BS. VET. MED. J. JANUARY 2009 VOL. 19, NO.1, P. 51-56

Beni-Suef
Veterinary Medical
Journal

Mineral status in blood serum of newborn calves in Assiut Governorate

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The dynamics of some serum mineral concentrations during the first weeks of life of native and crossbred newborn calves in Assiut governorate were investigated. Blood samples of 25 Balady and 25 crossbred (Friesian x native) male calves were investigated. Blood was drawn from calves at 1, 7, 14 and 21 days after parturition. Serum levels of calcium (Ca), phosphorous (P), magnesium (Mg), sodium (Na), chloride (Cl), potassium (K), iron (Fe), Copper (Cu) and zinc (Zn) were monitored. Levels of Ca, P, Fe, Cu and Zn increased ($P < 0.05$) in relation to age of Balady and crossbred calves when compared by the day 1 of age. In contrast, decreased in concentrations of Na and Cl ($P < 0.05$) in relation to age of Balady and crossbred calves when compared by the day 1 of age were detected whereas Mg and K values remained unchanged. Native calves had higher ($P < 0.05$) Ca, P and Fe in the 7th day than crossbred calves whereas Na and Cl were higher ($P < 0.05$) in native calves than crossbred calves at the first day after birth. Results from this study suggested that breed and age may play an important role in mineral homeostasis during the first weeks of life in the newly borne bovine calves.

The transition at birth of a calf from a fetal to neonatal environment is very dramatic (Xu, 1996). This transition is from sole dependency on maternal sources to one in which the neonate must maintain homeostasis (Egli and Blum, 1998). Because the physiological changes are tremendous, the first period of life is crucial for survivability (Radostits *et al.,* 2000 and Latimer *et al.,* 2003).

Ingestion of colostrum is important for morphological and functional development of newborns (Xu, 1996). Intake of the first colostrum causes typical metabolic and endocrine changes in blood of newly borne calves (Blum and Hammon, 2000). Colostrum intake modifies gastrointestinal tract (GIT) development and digestive and absorptive capacities in neonates, not only through provision of nutrients, minerals, vitamins and energy, but probably also due to effects of growth-promoting factors in various species, including calves (Blum and Hammon, 2000).

In newborn calves, great morphological and functional changes are necessary and calves must adapt to various environmental adaptation (Latimer *et al.,* 2003). At birth, many changes occur, enabling survival of newborns (Heidarpour *et al.,* 2008 and Mohri *et al.,* 2008). Nutrient supply is converted from maternal sources to the GIT so that the GIT is the most markedly affected organ (Xu, 1996). Also, the kidney assumes control of electrolyte and water balance rather than the placenta (Radostits *et al.,* 2000). Other changes in newborn calves are alterations in blood metabolites and functionality of the liver and other organs (Blum and Hammon, 2000). So that, the age of the calf has an important role for the precise interpretation of laboratory results (Thrall, 2004). In this concept, Mohri et al. (2007) found that many values vary with the age of the animal, with major changes occurring after birth. These modifications make the newborn calves are characterized by marked metabolic and endocrine changes which continue during the first weeks of life (Mohri *et al.,* 2007). Changes in concentrations of various blood constituents may be related to maturity of organs, initiation of specific enzymatic activities, or simply physiological adaptation to the new environment (Thrall, 2004).

Blood biochemistry analyses are valuable tools for evaluating health of livestock, both in diagnosing disease and clinical monitoring of the individual (Meyer and Harvey, 2004). Diseases of the newborn and neonatal mortality are a major cause of economic loss in livestock production. Thus, knowledge on serum biochemical changes could help and promote the ability of clinicians to more accurate interpretation of clinical pathology data and diagnosis of neonatal diseases (Mohri *et al.,* 2007). The ability to interpret laboratory data is based on knowledge regarding the normal physiologic mechanisms underlying each laboratory test (Mohri *et al.,* 2008).

This study was undertaken to determine chronological changes of blood serum minerals in native and crossbred bovine neonates from birth to 3 weeks of age in Assiut governorate.

Material and Methods

Animals. In this study, 25 (Balady) and 25 crossbred (Friesian x native) male calves born from multiparous cows in different localities in Assiut Governorate were used. All the selected cattle reared under the same management and environmental conditions. Animals used in this study reared in small scales under unorganized farming with unsatisfactory standards of animal management. The common food available for the mother cows consisted mainly of Barseem (*Trifolium alexandrinum*) and wheat (*ad lib*) in addition to concentrate mixture (1-2 kg/head/day). All newborn calves were left with their mothers and received their first colostrums for 3-4 days and then milk throughout the period of the experiment. All newborn calves and their mothers were subjected to careful clinical and laboratory investigations No metabolic or reproductive disorders occurred for cows around parturition. Also, there was no evidence of health disorders among calves in all groups.

Blood sampling. Blood was drawn from the jugular vein of all newborn calves in centrifuge tubes (without anticoagulant for collection of serum) at the day one after parturition (after fed colostrum) and at the day 7, 14 and 21. The blood was allowed to coagulate and the harvested serum was stored at -20°C until processing.

Biochemical analysis. Blood serum calcium, inorganic phosphorus, and magnesium levels were determined spectrophotometrically by using already manufactured colourometric test kits (Eltech Co. Egypt) according to manufacture instructions and the methods described by Henry (1968). The concentrations of serum sodium and potassium were carried out using flame photometer (Corning 400) using calibrated standards for Na and K. The chloride concentrations in the serum were measured using a chloride meter (Corning chloride meter 925).

Blood serum was used for determination of iron, copper and zinc concentrations by using acetylene type computerized atomic absorption technique (GBC, 932 AA) according to its manufacture guides.

Statistical analysis. Changes of variables with age and breed of calves were analyzed using analysis of variance (ANOVA). The SPSS program for windows (SPSS, Chicago, IL) according to SPSS (1999). Significant levels were set at $P < 0.05$.

Results

Mean serum macro-elements profiles (Ca, P and Mg) for all calves are shown in table 1 and figure 1. It was noticed that the values of serum Ca in the 7 and 14 day were variably increased ($P < 0.05$) in Balady and crossbred calves then the values tended to restore in Balady and decreased in crossbred calves at the day 21, whereas the values of serum P were significantly increased ($P < 0.05$) in the day 7, 14 and 21 when compared by the day 1 of age. Blood serum magnesium values in the day 7, 14 and 21 did not changed when compared by the day 1 of age. Native calves had higher ($P < 0.05$) Ca and P in the 7th day than crossbred calves.

Mean serum electrolytes (Na, K and Cl) are shown in table 2 and figure 2. Serum Na and Cl concentrations declined ($P < 0.05$) in the 7, 14 and 21 day when compared with the 1st day. On the other hand, serum K levels did not significantly changed by time in both breeds. Native calves had higher ($P < 0.05$) Na and Cl than crossbred calves at the first day after birth. The values of serum Na in native calves were significantly higher ($P < 0.05$) than that in crossbred calves at the days 14 and 21, whereas the values of serum Cl did not significantly differed between both breeds in the days 7, 14 and 21.

Mean serum trace elements (Fe, Cu and Zn) for all calves are shown in table 3 and figure 3. The concentrations of serum Fe increased ($P < 0.05$) in the 7, 14 and 21 day, but the values of serum Cu and Zn increased ($P < 0.05$) in the days 14 and 21 in both breeds when compared with the 1st day. Native calves had higher ($P < 0.05$) serum Fe level in the 1st and 7th day than crossbred calves, but the values of Cu and Zn did not differed between breeds throughout the period of the experiment.

Table (1): Serum concentrations (Mean ±SE) of Ca, P and Mg (mmol/l) in native and crossbred newborn calves during the first 21 days of life.

Day	Ca		P		Mg	
	Native	Crossbred	Native	Crossbred	Native	Crossbred
1	2.66±0.13	2.71±0.15	2.34±0.31	2.21±0.29	0.89±0.09	0.92±0.14
7	2.97±0.22	2.80±0.18*	2.54±0.24	2.33±0.18*	0.91±0.12	0.84±0.09
14	2.81±0.19	2.77±0.21	2.64±0.23	2.57±0.28	0.88±0.13	0.92±0.12
21	2.71±0.23	2.61±0.24	2.59±0.19	2.48±0.31	0.87±0.08	0.93±0.13

* Significant difference between native and crossbred calves ($P < 0.05$).

Table (2): Serum concentrations (Mean ±SE) of Na, K and Cl (mmol/l) in native and crossbred newborn calves during the first 21 days of life.

Day	Na		K		Cl	
	Native	Crossbred	Native	Crossbred	Native	Crossbred
1	154.2±5.1	145.1±4.6 *	4.6±0.42	3.9±0.50	108.2±4.1	103.1±5.6 *
7	148.3±5.9	142.6±4.1	4.9±0.51	4.2±0.43	98.51±5.2	96.11±4.3
14	141.5±4.6	128.7±4.4 *	4.6±0.39	4.5±0.41	96.83±3.6	96.64±4.8
21	141.8±4.2	124.3±5.1 *	4.5±0.41	4.3±0.39	95.60±4.3	97.21±3.9

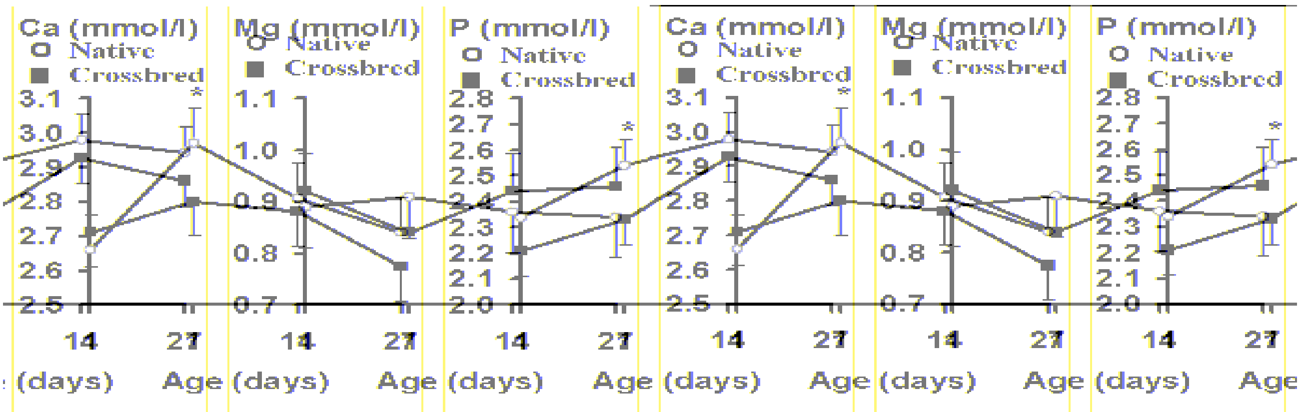
* Significant difference between native and crossbred calves ($P < 0.05$).

Table (3): Serum concentrations (Mean ±SE) of Fe, Cu and Zn (µmol/l) in native and crossbred newborn calves during the first 21 days of life.

Day	Fe		Cu		Zn	
	Native	Crossbred	Native	Crossbred	Native	Crossbred
1	15.8±0.68	11.5±0.86 *	10.2±0.51	11.1±0.54	8.70±0.31	9.11±0.28
7	22.3±0.81	17.4±0.94 *	11.1±0.43	10.8±0.61	10.2±0.24	11.4±0.31
14	20.6±0.74	21.4±0.82	13.4±0.32	14.6±0.45	13.1±0.26	14.2±0.34
21	21.1±0.66	23.1±0.68	13.5±0.41	15.1±0.41	13.9±0.32	14.1±0.41

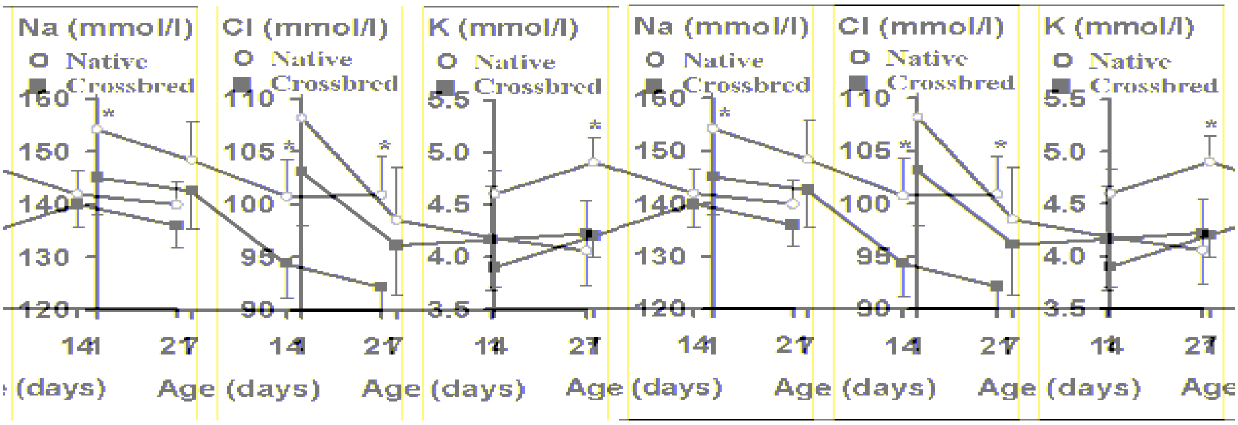
* Significant difference between native and crossbred calves ($P < 0.05$)

Fig. (1): Serum concentrations (Mean ±SE) of Ca, P and Mg in native and crossbred newborn calves during the first 21 days of life.



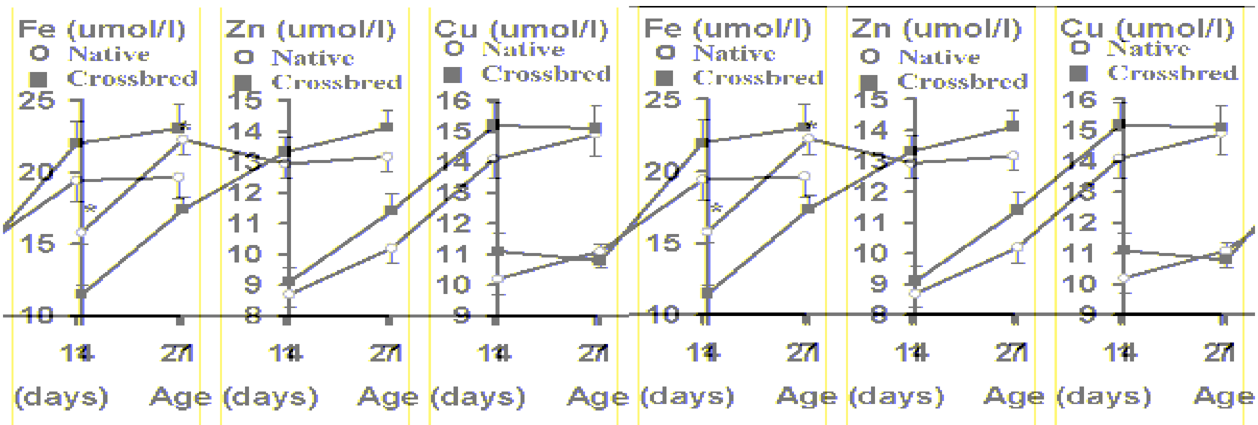
*Significant difference between native and crossbred calves ($P < 0.05$).

Fig. (2): Serum concentrations (Mean ±SE) of Na, K and Cl in native and crossbred newborn calves during the first 21 days of life.



*Significant difference between native and crossbred calves ($P < 0.05$).

Fig. (3): Serum concentrations (Mean ±SE) of Fe, Cu and Zn in native and crossbred newborn calves during the first 21 days of life.



*Significant difference between native and crossbred calves ($P < 0.05$).

Discussion

In this study, serum Ca, P, Mg, Na, K, Cl, Cu and Zn levels were within the published values for newborn calves reared under the Egyptian environment (Mohammed, 1984; Komy *et al.,* 1991 and Hafez *et al.,* 2001) and also newborn calves reared in temperate areas (*Radostits et al.,* 2000). However, the values of serum Fe were lower than those previously reported (Mohammed, 1984). The difference may be related to the variations in the feeding, management and environmental conditions (Thrall, 2004).

During the first weeks of life considerable metabolic changes occur (Blum and Hammon, 2000). In the current work, serum Ca and P levels increased in the 2nd week of age. Age-related changes have been previously detected for Ca and P in Friesian newborn calves (Mohri *et al.,* 2007). Egli and Blum (1998) and Birgele and Ilgaža (2003) reported that Ca levels were high in the first days of life, but the same is not true for P and Mg. Steinhardt and Thielscher (1999) found that P concentrations changed differently in newborn calves with age. Numerous physiologic processes, particularly maximum bone mineralization in growing neonates, are associated with increased requirements of Ca and P (Radostits *et al.,* 2000). The higher amount of Ca and P in calves may be caused by growth hormone, which is high in growing animals and enhances renal phosphate reabsorption (Rosol and Capen, 1997). Furthermore, Ca and P are the major mineral components of the mother' milk, which would affect blood concentrations of these minerals in the neonate (Thrall, 2004).

In the present study, serum Na and Cl concentrations were high at birth and then declined. Also, native calves had higher Na and Cl than crossbred calves at the first day after birth. These changes may be due to the high content of these minerals in the colostrum (Mohri *et al.,* 2007). Maach *et al.* (1991) found reduction in Na and Cl and non-significant change in K in newborn Friesian calves in Moracco. Mohri *et al.* (2007) found that Na, K and Cl showed significant differences between day 14 compared with the concentration at the day1. Changes of these variables in newborn calves with age means that there were directed time specific adaptation processes (Steinhardt and Thielscher, 1999 and Muri *et al.,* 2005).

The concentrations of Fe, Cu and Zn in the present study were low at the first day after birth and then increased. Furthermore, native calves had higher serum Fe level in the 7th day than crossbred calves. These results agree with the reports of Knowles et al. (2000) and Egli and Blum (1998) who reported low iron levels in newborn calves, which may be related to the low Fe content in the diet. Kume and Tanabe (1993) reported that the increase in plasma Cu of newborn calves was due to the deposits of liver Cu rather than to colostral Cu, but low colostral Fe was insufficient to maintain serum Fe levels. McDowell (2003) cited that newborn calves usually had low Fe stores because the maternal milk is low in Fe.

Results from this study suggested that extreme caution must be exercised when interpreting mineral components from newborn calves of different breeds. Breed and age with the possibility of maturation of organs, play an important role in attaining mineral homeostasis during the first weeks of life in the bovines.

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صورة المعادن في مصل دم العجول حديثة الولادة في محافظة أسيوط

في هذه الدراسة تم فحص تغيرات المعادن خلال الأسابيع الأولى في مصل دم عينة من العجول البلدي والخليط حديثة الولادة في محافظة أسيوط. ولهذا الغرض تم فحص عدد 25 عجل بلدي و 25 عجل خليط (فريزيان × محلي). تم الحصول على عينات دم من هذه العجول في اليوم الأول بعد الولادة ثم في اليوم 7 و 14 و 21 وذلك لقياس مستوى الكالسيوم والفوسفور و الماغنيسيوم والصوديوم والبوتاسيوم والكلوريدات والحديد والنحاس والزنك في مصل الدم. وقد أوضحت النتائج زيادة في تركيز الكالسيوم والفوسفور والحديد والنحاس والزنك ($P<0.05$) بمرور الوقت في كل من العجول البلدي والخليط مقارنة باليوم الأول من العمر وفي المقابل كان هناك نقص في تركيز الصوديوم والكلوريدات ($P<0.05$) بمرور الوقت في كل من العجول البلدي والخليط مقارنة باليوم الأول من العمر بينما لم تتغير قيم الماغنيسيوم والبوتاسيوم. وكانت قيم كل من الكالسيوم والفوسفور و الحديد أعلى ($P<0.05$) في العجول البلدي التي تم فحصها في اليوم السابع من العمر عن العجول الخليط ولكن قيم كل من الصوديوم والكلوريد كانت أعلى ($P<0.05$) في العجول البلدي عن العجول الخليط في اليوم الأول من العمر. نتائج هذه الدراسة ترجح أن العمر والسلالة لهما دورا هاما في اتزان بعض عناصر الدم أثناء الأسابيع الأولى من حياة العجول.