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# EFFECT OF SUPPLEMENTAL CHROMIUM ON SOME BLOOD CONSTITUENTS IN CALVES

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*ABSTRACT.* The study was designed to investigate the effect of chromium picolinate given during the milk period on blood metabolites in calves, measured immediately after weaning. Experimental calves (3 males + 2 females) were fed the control diet supplemented with chromium as Cr-picolinate (Hankintatukku Oy Finland) on d 10 (150 µg), d 30 (250 µg) and d 60 (350 µg). Chromium was dissolved in the milk just prior to feeding. Blood was collected via jugular venipuncture at the age of 3 days and after weaning (d 60). Plasma glucose levels in experimental calves tended to be higher than those in the control animals, both before the onset of Cr treatment and at the end of the experimental period. Supplemental chromium-picolinate decreased plasma cholesterol ($P<0.05$) and cortisol ($P>0.05$) levels, but had no effect on plasma indol, glucose and urea levels, after weaning of the calves. The data obtained suggest that supplemental chromium does not have any effect on the equilibrium between the microorganisms that normally reside in the gastrointestinal tract.

*Key words: calves, milk period, chromium additive, plasma cholesterol, cortisol, glucose, urea*

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Chromium takes part in carbohydrate and protein metabolism (Mertz, 1993; Pagan et al., 1995). It potentiates insulin secretion and sensitizes insulin sensitive cells through a chromodulin mediated mechanism (Vincent, 2000).

Chromium stimulates insulin secretion and decreases corticosterone and glucose concentrations in Japanese quail exposed to heat stress (Sahin et al. 2002). Relatively much papers have been published concerning the effect of supplemental organic and inorganic chromium compounds on carbohydrate metabolism in calves (Kegley et al. 2000; Bunting et al. 1994; Chang and Mowat, 1992; Kegley and Spears, 1995). However the effect of supplemental chromium on plasma insulin and glucose levels in calves is not consistent. There are data showing insulin potentiating effect or no effect of chromium in calves (Kegley and Spears, 1995; Bunting et al., 1994)

The results concerning glucose clearance rate during intravenous glucose tolerance test in chromium supplemented calves are not consistent too (Kegley et al., 2000; Bunting et al., 1994). These contradictory data suggest that the discrepancy could be due to many factors: bioavailability of the chromium compound, level of chromium sufficiency, environmental stress, age of the animals etc.

This study was designed to investigate the effect of chromium picolinate given during the milk period on some blood metabolites in calves, measured immediately after weaning.

The study was conducted at the Experimental Research Station, Vidin. Six male and 4 female Simmental calves were used in this study. Calves were stratified by weight and sex and were raised from birth through 60 d of age in individual cages placed on open ground.

Control calves (3 males + 2 females) were fed as shown in Table 1.

*Table 1:* ***Control diet***

| Age (days) | Full-fat milk kg | Starter mixture kg | Alfalfa hay kg |
|---|---|---|---|
| 1-30 | 6 | 0.5 | 0.3 |
| 30-60 | 6 | 0.8 | 0.5 |

Experimental calves (3 males + 2 females) were fed the control diet supplemented with chromium as Cr-picolinate (Hankintatukku Oy Finland) on d 10 (150 µg), d 30 (250 µg) and d 60 (350 µg). Chromium was dissolved in the milk just prior to feeding. Blood was collected via jugular venipuncture under sterile conditions at the age of 3 days and after weaning (d 60). On d 60 calves were given starter diet only.

Adrenal response to weaning was assessed by the level of cortisol as determined by Kanchev et al. (1976). Plasma urea levels were assayed as described by Rerat et al. (1976). Plasma cholesterol and indol were determined by the methods of Watson (1960) and Balahovski as cited by Chilov (1959), respectively. Plasma glucose level was determined by the methods of Cerioki as modified by Profirov (1990). The results are expressed as means ± S.E.M. and were analyzed by Student t-test.

Basal plasma cortisol levels were significantly higher ($P<0.01$) in the experimental group.

The observed difference in cortisol levels is less likely to be due to blood sampling, since blood was collected within 5 min for each animal. Plasma cortisol levels in both groups were within the baseline limits of cortisol which can vary greatly in different breeds - from 0.5 to 9 ng/ml (Grandin, 1997). The higher baseline cortisol levels in experimental group could be due to the temperament of each individual animal, which is a heritable trait (Grandin, 1997). Futhermore, plasma cortisol levels in neonatal calves differ from those of the adult animals due to the fact that their adrenal glands are not mature yet (Madjarov, 1980).

Plasma cortisol level in control group tended to be higher during the I$^{st}$ day following weaning compared to the basal level. The lack of significant cortisol enhancement after weaning suggests that weaning was not stressful in our case and could be due to the fact that the calves have been separated from their mothers at one day of age and succeeded to habituate to the individual cells, in which they were raised up to the day of weaning.

Our previous study has shown that transition from liquid to solid food after weaning is not stressful for both kids and does “if the natural physical contact mother-kid is not disrupted (Popova-Ralcheva et al., 1999). Therefore weaning-induced stress stimuli have psychological rather than nutritive origin.

Plasma cortisol levels in experimental calves, unlike those in control calves tended to be lower after weaning as compared to baseline levels, even though the absolute cortisol values were somewhat higher than in control calves.

Chromium research by Depew et al. (1998) showed a decline of plasma cortisol in calves given 1 ppm supplemental chromium-picolinate from birth through 8 weeks of age. However their overall conclusion was that supplemental Cr picolinate had minor effect on the metabolism of conventionally managed dairy calves.

Plasma glucose levels in experimental calves tended to be higher than those in the control animals, both before the onset of Cr treatment and at the end of the experimental

period (Fig. 1). It is known that glucocorticoids stimulate gluconeogenesis and inhibit glucose utilization (Brockman, 1986).

Therefore, the higher glucose levels ($P<0.05$) in experimental calves at the onset of the experiment could be related with the higher cortisol levels ($P<0.01$) as compared to cortisol levels in control calves. However, plasma glucose in Cr supplemented calves did not decline after weaning despite the fact that cortisol tended to decline at that time. This discrepancy could be due to the fact that calves are more sensitive to insulin during initial few weeks of life than at 8 weeks of age (Depew et al., 1998).

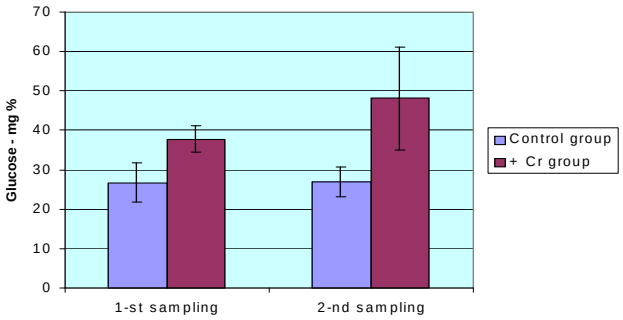


*Fig. 1. Plasma glucose levels (mg %) in untreated and chromium treated calves*

Plasma cholesterol levels after weaning declined in both control and experimental groups (Fig. 2). However, cholesterol levels in chromium supplemented calves were significantly lower ($P<0.05$) compared to control ones.

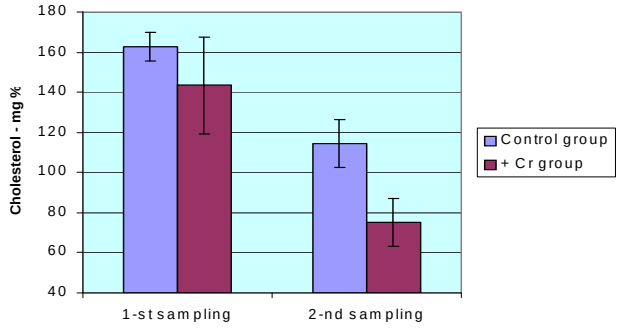


*Fig. 2. Plasma cholesterol levels (mg %) in non treated and chromium treated calves*

This result is in contrast with the report of Moonsie and Mowat (1993). They did not observe an effect of supplemental chromium supplied from high Cr yeast on plasma cholesterol level in feeder calves. The observed discrepancy could be due to many factors, such as the cromium source, age of the animals, exposure to stress etc.

Cortisol levels in control group showed that weaning caused no stress, and it is known that various stressors increase urinary excretion of Cr (Anderson et al., 1982). These data suggest that urinary excretion of Cr in our study was not increased after weaning.

Therefore, the lower level of supplemental Cr in our trial, compared to that conducted by Depew et al. (1998) was most probably sufficient to meet Cr requirement, since weaning caused no stress, as indicated by cortisol level and, therefore, no increase of Cr mobilization from tissues.

It has been found that 0.2 ppm supplemental chromium is sufficient to improve weight gain in stressed feeder calves (Monsie-Schageer and Mowat, 1993).

Supplemental chromium had no significant effect on plasma urea level (Fig. 3). Our results are consistent with those of Bunting et al. (1994) obtained on calves. However some studies have shown increased urea level in chromium supplemented steers (Chang and Mowat, 1992; Kegley et al., 2000). This discrepancy may be due in part to the age of the animals and the level of dietary protein used in the different studies.

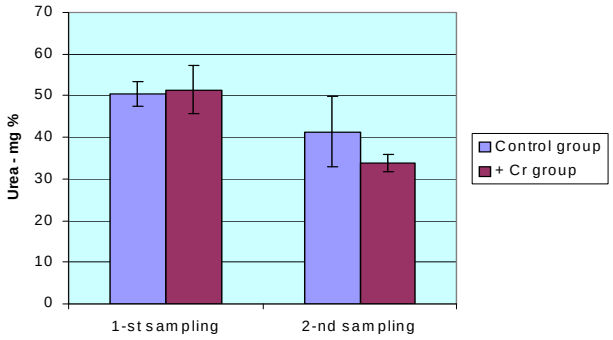


*Fig. 4. Plasma urea levels (mg %) in untreated and chromium treated calves*

Plasma indol levels tended to be lower in chromium supplemented calves (Fig. 4).

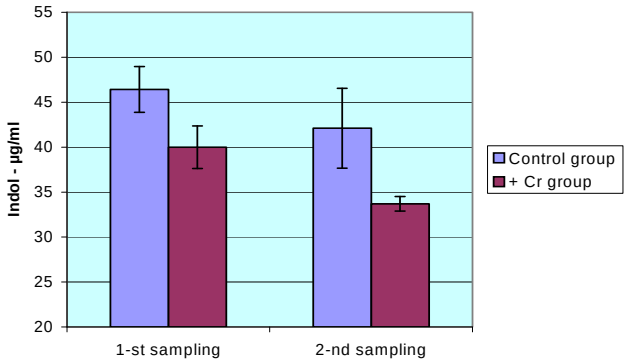


*Fig. 4. Plasma indol levels (µg/ml) in untreated and chromium treated calves*

This suggests that chromium does not have any effect on the equilibrium between the microorganisms that normally reside in the gastrointestinal tract. Supplemental chromium-picolinate decreased plasma cholesterol ($P<0.05$) and cortisol ($P>0.05$) levels, but had no effect on plasma indol, glucose and urea levels, after weaning of the calves.

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