed a higher average content of lactose (5.1 %; s_x = 0.197 %), which corresponds to the fact that the cows were in their first lactation and in its first half. Variability of this feature was low both in case of s_x and V_x (3.7) – table No. I.

When the correlations were evaluated (tables No. II, III, IV) we found mainly a very significant negative correlation to a somatic cell counts (–0.505**) and to the freezing point of milk (–0.238**). Correlation of lactose content (in %) and log of somatic cell counts is also evident from the figure 2. On the other hand very significant positive correlations were proven in fatless dry matter (+0.539**) and content of total dry matter (+0.189**). Relation to other milk components was non-significant. Also a relation of lactose content to other reproduction traits was non-significant.

Concentration of urea (mg.100 ml^{-1})

Concentration of urea, indicating a level of nutrition of the cows, was in average higher (36.76; s_x = 7.02 mg.100 ml^{-1}) – table No. I, than generally valid physiological values and at the same time the variability of this feature was higher. When we consider concentration of urea and an observed percentage of rough protein in milk (3.43 %) it is evident that energy and rough proteins were very well provided in the feed ration.

Calculated correlations of urea and reproduction features may not be a valuable piece of information because values out of a physiological range (higher and lower) might be a cause of reproduction malfunctions. That is why we have carried on a comparison within a physiological range (20.00–31.00 mg.100 ml^{-1}) and when the concentration of urea was increased (above 31.0 mg.100 ml^{-1}). This comparison is shown in table No. V and it is evident that when the content of urea was within a physiological range (20.00–31.00 mg. 100ml^{-1}), better reproduction results are reached (number of inseminations = 1.69; SP = 97.86 days), compared to an increased concentration of urea (above 31.0 mg.100 ml^{-1}; number of inseminations = 2.0; SP = 103.2 days). A decreased concentration of urea (under 20 mg.100 ml^{-1}) which may be according to some authors (e.g. Říha, J. and Hanuš, O., 1999) a cause of a deteriorated reproduction, did not appear in the examined group of cows.

Concentration of acetone (mg.l^{-1})

A content of acetone, as an indicator of metabolic malfunctions, was in its average on the level of physiological values (3.49 mg.l^{-1}) but the variability was at the same time very high (s_x = 2.799 mg.l^{-1}; V_x = 41.0). The variability is evident also from the maximal reached value (31.69 mg.l^{-1}) – table No. I. When the reproduction traits and concentration of acetone were compared, both in its physiological range (4–7 mg.l^{-1}) and when its values were higher (above 7 mg.l^{-1}), reproduction malfunctions were apparent. When the concentration was physiological, number of insemination was 1.82 and length of service period was 95.63 days. On the other hand, when the concentration of acetone was higher, number of insemination increased to 2.24 and the length of service period went up to 103.2 days. These differences were not statistically significant.

Somatic Cell Counts (thousand.ml^{-1})

The examined herd reached a very good average somatic cell counts (199 thousand.ml^{-1}). That, together with a higher average titration acidity (8.14 SH), indicates a good state of health of udders of the examined first-calf cows – table No. I. Also in case of somatic cell counts we evaluated reproduction indicators – comparing average values (up to 300 thousand.ml^{-1}) and increased values (above 300 thousand.ml^{-1}). Also in this feature we found reproduction features lower within the physiological range (number of inseminations = 1.92; SP = 101.4 days) than when the number of somatic cell was increased (number of inseminations = 2.03; SP = 108.2 days). Even though the average service period was longer by 6.8 days, these differences were not statistically significant.

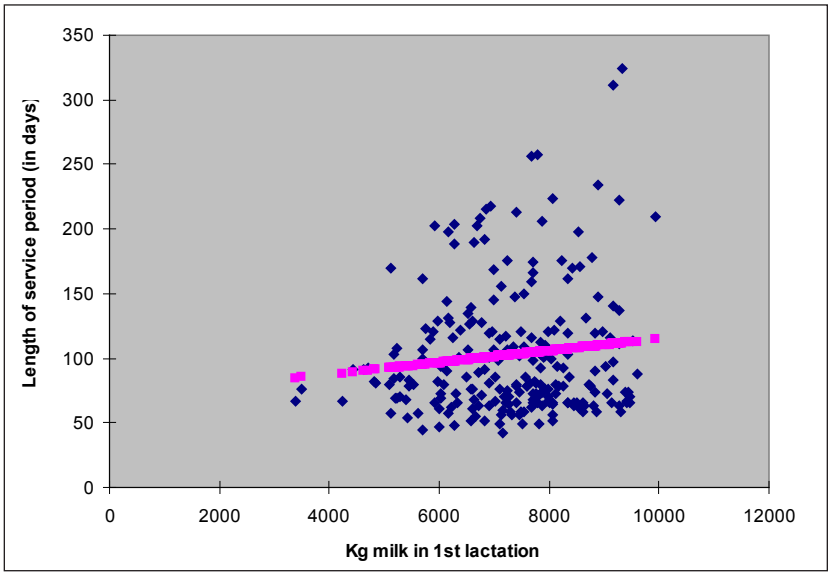
The conclusions stated show that increased concentrations of urea, acetone, somatic cell counts and percentage of fat may be connected to deteriorated reproduction indicators. This negative relation was not proven to an interval describing number of days between calving and the first insemination.

Also other authors proved that increased concentration of some milk components is connected to a worsened reproduction. Very important is the observation of the urea concentration (Oltner, R. and Wiktorsson, H., 1983; Gustafsson, A. H. and Emanuelson, U., 1993; Hanuš, O. et al., 1993; Homolka, P. and Vencl, B., 1993; Piatkowski et al., 1981;. Baker, L. D. et al., 1995 and other) and acetone concentra-

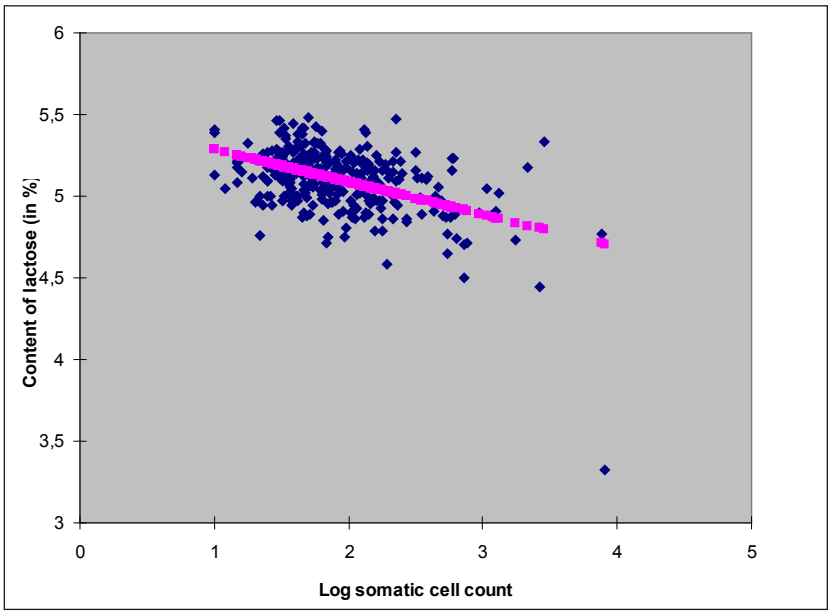
tion (Gustafsson, A. H. and Emanuelson, U., 1993; Hanuš, O. and Ticháček, A., 1997; Gravert, H. O. et al., 1986;. Hlásný, J., 1997; Říha, J. a Hanuš, O. 1999b; and other). Also Říha, J. a Hanuš, O. (1999a) came to similar conclusions. They proved that the higher concentration of urea, i.e. supposed higher nitrogen stress of the organism, the worse important practical indicators of cow fertility are – mainly the length of service period, insemination interval and getting pregnant after the 1st insemination. Also Baker, L. D. et al., (1995) found that high concentrations of urea in bodily fluids of the cows reduce metabolic effectiveness of milk production, influence negatively health and reproduction.

CONCLUSION

We have found out that when the concentration of urea, acetone, somatic cell counts and percentage of fat in milk of Czech Fleckvieh cows was increased, reproduction traits worsened (number of inseminations, length of service period). The differences were not statistically significant. This negative relation was not proven to an interval (number of days between calving and the first insemination), where a company management may have a significant influence. We have also calculated very significant negative correlations between milk production (in kg) and a content of rough protein, fat, casein, pure protein and some macroelements (Na, Mg, P).



1: *Correlation between length of service period (in days) and kg of milk in lactation (r = +0.116)*



2: *Correlation between content of lactose (in %) and log somatic cell counts. (r = –0.505)*

I: *Basic statistical parameters of milk and reproduction traits*

Traits	Unit	n	mean	s_x	V_x	min.	max.
Milk in lactation	kg	307	7047.42	1508.11	21.4	1938	10715
Services per conception	number	287	1.93	I.26	65.28	1	8
Service period	days	230	102.3	49.71	48.58	42	324
Days between calving and first insemination	days	247	70.38	19.91	28.29	42	231
Daily milk yield	kg.day^{-1}	345	23.9	5.36472145	18.4	4.8	40.8
Fat content	g.100g^{-1}	345	3.9	0.629	19.5	2.02	5.99
Lactose	g 100g^{-1}	345	5.1	0.197	3.7	3.32	5.48
Solid non fat	g.100g^{-1}	345	9.09	0.308	3.3	7.7	9.95
Dry matter	g.100g^{-1}	345	12.99	0.738	5.9	10.62	15.26
Somatic cell count	thous. ml^{-1}	345	199	655.7	537.4	10	8011
log Somatic cell count		345	1.9086	0.4652	22.3	1	3.9037
Urea concentration	mg.100 ml^{-1}	345	36.76	7.018	21.1	15.5	59.18
Acetone concentration	mg.l^{-1}	345	3.49	2.799	41	0.01	31.69
log Acetone concentration		345	0.377	0.5042	60.5	–2	1.5009
Alcohol stability	ml	337	0.44	0.171	51.8	0.16	1.02
Titration acidity	°SH	334	8.14	1.086	13.1	3.95	11.22
Electrical conductivity	mS.cm^{-1}	345	3.88	0.365	10.5	3.11	5.88
pH		345	6.66	0.136	2	5.53	7.12
Milk freezing point	°C	343	–0.5281	0.0087	–1.6	–0.5686	–0.482
Rennet coagulation time	sec.	327	124	58.038	59.2	24	505
Curds cake quality		327	2	1.002	33.4	1	4
Cheese curd firmness		327	1.8	0.15	8.3	0.5	2
Whey volume	ml	327	34	2.907	8.5	13	41
Crude protein content	g.100g^{-1}	345	3.43	0.251	7.1	2.8	4.2
Casein content	g.100g^{-1}	345	2.75	0.24	8.5	1.81	3.4
True protein content	g.100g^{-1}	345	3.24	0.246	7.3	2.58	4
Whey protein content	g.100g^{-1}	345	0.48	0.095	17.6	0.26	1.11
Non protein nitrogen matters	g.100g^{-1}	345	0.19	0.054	31.8	0.09	0.52
Urea nitrogen ratio on non protein nitrogen	g.100g^{-1}	345	58.48	16.532	29.1	16.03	99.48
Fat/crude protein ratio	g.100g^{-1}	345	1.14	0.184	20.2	0.58	1.81
The casein numbers calculated on the basis of CP	g.100g^{-1}	345	80.26	2.981	3.7	59.15	86.54
The casein numbers calculated on the basis of TP	g.100g^{-1}	345	85.06	2.926	3.5	61.99	92.02
Fermentation ability of Milk	°SH	335	31.76	3.548	11.9	20.4	42.54
J–pH		335	4.87	0.18	3.6	4.46	5.3
Lactobacilli	CFU.ml^{-1}	335	26705970	15247154	72.6	2700000	89000000
log Lactobacilli		335	7.3573	0.2557	3.5	6.4314	7.9494
Streptococci	CFU.ml^{-1}	335	801791045	2650374465	441.7	200000000	49000000000
log Streptococci		335	8.7986	0.1831	2.1	8.301	10.6902
Fermenting noble microorganisms	CFU.ml^{-1}	335	828497015	2651379317	427	214000000	49034000000

Traits	Unit	n	mean	s_x	V_x	min.	max.
log Fermenting noble microorganisms		335	8.8163	0.1812	2.1	8.3304	10.6905
Ratio streptococci/ lactobacilli		335	37.353	83.477	292.2	8.718	1441.177
Citric acid concentration	$mmol.dm^{-3}$	264	9.645	1.946	19.6	3.726	14.908
Citric acid concentration	w [%]	264	0.18	0.036	18.9	0.07	0.279
Ca	$mg.kg^{-1}$	264	1323	181.515	13	664	1782
P	$mg.kg^{-1}$	261	1153	159.352	14.6	824	1675
Na	$mg.kg^{-1}$	264	377	90.153	31.1	230	1100
Mg	$mg.kg^{-1}$	264	116.403	11.52	10.2	85	145.3
K	$mg.kg^{-1}$	264	1661	140.882	9	1183	1989
I	$ug.dm^{-3}$	229	332	128.381	57.8	116	691

SOUHRN

Analýza vztahu mezi mléčnými složkami a reprodukcí u krav prvotelek českého strakatého skotu

Cílem práce bylo vyhodnocení vzájemného vztahu mezi reprodukcí a mléčnými ukazateli u krav českého strakatého plemene. V období 90–180 dnů po otelení byl u každé dojnice proveden rozbor mléka na jednotlivé mléčné složky a vlastnosti mléka (celkem u každého vzorku 40 analýz). Součástí databáze byly údaje o původu a reprodukčních ukazatelích (servis perioda, inseminační index, interval) u každé krávy.

Při hodnocení vypočítaných korelací dosáhla mléčná užitkovost průkazné (* $p < 0,05$) až vysoce průkazné (** $p < 0.01$) negativní korelace k obsahu některých mléčných složek: tuku (–0,253**); hrubých bílkovin (–0,256**); kaseinu (–0,197**); čistých bílkovin (–0,247**); také k obsahu některých makroprvků jako: fosforu (–0,245**); sodíku (–0,261**); hořčíku (–0,151*).

Vztah mléčné užitkovosti (v kg) k reprodukčním znakům (počet inseminací a délka servis periody) ukazuje neprůkazné kladné korelace. Se zvyšující se mléčnou užitkovostí byl vyšší počet inseminací a delší servis perioda. To potvrzuje obecnou tendenci zhoršování reprodukce se zvyšující se mléčnou užitkovostí.

U koncentrace močoviny, koncentrace acetonu, počtu somatických buněk a procentickém obsahu tuku v mléce krav českého strakatého plemene bylo zjištěno při jejich zvýšeném obsahu zhoršení reprodukčních ukazatelů (počet inseminací, délka servis periody). Tyto rozdíly nebyly statisticky průkazné. Tento negativní vztah nebyl prokázán k intervalu, kde se dá předpokládat zásadnější vliv managementu v podniku.

český strakatý skot, mléčná užitkovost, reprodukce, mléčné složky

Použité zkratky
SCC = počet somatických buněk, SP = servis perioda, SC = inseminační index; CFI = inseminační interval = počet dnů od otelení do první inseminace

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II: *Correlation between reproduction and milk traits*

		Milk in lactation (kg)	kg Protein	Daily milk yield	Fat	Lactose	Solid non fat	Dry matter	Somatic cell count	logSom. cell count	Urea	Acetone	log Aceto	Alcohol stability	Titration acidity	Electrical conduct.	pH
Milk in lactation (kg)	P.	1	.562(**)	.622(**)	–.253(**)	.258(**)	–0.089	–.247(**)	–.192(**)	–.118(*)	.228(**)	–0.014	0.017	–0.054	0.028	0.051	–0.019
	n	307	307	307	307	307	307	307	307	307	307	307	307	307	304	307	307
Fat (%)	P.	–.253(**)	–.098	–.179(**)	1	–.057	.188(**)	.903(**)	.016	.08	–.017	–.031	.011	.142(*)	.066	–.272(**)	.029
	n	307	308	308	308	308	308	308	308	308	308	308	308	308	305	308	308
Crude protein (%)	P.	–.256(**)	0,044	–.291(**)	.269(**)	–.124(*)	.717(**)	.535(**)	.101	.054	.021	.066	–.036	–.105	.384(**)	–.018	–.086
	n	307	308	308	308	308	308	308	308	308	308	308	308	308	305	308	308
Lactose (%)	P.	.258(**)	.114(*)	.139(*)	–.057	1	.539(**)	.189(**)	–.505(**)	–.467(**)	.075	–.076	–.071	.028	.260(**)	–.462(**)	–.185(**)
	n	307	308	308	308	308	308	308	308	308	308	308	308	308	305	308	308
SC	P.	.038	–.118(*)	–.102	.057	.026	.003	.048	.049	–.021	–.001	–.02	–.021	–.006	–.011	.017	–.083
	n	287	287	287	287	287	287	287	287	287	287	287	287	287	284	287	287
SP	P.	.116	–.069	–.047	.015	.042	–.022	.003	.071	.003	–.049	.031	–.06	.115	.026	.089	–.140(*)
	n	230	230	230	230	230	230	230	230	230	230	230	230	230	228	230	230
CFI	P.	–.059	–.031	–.042	.073	.054	.072	.092	.024	.039	–.111	–.021	–.055	–.014	.042	–.027	.011
	n	247	247	247	247	247	247	247	247	247	247	247	247	247	245	247	247

* $p < 0.05$ ** $p < 0.01$
P = Pearson; n = count
SC = services per conception; SP = service period; CFI = days between calving and first insemination

III: *Correlation between reproduction and milk traits*

		Milk freezing point	Rennet coagulation time	Curds cake quality	Cheese curd firmness	Whey volume	Crude protein content	Casein content	True protein content	Whey protein content	Non protein nitrogen matters	Urea nitrogen ratio on non protein nitrogen	Fat/crude protein ratio	Casein/crude protein	Kasein/true protein	J-SH	J-pH
Milk in lactation (kg)	P.	-.167(**)	-.118(*)	-.029	-.041	.199(**)	-.256(**)	-.197(**)	-.247(**)	-.141(*)	-.058	.196(**)	-.118(*)	.034	.041	-.112	.126(*)
	n	305	297	297	297	297	307	307	307	307	307	307	307	307	307	305	305
Fat (%)	P.	.07	.021	-.006	.117(*)	-.129(*)	.269(**)	.276(**)	.248(**)	-.057	.113(*)	-.126(*)	.869(**)	.116(*)	.151(**)	.018	.127(*)
	n	306	298	298	298	298	308	308	308	308	308	308	308	308	308	306	306
Crude protein (%)	P.	-.117(*)	.116(*)	-.170(**)	-.147(*)	-.270(**)	1	.911(**)	.975(**)	.217(**)	.192(**)	-.181(**)	-.238(**)	.177(**)	.162(**)	.199(**)	.094
	n	306	298	298	298	298	308	308	308	308	308	308	308	308	308	306	306
Lactose (%)	P.	-.238(**)	-.326(**)	-.133(*)	-.016	.244(**)	-.124(*)	.008	-.130(*)	-.359(**)	.015	.039	.008	.256(**)	.300(**)	-.126(*)	.199(**)
	n	306	298	298	298	298	308	308	308	308	308	308	308	308	308	306	306
SC	P.	-,007	.031	-.04	-.134(*)	-.001	-.043	-.033	-.058	-.067	.06	-.025	.079	.004	.043	.011	-.027
	n	285	277	277	277	277	287	287	287	287	287	287	287	287	287	285	285
SP	P.	-.046	-.001	.09	-.046	-.011	-.065	-.082	-.084	-.006	.075	-.094	.049	-.066	-.028	.022	-.059
	n	229	221	221	221	221	230	230	230	230	230	230	230	230	230	229	229
CFI	P.	-.063	.033	.109	.034	-.019	.03	.037	.033	-.009	-.011	-.064	.063	.035	.026	.061	-.019
	n	246	238	238	238	238	247	247	247	247	247	247	247	247	247	246	246

* $p < 0.05$ **$p < 0.01$
P = Pearson; n = count
SC = services per conception; SP = service period; CFI = days between calving and first insemination

IV: *Correlation between reproduction and milk traits*

		Lactobacilli	log Lactobacilli	Streptococci	log Streptococci	Fermenting noble microorg.	log Ferm. n. microorg.	Ratio streptococci/ lactobacilli	Citric acid mmol.dm^{-3}	Citric acid [%]	Ca	P	Na	Mg	K	I
Milk in lactation (kg)	P.	–.052	–.125(*)	–.06	–.172(**)	–.061	–.172(**)	–.018	.109	.106	–.078	–.245(**)	–.261(**)	–.151(*)	.136(*)	.019
	n	305	305	305	305	305	305	305	229	229	229	226	229	229	229	195
Fat (%)	P.	–.135(*)	–.128(*)	.022	.085	.021	.076	.055	.059	.058	.001	.185(**)	–.028	.146(*)	–.141(*)	–.079
	n	306	306	306	306	306	306	306	229	229	229	226	229	229	229	195
Crude protein (%)	P.	–.171(**)	–.168(**)	–.045	–.05	–.046	–.058	–.014	–.07	–.072	.146(*)	.425(**)	–.065	.313(**)	–.12	–.096
	n	306	306	306	306	306	306	306	229	229	229	226	229	229	229	195
Lactose (%)	P.	–.123(*)	–.149(**)	–.002	–.037	–.003	–.042	.04	.066	.064	.073	.09	–.645(**)	–.014	–.029	–.147(*)
	n	306	306	306	306	306	306	306	229	229	229	226	229	229	229	195
SC	P.	0	.017	.036	.047	.035	.046	.014	–.005	–.002	–.088	–.06	.077	.077	.064	.053
	n	285	285	285	285	285	285	285	215	215	215	213	215	215	215	181
SP	P.	–.045	–.029	–.053	–.036	–.055	–.038	–.009	.017	.018	–.071	–.012	.028	.019	.037	.141
	n	229	229	229	229	229	229	229	175	175	175	173	175	175	175	141
CFI	P.	–.004	–.013	–.041	–.034	–.041	–.034	–.037	.074	.075	.034	.125	–.037	0	–.06	–.024
	n	246	246	246	246	246	246	246	186	186	186	183	186	186	186	152

* $p < 0.05$, ** $p < 0.01$
P = Pearson; n = count
SC = services per conception; SP = service period; CFI = days between calving and first insemination

V: *Relations between reproduction and selected milk traits*

			Milk in lactation (kg)		Fat (%)		Crude protein (%)		Urea (mg.100ml^{-1})		Acetone (mg.l^{-1})		Somatic Cell Count (ths.ml^{-1})	
			range	mean	range	mean	range	mean	range	mean	range	mean	range	mean
Milk in lactation (kg)	physiolog. range	mean			3.27-4.53	7114.18	3.18-3.68	7021.00	20.0-31.0	6566.9	4.- 7	6964.7	≤ 300 ths	7087.6
		s_x			($\bar{x}$ ±1s)	1556.69	($\bar{x}$ ±1s)	1692.01		1516.8		1437.7		1525.1
	increased content	mean			> 4.53	6155.12**	> 3.68	6512.3**	> 31.0	7182.7**	> 7	6889.2	> 300 ths	6747.6
		s_x				1595.42		1281.78		1477.7		1203.8		1336.9
SC (count)	physiolog. range	mean	5539-8555	1.91	3.27-4.53	1.90	3.18-3.68	1.80	20.0-31.0	1.69	4.- 7	1.82	≤ 300 ths	1.92
		s_x	($\bar{x}$ ±1s)	1.26	($\bar{x}$ ±1s)	1.24	($\bar{x}$ ±1s)	1.13		1.02		1.10		1.25
	increased content	mean	> 8555	2.00	> 4.53	2.00	> 3.68	2.07	> 31.0	2.00	> 7	2.24	> 300 ths	2.03
		s_x		1.29		1.14		1.42		1.31		1.23		1.34
SP (days)	physiolog. range	mean	5539-8555	102.32	3.27-4.53	101.00	3.18-3.68	100.03	20.0-31.0	97.86	4.- 7	95.63	≤ 300 ths	101.4
		s_x	($\bar{x}$ ±1s)	47.00	($\bar{x}$ ±1s)	50.94	($\bar{x}$ ±1s)	49.19		44.72		34.50		49.74
	increased content	mean	> 8555	112.98	> 4.53	105.32	> 3.68	100.3	> 31.0	103.2	> 7	121.4	> 300 ths	108.2
		s_x		65.74		47.5		46.13		50.57		58.25		49.18
CFI (days)	physiolog. range	mean	5539-8555	69.56	3.27-4.53	71.34	3.18-3.68	69.85	20.0-31.0	71.73	4.- 7	70.22	≤ 300 ths	70.06
		s_x	($\bar{x}$ ±1s)	20.48	($\bar{x}$ ±1s)	19.88	($\bar{x}$ ±1s)	16.82		19.76		16.49		20.51
	increased content	mean	> 8555	71.17	> 4.53	69.94	> 3.68	72.86	> 31.0	70.12	> 7	72.33	> 300 ths	72.52
		s_x		14.85		24.48		21.93		19.93		20.52		15.30

* $p < 0.05$, ** $p < 0.01$

SC = services per conception; SP = service period; CFI = days between calving and first insemination

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