8. Summary

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Experimental research of metabolic effects of calcium chloride and calcium sulfate on the macromineral balance of dairy cows under different feeding-conditions.

With an incidence of 5 – 10 % the parturient paresis is one of the most important metabolic diseases of the dairy cow. Due to the economic losses resulting from this disease prophylaxis has a crucial role. An appreciably successfully used preventive method is the employment of anionic salts on the basis of the DCAB concept. The dietary-cation-anion-balance (DCAB) is calculated by the difference of the cations sodium and potassium to the anions chloride and sulfate. With the purposeful employment of anionic salts the DCAB and thus the incident of parturient paresis can be reduced.

To optimise the use of anionic salts and to uncover possible negative effects on the electrolyte balance, the effects of anionic salts under different feeding-conditions were examined. The metabolic effects of calcium chloride and calcium sulfate were examined for the major elements in a long-term study, a reduced energy input, a reduced calcium supply, increased potassium and sodium supply, a once-a-day administration of anionic salts, a rising sulfate supply and on the basis of daily profiles.

Different anionic salts and salt combinations were fed directly in the rumen of eleven rumenfistulated, nonlactating, nonpregnant dairy cows of the breed Holstein Frisian (age 6 - 11 years). $CaCl_2$, $CaSO_4$, $KHCO_3$ and $NaHCO_3$ were the anionic salts used in the different experimental phases. Following this so-called salt-phase a washout-phase followed, in which the animals received no salts. In regular intervals fodder samples were analyzed, blood and urine samples were collected and the elements calcium, chloride, magnesium, sodium, potassium and phosphate as well as creatinine were analyzed for the calculation of the fractional excretion.

The biostatistic evaluation took place via a two-factorial analysis of variance in a mixed model with the fixed factor sample day and the coincidental factor cow and following Post-Hoc-Test after Dunnett for the sample day in the comparison to the day of the zero-sample with corrected α. The accepted normal distribution was confirmed by means of the Kolmogorov Smirnov Test with significance correction after Lilliefors for the standardized residues of the linear model $\alpha = 0.05$. Moreover an average value comparison of the two groups of salts to each other on each sample day was accomplished by a t-test done with random samples. Likewise the experiments 8 and 9 and 4, 5 and 6 respectively were compared to each other with random samples on each sample day by means of the t-test. A linear regression analysis was performed between the parameters DCAB and the average

values of the calcium concentration in serum and urine of the next to last and last sample day of the salt phase.

The application duration of anionic salts should take place at least six days and maximally ten to 14 days. It is advisable to give the anionic salts up to the time of calving since after two days a clear decrease of the effect of anionic salts is already present.

A changed energy supply, e.g. catabolism, which develops from a reduced food intake towards the time of calving, does not have any essential influence on the effects of anionic salts. The equivalent supply of potassium to calcium chloride and/or calcium sulfate respectively leads to a complete loss of effect of anionic salts. However, the administration of an equivalent quantity of sodium does not reduce the effect of these anionic salts completely.

A reduced calcium supply does not cause any substantial increase in the effect of anionic salts on the calcium balance. Negative effects on the electrolyte balance could not be observed, but should additional calcium be given during the application of anionic salts as there is the possibility of health problems following calcium-poor or calcium-balanced nutrition. The administration of anionic salts can take place both once or twice daily, since over the day a continuous effect is present. The effect of the anionic salts on the calcium mobilization and absorption can already be observed four hours after the first administration.

An increase of the sulfate quantity up to six equivalents leads to no negative changes of the electrolyte balance, but to a negative change in the health status of the animal. There are no marked differences between the effect of calcium chloride and calcium sulfate.

Between the DCAB and the calcium concentration in the urine a linear correlation exists ($r_{CaCl2} = -0,8$, $r_{CaSO4} = -0,87$, $p < 0,05$) . The calcium concentration in the urine represents an evaluation criterion for the acidotic effect of the anionic salts. The concentrations of chloride, magnesium, sodium, potassium and phosphate in the serum and urine cannot be consulted for the evaluation of the effectiveness of anionic salts. An increase of the chloride supply leads to an increase of the chloride excretion. The connection between intake and excretion in the urine could be particularly proven with potassium and sodium. For the evaluation of the electrolyte balance of the major elements the serum and urine concentrations are sufficient. The determination of the fractional excretion is not necessary if the supply is meeting the demand.