

Fate of Copper and Zinc in Cattle Manure

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Abstract—In view of optimizing the yield of cattle in terms of meat, milk and even fertility, farmers are incorporating in the cattle's ratio excessive supplies of Copper and Zinc. These elements are not well assimilated by the cow and therefore, the majority of these elements will be present in the dung which will form the manure. Heavy metals are potentially toxic to humans and the environment. However, metal toxicity depends on chemical associations in soils. For this reason, determining the chemical form of a metal in soils is important to evaluate its mobility and bioavailability. Therefore, sequential extraction was used to fractionate copper and zinc. This research aimed at evaluating the influence of the application of enriched cattle manure on soils by applying 0.15 g of dried cattle manure on 20 g of an agricultural soil in the region of Zahle, Lebanon. Knowing that the mineralisation of the manure incorporated in the soil released an important amount of trace metals, a chemical approach was developed to follow the kinetic of carbon mineralization. The results showed the presence of the metals in the residual fraction to be dominant, followed by the fraction bound to organic matter in the copper's case and that bound to oxides in the zinc's case. Moreover, the addition of manure has a significant effect on the accumulation of heavy metals in the soil since a significant increase in the concentration of these elements in the soil was noted after the manure application.

Keywords—Copper, Fractionation, Manure, Mineralization, Zinc

I. INTRODUCTION

DURING the last century, the agricultural sector underwent significant changes mainly seeking higher income. In the field of animal husbandry, modernization and intensification led to radical changes in the structure and techniques applied. One of the major changes concerned animal nutrition that is calculated nowadays according to the animals' growth stage and tailored to their needs [1]. Minerals present in the animal ration plays a significant role even if they are found in trace quantities [2]. The essential role of trace metal elements (TME) is due to the fact that they are part of the composition of many enzymes, hormones and vitamins. However, these elements are not easily assimilated by animals [3]. Therefore, there is a need to administer them in excess in the diet of the animals in order to avoid any imbalance. These excesses are eliminated mainly in the faeces but also in smaller amounts in the urine or milk [4]. Cattle's faeces is the most used fertiliser in the world [2], hence, faeces containing significant amounts of the Cu and Zn are spread on soils and can have an important impact on the environment. Nowadays soil pollution by TME is a major problems of soil and water pollution [5].

The first purpose of the work presented here is to quantify the contributions of Cu and Zn and identify their forms in the diet of a dairy herd. The second purpose is to quantify the concentrations and define the forms of these metals in faeces and manure and finally to study the availability of these elements in the soil through a chemical fractionation.

II. MATERIALS AND METHODS

A. Site Description and Sampling

Dairy Khoury is one of the oldest dairy companies in Lebanon where it roots stretch back to the 1940's. The Farm, located in Bekaa Valley more specifically in Zahlah contains 2000 cattle heads spread over 85000 m² of land. Fig. 1 locates the region of Zahlah within the map of Lebanon.



Fig. 1 Geographical map of Lebanon

A total of 17 feed samples, 4 soil samples and 6 manure samples were taken from the farm.

Each cow receives approximately 30 kg of feed per day. Table I shows the complete diet of a cow per day.

