NORMAL BLOOD AND MILK LEAD VALUES IN HORSES

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THERE ARE FEW reports in the literature of normal blood lead values in the horse (3, 4, 5, 6). To establish a background of normal data for this species, blood samples were collected from normal horses that had been reared under a variety of environmental conditions.

MATERIALS AND METHODS

ANIMALS

The ages, physiological states and the region of Ontario in which the horses were reared are described in this and the results section.

Mares

All mares sampled were the progeny of draft-type mares and quarter-horse type stallions. Their body weights ranged from 450 to 800 kilograms.

Pregnant The 40 pregnant mares were housed in one barn 20 kilometers from the city (Ottawa) during the last one-half of the gestation period. The ration fed was comprised of cereal grains and hay. Blood samples were collected between one and two months prior to parturition.

At Parturition The 12 mares in this group had foaled one to 12 hours prior to blood sample collection. All were reared in one of three rural areas (Atwood, Guelph and Ottawa), and were on grass pasture at the time of foaling. There was no history of illness or of exposure to lead containing compounds.

Lactating The 28 mares were reared in one of two rural areas and were together with their foals, on grass pasture at the time of blood sample collection.

Foals

The foals sampled were the progeny of the mares described above and were from quarter-horse or standard bred-type stallions.

At birth Blood samples were collected prior to the ten foals sucking colostrum milk.

At weaning Nineteen foals sucking mares while on grass pasture were sampled immediately prior to being weaned and transported to a barn 500 kilometers distant. The foals were between two and one-half and three and one-half months old at the time.

Nursing This group included the foals at weaning described above and 11 additional foals sampled while at pasture and sucking their dams.

Three Weeks Post Weaning The same group of 19 foals described above was sampled three weeks after weaning. In the interim, the foals were fed a reconstituted dried cow's milk powder, hay and water. The foals, despite moderate food consumption, lost body weight and were diarrheic on several occasions during this period of adjustment.

Five Weeks Post Weaning The same 19 foals described above were sampled after they had adjusted to a ration of complete horse feed pellets for a period of seven to ten days. Their appetites and body systems function were normal at the time of sampling.

Police Force Horses

Blood samples were collected from thirty-five of a group of 50 city police horses. The horses were reared at one of three locations in the city of Toronto and the history of each horse including the length of time it had been within the city limits was known. For the purpose of this study, they were divided in two groups; one group had been housed in the city for more than five years and the other group for less than five years. The majority of the horses were geldings and of the hunter type. They were used mainly for patrol and parade duties.

BLOOD AND MILK SAMPLES

Blood samples were collected by jugular venipuncture in lead-free vacutainer tubes,[1] stored at 4°C and shipped to the laboratory via air express in refrigerated containers. Whole blood lead values were established following wet ashing, complex formation with dithizone and colorometric estimation by spectrophotometry (detailed method available on request from G.B.). This laboratory, listed as number 26 in the publication, was one of 18 found to produce acceptable results in a laboratory reliability study of blood lead analysis (7).

Colostrum and milk at the commencement and during lactation, respectively, were col-

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[1]Becton, Dickinson and Co., Rutherford, N.J.

TABLE I

NORMAL WHOLE BLOOD LEAD VALUES IN HORSES

Description	Number of Animals	Age		Blood Pb (μg/100 gm whole blood)		
		Range	Mean	Range	Mean	Standard Deviation
Pregnant Mares	40	3–13 years	7.2 years	6–21	11.9	4.0
Mares at Parturition	12	2–20 years	7.4 years	5–90	20.08	24.6
Lactating Mares	28	2–16 years	5.1 years	5–20	10.00	4.14
Foals at Birth	10	0.5–8 hours	5.1 hours	<5–5	5	0.00
Foals at Weaning	19	6–10 weeks	8 weeks	5–25	10.68	4.57
Foals, 3 weeks post weaning	19	9–13 weeks	11 weeks	5–43	16.00	9.17
Foals, 5 weeks post weaning	19	11–15 weeks	13 weeks	5–8	5.42	0.90
Nursing Foals	30	4 days–2-1/2 months	7 weeks	5–43	12.93	8.61
Metro Police Horses (In city 5–10 years)	12	8–14 years	11.3 years	5–17	8.17	4.30
Metro Police Horses (In city 1–5 years)	23	2–10 years	6.30 years	5–12	6.04	2.14

lected from the mares described above. Samples were collected in polyethylene containers after the mare's teats had been cleaned and defatted with alcohol and dried with cotton swabs. The same dithizone method was used to determine colostrum and milk lead values.

The lowest accurate value of the test, 5 μg Pb/100 gms whole blood, was used in calculating the mean and standard deviation.

RESULTS AND DISCUSSION

The results of the whole blood lead determinations are summarized in Table I. The mean and standard deviation from 193 blood samples collected from 158 normal young and adult horses was 10.7 ± 8.51 μg Pb/100 gm whole blood. These results indicate that 95% of the whole blood lead values in normal horses would lie between the lower limit of dithizone method, 5 μg, and 27 μg Pb/100 gms whole blood at the upper limit.

With two major exceptions, namely mares at parturition and foals sampled while in the process of adjusting to a change of diet at three weeks post weaning, the blood lead values were constant. At and prior to parturition, there would be increased mobilization of calcium from bone for milk production and fetal development. Any cause of increased mobilization of mineral from bone has been shown to cause a concurrent mobilization of lead from bone, thus producing an increase in blood and tissue lead values (2, 4).

It appeared that weaning and changing the ration of foals was associated with a marked increase in blood lead values. It has been reported that diseases which produce changes in electrolyte and acid-base balance are followed by a greatly increased mobilization of lead from bone in particular (1, 2, 4). In the present study, the foals lost sufficient body weight in the first three weeks after weaning to increase the catabolism of body energy stores. This change together with the diarrhea that occurred would be of sufficient magnitude to induce these changes.

The high blood lead value (90 μg Pb/100 gm whole blood) from one mare at parturition was not related to known exposure to lead, illness or contamination of the sample. On a repeat sample taken two months later, the value was 15 μg PB/100 gm whole blood. Although the results of the second sample suggest that the first was contaminated with lead, we have occasionally noted similarly elevated values in samples from horses with no clinical evidence of disease. It is important under these conditions to verify such results by a repeat sample in order to avoid errors in the interpretation of laboratory tests and the diagnosis of disease.

It is noteworthy that horses reared and used within the city of Toronto (population approximately 1.8 million) had blood lead values comparable with values from horses reared under rural conditions. These results suggest that the level of lead exposure in this city is approximately the same as that of horses reared under rural conditions in the province of Ontario.

The ten colostrum and 12 milk lead determinations conducted on samples from different mares contained less than 50 μg Pb/liter. To the best of our knowledge, lead values in mare colostrum and milk have not been reported. For comparative purposes, the values reported

for mares are similar to those reported for normal cow's milk (1, 2, 3, 4, 5, 8).

Summary

A total of 193 blood samples were collected for whole blood lead determination from 158 normal young and adult horses. The overall mean and standard deviation was 10.7 ± 8.51 μg Pb/100 gm whole blood.

The highest blood lead values were found in mares at parturition and a group of foals sampled shortly after they had been weaned and during a period when they were adjusting to a commercially prepared ration.

The blood lead values from a group of horses reared in a large city were as low or lower than horses reared under rural conditions.

Normal colostrum and milk lead values were less than 50 μg Pb/liter.

Résumé

Les auteurs ont prélevé 193 échantillons de sang entier chez 158 poulains et chevaux adultes, en vue d'en déterminer la teneur en plomb. La moyenne générale et la déviation standard s'établissaient à 10.7 ± 8.51 μg Pb/100 gm de sang entier.

C'est chez les juments en gestation et dans un groupe de poulains saignés peu après le sevrage, alors qu'ils s'habituaient à une ration commerciale, qu'on observa la plus haute teneur du sang en plomb.

Dans un groupe de chevaux élevés dans des grandes villes, les valeurs du sang en plomb s'avérènt aussi basses, ou plus basses, que chez les chevaux de la campagne.

Les valeurs en plomb du colostrum normal et du lait s'établissaient à moins de 50 μg Pb/litre.

Acknowledgments

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ABSTRACT

Plommet, M. (1968) (Origin of antibodies in milk.)–Annls Biol. anim. Biochim. Biophys. 8, 407–417 (F.e.) (INRA Stn de Pathol. de la Reprod., CRVZ de Tours-l'Orfrasière, 37 Nouzilly).

After s/c vaccination of ewes with *Salmonella* or *Brucella* cellular antigens, titres of antibodies in the milk were about 25 times lower than in the blood. After intramammary injection of *Brucella* antigen, titres of agglutinins in the milk were on average a half of those in the blood, but in some animals were higher than in the blood. These results were not affected by s/c or intramammary injections of other bacterial antigens. It was concluded that antibodies can pass from the blood into the milk, and can also be synthesized in the udder.

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