

ABSTRACT OF THESIS

COPPER DEFICIENCY AS A POTENTIAL PRE-DISPOSING FACTOR FOR CHRONIC WASTING DISEASE IN CAPTIVE ROCKY MOUNTAIN ELK (*CERVUS ELAPHUS NELSONI*)

Chronic wasting disease (CWD) is a progressive, fatal, neurological disease of elk, deer, and moose, in which spongiform lesions appear in the neurons of the brain, and animals lose body conformation in the last stages before death. CWD is thought to be caused by a posttranslational, conformational change in the normal cell surface protein PrP^C, where the disease causing isoform, PrP^d, is both heat- and protease-resistant. The normal function of PrP^C is unknown, but studies have shown that it has a high affinity for binding copper. Two differing views exist about the role of copper and PrP^d. One theory suggests that the PrP^C copper-binding may be the trigger for conversion to PrP^d, while the other theory suggests that copper-antagonist cations, such as manganese, could bind in place of copper on PrP^C and cause the transformation into PrP^d. This study derives from the latter theory and looks at levels of trace metals in both brain and liver samples of CWD-positive and CWD-negative farmed elk from Colorado. The hypothesis of this study is that copper deficiency is associated with chronic wasting disease as a potential pre-disposing factor; thus, CWD-positive animals will have lower copper levels than CWD-negative animals.

No significant correlations were found between copper levels in brain and liver or between manganese levels in brain and liver. No significant correlations were found between copper and manganese levels in either brain or liver. For brain copper levels, 75% of the animals sampled were within the normal reference range, whereas 93% of the livers sampled showed that the animals were copper deficient.

Sixty-six per cent of the brain manganese levels were higher than normal, while 39% of the liver manganese levels were normal. Based on application of analysis of variance, the difference in the mean copper levels between chronic wasting disease positive and negative animals was found to be statistically significant in both brain and liver ($p=0.002$ and $p=0.026$, respectively); specifically, CWD-positive animals had lower mean copper levels than CWD-negative animals in both brain and liver (10.6023 ppm and 16.2967 ppm, respectively in brain; 25.1073 ppm and 31.8933 ppm, respectively in liver). Mean liver cobalt levels were higher in CWD-positive animals than in CWD-negative animals (0.1510 ppm and 0.1235 ppm, respectively).

Almost all of the samples analyzed for liver copper levels showed that the elk were in a copper deficient state, whether they were positive or negative for the disease. Manganese showed no differences in the mean levels in brain or liver between CWD-positive and CWD-negative animals. Based on the results of this study, we can conclude that: manganese does not appear to replace copper on PrP^C and there appears to be an association between copper levels and chronic wasting disease; however, it is unclear whether the disease causes copper depletion or if having significantly lower copper levels than other animals pre-disposes an animal to contract CWD.

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