Brief Research Report

THE DETERMINATION OF TRACE NUTRIENT METALS IN CATTLE FEEDS*

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Trace metals are of great importance in animal nutrition. The dietary elements essential for animals include Cr, Mn, Fe, Co, Cu, Zn and Mo[1]. Most of the trace nutrient elements needed by livestock are supplied through the daily intake of animal feed. According to the guideline requirements specified by the Agricultural Research Council[2], cattle diets are considered adequate if they contain at least 10 mgCu/kg, 50 mgZn/kg and 40 mgMn/kg. Toxicity symptoms are manifested when the concentration of Cu and Zn in the feed exceeds 115mg and 5000mg/kg[3] respectively.

The choice of a suitable digestion technique in multi-element analysis is generally based on the need for a method that is adequate for the determination of the required elements. Previous work[4] has demonstrated that the nitric-perchloric acid mixture is relatively trouble-free and particularly suitable for recovery of trace elements. As reported by other workers[5], flame (FAAS) may be employed for the determination of metals including Cu, Zn and Mn when their concentration is high enough in preference to graphite furnace atomic absorption spectrometry (GFAAS) since it is more rapid and less prone to interferences. AAS techniques typically involve the use of a calibration procedure for standardisation. The use of standard additions or normal concentration calibration depends on the complexity and nature of the sample matrix.

The objective of the present study was the establishment of a model analytical method for determining the trace nutrient elements Cu, Mn and Zn in cattle feeds and mineral mix supplements. The selection of these metals was instigated by their nutritional importance, their adverse effects at deficient and toxic levels, as well as the intriguing methods of analyses available for trace amounts. The determination of Cu, Zn and Mn was carried out on samples of compound pellet cattle feeds (F), and mineral-mix supplements of two types: dairy (D) and calf-starter (CLF-ST). The supplements contain minerals and trace metals in relatively high concentrations. The specified composition[6] of the feeds was 15 – 30 mgCu/kg, 50 – 100 mgZn/kg and 60 – 100 mgMn/kg. The mineral-mix supplements were specified[6] to contain 1000 – 1500 mgCu/kg, 3000 – 5000mgZn/kg and 3000 – 6000mgMn/kg.

Sample group A was digested by the Kjeldahl method, tested for Cu and Mn by GFAAS, and for Zn by FAAS. Group B was digested by the digestion tube block method, and tested for Cu, Mn and Zn using the same techniques as in group A. Group C was digested by the digestion tube block, followed by determination of the metals by FAAS. A control sample, consisting of maize and barley, (M + B), was included with sample groups B and C, and spiked with known quantities of Cu, Zn and Mn stock solutions to determine the percentage recovery following sample treatment. A standard reference material (bovine liver) was also used to evaluate the accuracy of the technique.

The results obtained in this investigation showed that concentration of trace nutrient metals in cattle feeds was 25.1±2.2mgCu/kg, 103.9±1.8mgMn/kg and 76.5±5.3mgZn/kg. The mineral mix supplements were found to have trace metals concentrations of 1191±106mgCu/kg, 4659±180 mgMn/kg, and 3300±190mgZn/kg. All results compared well with specified ranges. The comparison of digestion method showed that the digestion tube block method was more precise and more adequate for complete dissolution of the samples than the Kjeldahl digestion. The digestion tube

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block method was a relatively faster technique of sample preparation, enabling the simultaneous digestion of up to 40 samples at a time and accurate temperature control. In all sample groups, the % recovery was satisfactory and higher than 94 %.

The determination of Cu and Mn in feeds and supplements by FAAS gave results that were more accurate and precise. Compared to GFAAS, FAAS also offered the possibility of working in higher concentration ranges without the need for serial dilutions. The method of extended linear range was found to be very convenient for the determination of the metals in mineral supplements at a higher concentration range. The results of this study showed that there was no significant difference between the method of normal calibration and the method of standard additions. Based on the results obtained, the recommended procedure for the routine determination of Cu, Mn and Zn in compound dairy feeds and supplements is tube digestion followed by FAAS using the normal calibration technique.

References:

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