

# Chemical Changes in the Serum Associated With Equine Encephalomyelitis and Moldy Corn Poisoning of Horses

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Specific infectious equine encephalomyelitis and moldy corn poisoning in horses are becoming more prevalent in Iowa yearly. Encephalomyelitis has been described, the etiology determined, the mode of transmission established and the typical clinical and pathological findings resolved<sup>1</sup>.

The disease of horses resulting from the feeding of moldy corn has been substantiated by Schwarte, Biester and Murray<sup>2</sup>. These investigators have produced the disease under experimental conditions and have recorded the development, course, clinical symptoms and post-mortem findings of the test horses.

Both of these disease are accompanied by mental symptoms. Their differential diagnosis is based largely on seasonal occurrence, history and post-mortem findings<sup>3</sup>. Certain confusing factors exist and a great deal of information must still be acquired about these two maladies.

The chemical composition of the blood of the different mammalian species reveals considerable variation, but within a single specie physiological deviations are usually relatively slight. Certain pathological conditions produce significant changes in the body fluids, either directly or indirectly. Chemical analyses of serum from normal and diseased animals have been made in an attempt to secure pertinent facts about specific pathological processes.

The blood samples used in the study of horses suffering with encephalomyelitis were obtained from animals presented for treatment at the clinic here at the Iowa State Veterinary College. Specimens were taken from the jugular vein and the clear serum removed from the clot by centrifur-

galization. After precipitation of the protein with trichloroacetic acid, the inorganic phosphorus, calcium and magnesium in the filtrate were determined quantitatively.

In Table I the results of the analyses are compared with the values obtained from serum of healthy horses. Available data on the chemical composition of normal equine serum is quite limited. Errington<sup>4</sup> reported the serum phosphorus of adult horses as ranging from 2.56 to 4.83 milligrams per 100 cc., with a mean of 3.55 mg., and serum calcium of the same as 11.5 mg. per 100 cc., with a mean of 12.94. Eveleth<sup>5</sup> reported plasma magnesium for ten horses ranging from 2.0 to 3.0 mg. per 100 cc., with an average of 2.43. These values correspond closely with values of samples from normal horses which were analyzed at the same time as those from the diseased animals.

## Interpretation

We note that the inorganic phosphorus varied from 2.4 to 4.9 mg. per 100 cc. for the encephalomyelitis horses, a fluctuation which is almost the same as the accepted range for the normal adult horse. There is a tendency for the calcium to fall below the normal average. This corresponds to a similar condition reported by Eveleth and Schwarte<sup>6</sup> in their study of experimentally produced cholera in swine. They found a rather consistent lowering of the calcium as the disease progressed. Of greater significance, no doubt, are the frequent low magnesium values found in encephalomyelitis. Eveleth and Schwarte found little change in the magnesium during the course of the hog cholera.

The first encephalomyelitis case listed in

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Table I, No. 9146, shows a decided rise in the magnesium and also a consistent rise in the calcium as the disease ran its course and the animal returned to normal. Case No. 9084, too, showed a rise in the magnesium in the five day interval. Nine serum samples were analyzed for sugar content. The values obtained ranged from 87 to 125 mg. per 100 cc. of serum, a variation which indicates no marked disturbance of the carbohydrate metabolism.

Direct Van den Bergh tests were run on five encephalomyelitis samples and on three uninfected samples. Three of the five from the infected group showed very high icteric indices; the others were normal<sup>7</sup>.

mental cases of moldy corn poisoning the magnesium increased slightly. No. 4 died of the disease before it was bled a second time. No. 5 showed extreme lowering of the calcium. No. 7 is a case which showed incoordination and mental symptoms. The etiological factor in this case was not determined, but the serum analysis shows a similarity with the moldy corn cases.

Case No. 8 was a male colt which developed incoordination in the hind legs in the fall of 1933. These symptoms became progressively worse and the animal was killed June 13, 1934. Post-mortem examination revealed considerable increase in the density of the leg bones and erosion of the articulating surfaces. Microscopically,

TABLE I. Inorganic phosphorus, calcium and magnesium in the serum of encephalomyelitis victims and in the serum of other equine patients. The values are given in mg. per cent.

Sample no.	Case no.	Date 1938	P	Ca	Mg	Clinical diagnosis
1		6-11	3.5	12.8	2.4	Umbilical hernia
12		6-13	5.1	12.5	2.2	Tail amputation
15		6-13	5.2	12.4	2.5	Castration
16		6-15	4.1	12.3	2.2	Castration
64		7-29	4.1	13.3	2.4	Quittor
36	9146	7-18	4.2	11.2	1.7	Encephalomyelitis
43	"	7-20	3.9	12.0	1.6	"
54	"	7-25	4.4	13.4	2.6	"
40	9084	7-20	3.4	12.3	1.9	"
53	"	7-25	4.2	12.1	2.1	"
37	9101	7-18	3.2	12.9	1.8	"
38	9128	7-18	3.2	12.1	2.0	"
39	9120	7-18	2.7	11.4	2.1	"
41	9176	7-20	4.4	11.6	2.1	"
42	9166	7-20	2.5	11.8	1.7	"
44	9156	7-20	3.7	11.5	1.9	"
58	9298	7-29	3.5	13.1	2.1	"
59	9270	7-29	3.7	12.7	2.1	"
60	9287	7-29	4.9	12.0	2.2	"
61	9274	7-29	2.4	12.1	1.8	"
62	9275	7-29	3.6	13.8	2.2	"

In moldy corn poisoning, Table II, a different effect on the blood serum is noted. Here we find a decided drop in the calcium, as it is undoubtedly mobilized to neutralize and aid in the elimination of the toxic principle. The magnesium, on the other hand, was found to be normal or slightly raised. In each of the experi-

one of the parathyroids, which was about 8 mm. in diameter, contained a cyst 2 mm. in diameter.

It is possible that the cystic parathyroid gland was responsible for the high calcium value found in the serum. Parathyroid extract, when injected intravenously, will markedly raise the calcium content of the

TABLE II. The inorganic phosphorus, calcium and magnesium in the serum of normal horses and in serum from horses manifesting incoordination. The values are given in mg. per cent.

No.	Date bled	P	Ca	Mg	Remarks
1	11/21/36	3.0	12.6	2.6	Before feeding moldy corn
2	" " "	2.7	11.5	3.0	" " " "
3	" " "	3.0	12.0	2.6	" " " "
4	" " "	3.0	12.5	2.8	" " " "
1	3/4/37	3.7	10.4	3.2	On moldy corn
2	" " "	3.3	10.7	3.3	" " "
3	" " "	3.1	9.6	3.0	" " "
5	7/15/36		7.6	3.3	On moldy corn diet
6	7/14/36		9.1	2.7	Injected with moldy corn extract
7	8/12/36		8.6	2.5	Dummies
8	5/25/34	5.4	14.1		Incoordination
8	6/5/34	4.7	14.7		"

blood plasma<sup>8</sup>. The incoordination of this animal was similar to that accompanying encephalomyelitis or moldy corn poisoning.

### Summary

Serum from normal horses, from animals showing symptoms of infectious equine encephalomyelitis and from cases of experimental moldy corn poisoning have been analyzed for inorganic P, Ca, and Mg content and the results compared.

1. In encephalomyelitis there is a significant lowering of the serum magnesium and a tendency for the calcium to be lowered.

2. In moldy corn poisoning the calcium is lowered noticeably and the magnesium remains normal or increases.

3. There is no apparent disturbance in the carbohydrate metabolism of the encephalomyelitis patients.

4. Hyperbilirubinemia may be present in encephalomyelitis.

5. Injection of an extract from moldy corn lowered the serum calcium in a manner similar to that accompanying the feeding of moldy corn.

6. Incoordination may be accompanied by a rise in the serum calcium.

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### Bibliography

- Hutyra, J., and Marek, J. Special pathology and therapeutics of the diseases of domestic animals. 4th English Edition. (1938) Vol. 3, pp. 302-309.
- Schwarte, L. H., Biester, H. E., and Murray, Chas. A disease of horses caused by feeding moldy corn. Jour. Amer. Vet. Med. Assn. Vol. XC, N.S. 43, No. 1. Jan., 1937. pp. 76-85.
- Biester, H. E. Moldy corn poisoning and differential diagnosis. The Iowa Veterinarian, Vol. 9:2. 1938. pp. 10-15.
- Errington, B. J. Variations in inorganic phosphorus and calcium content of the blood of horses. Thesis abstract, Cornell University.
- Eveleth, D. F. Comparison of the distribution of magnesium in blood cells and plasma of animals. Jour. Biol. Chem., Vol. 119, No. 1, pp. 289-292. 1937.
- Evelet, D. F., and Schwarte, L. H. Chemical changes in the blood of swine infected with hog cholera. Presented for publication. Jour. Amer. Vet. Med. Assn.
- Hawk, P. B., and Bergeim, O. Practical Physiological Chemistry. Tenth ed. pp. 447-448. 1931.
- Sollmann, T. A manual of pharmacology. Fifth ed. p. 852. 1936.

### OH, ELMER!

It was a mule patient. Elmer Bild was the senior on the case. After treating said mule for a week, Elmer followed his patient to the post mortem lab and ventured the guess that they would find a pretty bad case of emphysema of the uterus. It was a good guess, Elmer, but it happened to be a male mule.