

A Report
on the Proposal 15-78
entitled

"The Influence of Copper Deficiency on the
Incidence of the Rat Tail Syndrome"

Submitted to:

Texas Cattle Feeders Association

by

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on

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Background:

The progress report on the research associated with the rat tail syndrome which was submitted to the Research Committee of the TCFA on December 22, 1976, contained two long term objectives. These objectives were to establish the predisposing factors in the syndrome and investigate the syndrome's pathogenesis.

New observations made in connection with the syndrome on the Hawaiian Islands suggested that the possibility exists that a deficiency of copper may be predisposing to the syndrome by immunosuppression. Based on the long term research objectives together with the Hawaiian findings, the research project was designed to investigate the influence of copper on the animals' ability to resist an infection such as Bovine Papular Stomatitis.

Objectives:

- I. To determine, evaluate and correlate the effect of copper deficiency on the severity and course of a Bovine Papular Stomatitis infection in cattle.
- II. To determine and evaluate the effect of copper deficiency on the cattle's ability to resist infection by monitoring cell and humoral mediated immune system parameters.
- III. To determine and evaluate the copper requirements of Texas High Plains feedlot cattle.

Results:

One hundred head of steer calves were received on 7-15-78 at average pay weight of 553.45 pounds. The steers were randomly allotted to two treatments. One group of cattle (10 head) was fed a finishing diet

containing Cu at 10 ppm. The other group of cattle (90 head) were fed the same diet without additional copper and 20 ppm of molybdenum for 187 days.

I. All the animals examined developed a focal and presumably localized infection following Bovine Papular Stomatitis virus intra lingual inoculation. None of the animals developed the severe BPS infection commonly observed in cattle suffering from the rat tail syndrome.

II. The feeding of a copper deficient diet with molybdenum did not significantly alter the animals' purified circulating lymphocytes response to non-specific mitogens (Con A, PHA, PWM) Tables 1a and 1b.

III. Table 2 illustrates the serum copper levels for this trial. No differences were noted for serum copper levels between treatment or controls. Zinc levels in the serum increased during the first 60 days then dropped off during the 45 days with the experimental being lower than controls (Figure 1).

When the growth performance is considered (Table 3), the cattle receiving the 20 ppm molybdenum gained better and had better feed conversion than the controls. Normally cattle are very susceptible to molybdenum toxicity; however, high sulfate will prevent molybdenosis.

Conclusions:

I. The feeding of a copper deficient diet with molybdenum did not alter the severity or course of a BPS infection in cattle.

II. The feeding of a copper deficient diet with molybdenum did not adjust the cattles' ability to resist infection as judged by monitoring cell and humoral mediated immune system parameters.

III. The rations fed to Texas feedlot cattle apparently have adequate copper available for their type of cattle and circumstances involved.

Comments:

The reason for the negative results may be basically two fold. Firstly, the cattle used in the experiment were of a good "quality" whereas the rat tail syndrome is usually, but not always, associated with poorer quality animals. Secondly, the cattle apparently had adequate liver copper stores as none of the cattle fed the appropriate diet developed hypocupremia. The possibility therefore still exists that a trace element deficiency such as copper may predispose to a BPS infection and the rat tail syndrome.

Table 1a. Mean stimulation indices following lymphocyte transformation in steers fed conventional or copper deficient diets.

	Date														
	7/24/78	8/8/78	8/15/78	8/22/78	9/4/78	9/11/78	9/19/78	9/25/78	10/2/78	10/9/78	10/16/78	10/23/78	10/30/78	11/6/78	11/13/78
Conventional Diet															
Con A	121.9	47.5	59.6	60.6	56.9	41.9	46.2	66.0	39.4	38.7	31.2	41.1	32.4	44.9	40.0
PWM	62.8	37.9	39.9	50.7	46.8	33.3	33.4	38.4	31.1	25.8	25.4	22.3	17.9	24.1	27.7
PHA	22.3	17.8	26.6	28.5	39.5	23.1	30.8	32.7	27.3	17.9	18.8	15.5	14.2	14.4	18.0
Copper Deficient Diet															
Con A	141.4	66.4	79.0	60.8	75.1	50.8	62.8	57.2	48.4	46.6	45.2	33.3	34.3	31.6	59.2
PWM	77.9	47.9	61.1	54.0	68.3	39.7	46.5	48.2	40.4	35.9	37.9	18.3	29.0	9.6	43.2
PHA	30.1	26.4	42.2	41.4	55.1	30.7	43.0	39.0	36.9	26.2	24.9	16.7	21.6	8.9	32.9

Con A = Concanavalin A, PWM = Poke weed mitogen, PHA = Phyto hemogglutinin

Table 1b. Mean counts per minute following lymphocyte transformation in steers fed conventional or a copper deficient diet.

	Date														
	7/24/78	8/8/78	8/15/78	8/22/78	9/4/78	9/11/78	9/19/78	9/25/78	10/2/78	10/9/78	10/16/78	10/23/78	10/30/78	11/6/78	11/13/78
Conventional Diet															
Con A	138,795	201,436	207,223	207,943	205,197	211,094	234,577	164,295	173,895	140,390	180,911	129,014	122,427	101,852	123,993
PWM	132,147	164,574	154,346	168,156	175,176	165,300	185,157	127,616	131,660	96,259	147,225	79,096	77,456	64,032	87,933
PHA	45,751	88,366	108,628	111,688	146,824	147,480	162,724	101,133	115,417	59,011	113,637	71,761	64,514	44,354	67,889
Control	3,278	6,493	5,051	6,313	7,006	8,070	6,505	4,107	5,742	4,154	8,309	4,997	5,707	3,488	3,913
Copper Deficient Diet															
Con A	188,771	192,416	221,147	205,481	217,466	206,277	234,722	206,949	185,384	112,122	193,746	110,454	149,832	60,638	169,233
PWM	128,382	142,919	176,630	181,468	199,397	169,573	191,057	179,760	161,463	83,533	160,043	63,082	129,488	19,868	124,933
PHA	52,432	87,551	127,235	141,749	166,028	130,174	167,115	148,204	150,414	70,818	123,533	67,853	106,623	23,141	97,781
Control	2,197	4,370	3,374	4,218	4,042	5,071	5,587	5,193	5,325	2,888	7,162	3,889	5,895	2,620	3,826

Con A = Concanavalin A, PWM = Poke weed mitogen, PHA = Phyto hemogglutinin

Table 2. Serum copper values (ppm) in steers fed conventional and copper deficient diets.

	Date of Sampling													
	7/24/78	8/4/78	8/7/78	8/9/78	8/11/78	8/14/78	8/22/78	9/4/78	9/25/78	10/9/78	10/16/78	10/23/78	11/6/78	11/13/78
Conventional Diet														
Animal #														
5	0.52	0.89	1.12	0.24	1.05	0.85	0.46	0.83	0.75	0.95	1.15	0.82	0.69	0.62
8	0.92	0.89	1.12	0.42	0.96	1.46	0.65	0.65	0.69	0.75	0.75	0.62	0.56	0.56
21	1.00	1.08	1.02	0.24	0.51	1.38	0.83	1.02	1.08	0.82	1.08	0.49	0.69	0.75
31	1.12	0.89	1.12	0.78	0.78	1.73	0.74	0.65	0.82	0.95	0.75	0.69	0.62	0.89
36	1.21	1.08	1.12	0.42	0.42	1.90	0.83	0.74	0.82	0.69	0.82	0.69	0.75	0.69
52	1.31	1.28	0.71	0.78	0.42	1.38	0.65	1.39	1.22	1.15	0.82	0.89	1.15	0.82
57	1.12	1.08	2.03	0.78	0.42	2.08	1.11	0.46	0.82	1.28	1.15	0.75	0.89	0.85
84	1.12	1.67	1.32	0.78	0.96	1.55	0.83	0.65	0.82	0.82	0.95	0.69	0.82	0.69
86	0.72	0.89	1.32	0.24	0.24	1.20	1.11	0.65	0.62	0.89	0.89	0.49	0.75	0.69
97	0.72	0.49	1.32	0.60	0.24	1.20	1.02	0.83	0.89	0.89	0.95	0.75	0.75	0.69
Mean	0.97	1.02	1.22	0.52	0.60	1.47	0.82	0.79	0.85	0.91	0.93	0.68	0.76	0.72
Copper Deficient Diet														
Animal #														
18	0.82	1.08	1.22	0.24	0.96	1.38	0.74	1.02	0.56	0.89	0.89	0.75	0.75	0.75
32	0.92	1.28	1.52	0.33	0.42	1.20	1.02	0.83	0.69	0.62	0.62	0.49	0.56	0.62
43	0.72	1.43	1.72	0.60	0.60	1.38	1.11	0.65	0.75	0.95	0.89	0.62	0.82	0.62
44	1.02	1.18	1.72	0.78	0.60	1.73	0.93	0.27	0.89	0.75	0.95	0.82	0.95	0.75
47	0.92	1.08	1.32	0.60	0.78	1.46	1.02	0.83	1.35	1.35	1.08	0.95	1.02	0.69
65	0.92	0.89	1.52	0.42	0.60	1.55	0.83	1.39	0.82	0.82	0.82	0.56	0.95	0.89
68	0.92	1.28	1.52	0.60	0.78	1.73	1.02	1.02	0.95	0.69	0.82	0.62	0.75	0.69
91	0.92	1.08	1.12	0.42	0.42	1.73	0.93	0.37	0.95	0.49	1.02	0.75	0.75	0.69
96	0.62	0.79	1.72	0.78	0.60	1.73	0.83	1.11	0.82	0.95	0.82	0.75	0.62	0.69
100	0.92	1.08	1.32	0.78	0.87	1.55	0.46	1.11	1.15	0.82	0.82	0.69	0.95	1.08
Mean	0.87	1.107	1.47	0.55	0.663	1.54	0.89	0.86	0.89	0.83	0.87	0.70	0.81	0.74

Table 3. Performance Data Rat Tail Study

Item	Control	High Molybdenum	
Number of Animals	10	10	80
Average beginning weight (lb.)	522.6	517.2	521.4
Average weight at 187 days	931.4	950.0	959.8
Average daily gain	2.19	2.31	2.34
Average daily feed consumption lb/day	19.98	18.78	19.71
Feed per gain	9.12	8.12	8.42

Figure 1

