Application of Neutron Activation Analysis of Trace Element in Swine Serum

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Porcine blood analysis conducted to investigate the behavior of trace elements in this species of domestic animals have revealed that the plasma electrolyte levels and acid-base balance show significant changes with the condition under which the animals are places.
The data obtained indicate a possible participation of trace elements in these changes associated with physiological exercises, composition of feed, life environment , gestation, parturition or stress. Many studies have been reported by H.J.M.Bowen[1], D.Behne[2] and E.R.Miller[3] concerning analysis of trace elements in biological materials.
The present study was undertaken to investigate the interrelationship between trace elements in porcine tissues and other factors.

Materials and Methods

a) Analysis of blood Acid- Base Balance:
Heparinized blood samples drawn anaerobically from pigs via the caudal artery were analyzed on an ABL-1 blood gas autoanalyzer. After correction for various factors, the data were assessed with reference to the Siggaard- Andersen Acid-Base Chart.

b) Diagnosis of porcine stress syndrom(PSS)
Eight- week old piglets were examined for PSS by both the halothane sensitivity test, using 6% Halothane gas in oxygen adminstered by means of a gas tester for a maximum of 3 minutes, and the determination of serum creatine phosphokinase (CPK) activity (Antonik method).

c) Neutron activation analysis
Porcine serum specimens were lyophilized over 24 hours and, after finely pulverizing, placed in quantitis of 0.1 to 0.3 g in tightly capped bottles. These freeze- dried serum samples were then subjected to activation in a TRIGA Mark II nuclear reactor at the Nuclear Power Laboratory of RIKYO(St. Paul's) University.
For short- time irradiation, the specimenwas exposed to a thermal neutron flux(1.2×10^{12} $n \cdot cm^{-2} \cdot sec^{-1}$) for 5 minutes via an F_{24} ring port, then allowed to cool for 5 minutes, and assayed over 300 seconds with a Ge(Li) semiconductor(4K) pulse height analyzer (PHA).
Long- time irradiation was carried out with the specimen rack by a thermal neutron flux(5×10^{12} $n \cdot cm^{-2} \cdot sec^{-1}$) for 6 hours, followed by cooling for 2 weeks and subsequent measurement with a Ge(Li) 4K -PHA over 1 hour.

d) Standard samples: National Bureau Standard(office of Standard Materials)

e) The study encompassed the following tests:

1) relationship between PSS pigs and stress-Free pigs;

2) comparison of mineral- treated groups with an untreated control group;

3) Interrelation of plasma trace elements and Acid-Base Balance before and after delivery.

Results

a) The radiochemical analysis were made for the short life and long life nuclides.

	NBS(ppm)		Mineral Substance(ppm)	
	Bovine L,	Orchard L,	Chemi-Compound,	Hair,
Mg	700	694	52377	368.60
Cu	190	14.5	865.4	21.83
V	.14	.58	1.4	1.43
Cl	3000	740	-	47.90
Al	42	420	151.9	398.80
Mn	10.3	90	5064.2	26.33
Na	2230	83	409.7	2178.13
Ca	123	22100	10615.2	2119.23
S	1220	1900	-	9679.70
Se	1.1	.08	1.95	.43
Cr	.02	2.60	-	.36
Sb	.03	2.90	-	.03
Cs	.05	.04	-	.02
Rb	18.30	12.00	-	.44
Fe	270	300	2500.7	507.36
Zn	130	25	15965.7	165.88
Co	.2	.2	11.0	.38

	PSS(n=29)		Delivery(n=8)	
	Positive-	Free pigs	Before-	After
Mg	117.88	109.26	204.75	111.80
Cu	3.22	5.64	3.58	4.48
V	0.50	0.19	-	-
Cl	3308.11	3341.47	3510.70	3535.0
Al	-	16.65	-	-
Mn	1.85	1.09	1.28	0.66
Na	3547.30	3437.31	3407.75	3543.75
Ca	123.82	96.87	95.40	107.36
S	548.3	584.56	632.42	628.34
Se	1.17	0.47	0.87	0.92
Cr	-	0.06	-	-
Sb	0.01	0.02	0.01	0.01
Cs	0.001	0.031	0.003	-
Rb	0.139	* 0.258	0.240	0.289
Fe	2.433	3.077	2.919	10.998
Zn	0.748	0.830	0.726	1.03
Co	0.003	0.012	0.004	0.003

* Significantly Difference $P<.05$

0.5% Mineral(n=3),Mineral Substance(n=10)

	Add for swine foods	Addition-	non Add
Mg	2461.7	24.66	58.55
Cu	115.7	4.72	3.28
V	0.6	-	-
Cl	1798.6	3389.4	**3066.6
Al	83.9	-	-
Mn	84.7	0.933	0.43
Na	437.8	3556.60	3140.40
Ca	10598.5	87.07	104.48
S	430.1	717.47	521.96
Se	-	-	1.074
Cr	-	0.477	-
Sb	-	0.001	-
Cs	0.008	-	0.002
Rb	7.178	0.227	0.152
Fe	503.31	1.415	3.514
Zn	193.20	1.375	1.018
Co	0.48	0.005	0.006

** Significantly Difference $P<.01$

Acid-Base Balance

	Delivery(n=10)		Acupuncture(n=5)	
	Before	After	Before	After
Hb	17.7	17.4	19.2	18.3
pH	7.337	7.313	7.331	7.368
Pco2	40.4	47.35	39.3	39.0
Po2	89.7	88.7	103.6	100.9
HCO3	21.0	23.0	20.3	21.6
Tco2	21.9	24.2	21.4	22.7
BE	-3.4	-2.5	-4.4 ***	-2.5
SBE	-3.6	-2.1	-4.4	-2.7
SAT%	93.3	92.6	95.6	95.9
SBC	21.4	22.1	20.7	22.2

***Significantly Difference $P<.001$

Reference

1) H.J.M. Bowen., " The Elements in Biochemistry " Academic Press, London (1976). 2) D.Behne., "Application of Neutron Activation Analysis in the Investigation of Trace element Metabolism" J. Radio chem (1976).
3) E.R. Miller., " Amino- Acid and Mineral Balance"(1980)