



## **Investigation of Selected Heavy Metals Concentration in Animal Feeds in United Arab Emirates**

**Nizar A. Al Haj Ali<sup>1</sup>, Ideisan I. Abu-Abdoun<sup>2\*</sup>, Abdulla S. Janaan<sup>1</sup>,  
Jumana H. Hassan<sup>1</sup> and Maha A. Al Jeaidi<sup>1</sup>**

<sup>1</sup>*Department of National Laboratories, Ministry of Climate Change and Environment, Sharjah, United Arab Emirates.*

<sup>2</sup>*Department of Chemistry, University of Sharjah, Sharjah, United Arab Emirates.*

### **Authors' contributions**

*This work was carried out in collaboration among all authors. Author NAAHA carried out the experimental part and performed the statistical analysis. Author IIAA contribute to data analysis designed the study and wrote the first draft of the manuscript. Author ASJ contribute to data management and analyses of this study. Author JHH managed the literature searches. Author MAAJ contribute to the experimental work and design. All authors read and approved the final manuscript.*

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### **ABSTRACT**

The animal feed materials contaminated with heavy metals, which usually comes from soils to plant, atmosphere and contaminated seawater. Various animal feed and feed supplements imported by local agents at United Arab Emirates (UAE) subjected for analysis using ICP- MS technique the concentration of the four selected heavy metals, namely; Arsenic (As), Lead (Pb), Cadmium (Cd), and mercury (Hg), found to be within the national standard.

*Keywords: Heavy metals concentration; animal feed; ICP-MS analysis.*

\*Corresponding author: E-mail: [abuabdoun@sharjah.ac.ae](mailto:abuabdoun@sharjah.ac.ae);

## 1. INTRODUCTION

Environmental contamination is a serious problem to animals as well to human health, these trace metals found in soil, food, water and livestock organs, tissues and in livestock products are of main concern [1], several studies shows risk associated due to heavy metals in animal feed [2]. In recent years the modern industrialization and new agriculture techniques were main cause of environmental contamination [3].

The cattle feed products contain heavy metals, such as cadmium, lead, arsenic, mercury and some metalloids are special concern because these trace metals are quickly transferred through food chain and cause interruption to important biological function [4,5].

The main causes of environmental pollution were due to modern agricultural and industrial activities harms to ecological system [1,5].

Possible entry of heavy metals in soils include animal manures sewage sludge inorganic fertilizers and atmospheric deposition [6] transfer of trace metals from the agricultural soils and farming industrial environment, use of huge amount precipitation and gas absorption methods [7]. These toxic metals from various sources gradually taken up by plants and transferred to food chain, and accumulation of heavy metals in plants depends on nature of soil, type of plants and bioavailability of metals to uptake in soil - system [8].

Animal farms established in china produce annually around  $32 \times 10^9$  t of animal manure [9], which is used in agriculture soils to increase the fertility and organic stock concentration, which leads to environmental problems, like contamination of surface water with phosphate and nitrate.

The spreading of content of heavy metals in the atmosphere will transfer through food chain, and the trace metals have high density related to water which affects available in different forms (Cr, Hg Pb, Cd), there heavier masses, toxic nature were concerns to heavy metals are harmful even at low amount [10-13]. Some trace elements are essential for plants, animals and humans. Such as Co, Cr, Fe, Cu were usually low concentration and called micronutrients, found in various metal concentration (ppm or ppb) [14].

The important metals typically found in animal food as nutrients to improve the animal production (European Union (EU) Reg. 1881/2006). Exposure to higher concentration leads to cellular disorder and source of contamination [15]. Other metals such as Cd, Pb, As, Hg were non-essential and toxicants. However, these heavy metals harm to humans and animal health, due to its toxic nature, they can damage the organs, even at lower concentration and thus are important to keep under control.

The content of heavy metals depends on many factors such as soil fertility, nature of climate and area of the location. Usually soils contain different heavy metals and their concentration can be increased by adding pesticides or fertilizers, these can be eliminated through animal urination [16].

Our present study related to the investigation of concentration of selected heavy metals in different animal feed brought from many countries, usually used in UAE. The content of As, Pb, Cd and Hg of animal feed were analyzed using ICP- MS method.

## 2. MATERIALS AND METHODS

Different varieties of animal feed samples imported from different countries ports point for analysis. Animal feed supplement, fish feed (pellets), horse feed, wheat bran, and poultry and feed additive - mixed. The main aim of the study is focused on the heavy metal content in animal feed in UAE.

All the samples in this study were kept in airtight polyethylene bags and stored at 4°C until the experimental work is completed. The wet digestion technique was used to measure the concentration of four heavy metals. 1.0 gram of sample was transfer to keddahs flask and 3:1 ratio of HCl and HNO<sub>3</sub> was added to the sample for digestion. The digested sample, heated to 40°C about half hour and its temperature increased up to 100°C, until a clear solution and fumes were vanished, this shows the completion of digestion [17].

Distilled water was added to the solution and the Whatman filter paper used for filtration. The polyethylene bottles filled with digested solution and the heavy metal analysis were carried out using ICP- MS method.

### 3. RESULTS AND DISCUSSION

The heavy metal content of different animal feed samples imported in UAE from different countries are tabulated in Table 1. The four heavy metals (As, Cd, Hg, Pb) in concern to the Ministry of Climate Change and Environment (MOCCA), at United Arab Emirates (UAE) were analyzed using ICP- MS technique.

While the national standard in UAE for the maximum content of these metals in animals and fish feeds is as follows: Arsenic (As) 2 ppm in feed materials and (4) in complementary feeding stuffs, Cadmium (Cd) 1 ppm and 0.5 in complementary feeding stuffs, Mercury (Hg) 0.1 ppm and 0.2 in complementary feeding stuffs, Lead (Pb) 10ppm in both feed materials and complementary feeding stuffs. In this study we would like to report the mean values of the concentration of these metals is found as follows: Arsenic (As) 0.47 ppm, Cadmium (Cd) 0.08 ppm, Mercury (Hg) 0.09 ppm, Lead (Pb) 2.02 ppm.

The concentration of heavy metals shown below in Table 1 is the national standard, except for Mercury (Hg) concentration two samples of fish feed and feed supplement were found to be (0.26), (0.52) and (0.14).

The content of As in animal feed supplement (Gastroguts) is higher, the amount of Cd is higher in horse feed, and camel racing diet - mixed feed, the content of Hg was higher in Gastroguts used as animal feed supplement and concentration of Pb was higher in Animal feed

supplement and fish feeds, were compared to other samples used for our analysis, as shown the toxic metal concentrations of animal feed and supplements of our study compared with other animal feed and manures of various sources.

#### 3.1 Arsenic (As)

The more poisonous organ arsenic found in animal feed and livestock's due to modern forming activities. Usually As in present in liquids sprayers to control ectoparasites of animals and animal feed. Its chronic toxicity results in weight loss, mouth infection, decrease the milk yield. The acute toxicity effects were abdominal pain electrocardiogram [18].

The content of Arsenic (As) in different animal feed and its supplements ranged from 0.06-2.63 ppm. While the Arsenic values were lower. Like fish feed were 7 ppm, 6.9 ppm, horse feed 6.7-8.7 ppm and mineral feed as 12 ppm. Dairy cattle field, animal manure of as 3.03 ppm and 9.01 ppm respectively contain high amount of Arsenic [19].

#### 3.2 Cadmium (Cd)

Cadmium is toxic to both humans and animals. It accumulates in liver and kidney for long time exposure [20]. Usually Cd is not added in animal feed, but it is present in mineral supplement like zinc sulfate, phosphate and zinc oxide like impurity's and enters animal forms causes contamination [21].

**Table 1. Heavy metal concentration of animals and fish feeds**

Sample type	Physical texture	Ppm conc.			
		As (ppm)	Cd (ppm)	Hg (ppm)	Pb (ppm)
Fish feed	Sinking pellets	1.05	0.20	0.02	0.14
Fish feed	Small pellets	0.61	0.07	0.26	3.20
Fish feed	Small pellets	1.25	0.23	0.14	0.27
Animal feed supplement	Pellets	0.27	0.08	0.01	0.41
Animal feed supplement (Gastroguts)	Crumbles	2.63	0.05	0.52	8.35
Wheat bran	Light fluffy Texture	0.07	0.08	0.05	0.17
Poultry feed	Crumbles	0.06	0.04	0.02	2.17
Feed additive-sugar beet pellet	Pellets	0.06	0.04	0.00	0.87
Feed additive- mixed hay	Grassy	0.09	0.02	0.00	0.23
Feed additive-growth rabbit feed	Chunk	0.12	0.07	0.00	0.46
Horse feed	Mixed grain-chunks	0.20	0.10	0.06	0.23
Horse feed	Pellets	0.10	0.06	0.02	0.23
Horse feed	Mixed grain-chunks	0.25	0.03	0.06	0.34
Horse feed	Mixed grain-chunks	0.21	0.06	0.07	0.39
Camel racing diet -mixed feed	Pellets	0.17	0.15	0.01	0.58

**Table 2. Heavy metal concentration of animal feed from different sources**

Type of animal feeds	AS(ppm)	Cd(ppm)	Hg(ppm)	Pb (ppm)	Reference
Dairy cattle feed	1.07	0.51		2.74	24
Beef cattle feed	0.49	0.27		<1.00	24
Beef cattle feed	0.33	0.22		1.53	24
Poultry cattle	0.23	0.15		<1.00	24
Animal manures	3.43	0.53		5.67	24
Fish feed	7				21
Fish feed	6.9				21
Horse	8.7				21
Horse			0.344		21
Dairy cattle feed		4.44			21
Fish shrimp			0.087-0.012		21

The amount of Cd in our present study ranged from 0.02-0.20 ppm. The values are low compared to other samples, such as dairy cattle fields, animal manures and poultry as 1.79 ppm, 1.06 ppm and 0.19 ppm respectively [22]. Whereas in certain countries from year between 2001- 2013 the Cd levels in dairy cattle feed, beef cattle feed was 3.77ppm and 5.1 ppm respectively [19].

### 3.3 Mercury (Hg)

Mercury is more toxic even at low content. The main source of mercury pollution is due to sewage water and waste from industries. It is hazards to humans and as well as animals, the toxicity in animals leads to visual deviation and decrease of awareness. The Hg contents in fish is more than 0.4ppm which is harmful and may cause health problems to humans, on the other side; animal cattle may consume more amount of Hg which could lead to disorders such as visual, neuropathy and gastrointestinal through the food chain [23].

The quantity of Hg ranged from 0-0.52 ppm. Mercury concentration of present study shows little higher when compared to other samples in poultry farms as 0.344 ppm [19].

### 3.4 Lead (Pb)

The main source of lead contamination is due to industrial wastes, which may spread through soil, water and food. Lead poisoning widely found in animals, these led to more attention on animal health and environment. It deposited in bone, kidney and other tissues. Lead ingestion increase the lead levels in blood and causes blood lead burden [24].

The lead values ranged from 0.14-8.35 ppm. The high levels of Pb were reported in the current study. In which Animal feed supplement (crumbles), and fish feed contains significantly higher amount of Pb as 8.32 ppm, 3.20 ppm and 4.11 ppm respectively, when these results were compared to others.

Some samples shows that higher content of Hg was present in animal manure as 7.07 ppm, 3.62 ppm and 8.37 ppm respectively whereas horse feed contain significantly high amount of Hg as 52 ppm [22].

The heavy metal concentration of different animal feed and supplements analyzed in this work. Metals concentration of As, Cd and Hg were low compared to other animal food products of various sources, the content of Pb is a little higher in animal feed supplement and fish feed. These significant results shows that the animal feed products used in UAE contain normal levels of heavy metals. However, monitoring of the heavy metal's concentration carried out on random samples to avoid health risk problems associated to animals as well as humans health.

## 4. CONCLUSION

Investigation of the concentration of four heavy metals namely; Arsenic (As), Lead (Pb), Cadmium (Cd), and Mercury (Hg), in animals and fish feeds imported in UAE during the period of 2018 from different countries was measured using ICP- MS technique.

According to the national standard of UAE for heavy metals contents in animals feed three samples of mercury in fish feeds and complementary feed showed some variation.

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## COMPETING INTERESTS

Authors have declared that no competing interests exist.

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