International Research Journal of Biological Sciences _____ ISSN 2278-3202
Vol. **8(6),** 23-27, June **(2019)** *Int. Res. J. Biological Sci.*

Determination of heavy metals in cow (*Bos indicus*) dung collected from Hanumangarh district, Rajasthan, India

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Available online at: www.isca.in, www.isca.me
Received 28th January 2019, revised 25th May 2019, accepted 2nd June 2019

Abstract

Rapid development of heavy metal research has not been a new area of science. Heavy metal content in cow dung may be due to ingestion of contaminated fodder, water etc. It may affect the quality of the soil, contaminate crops and pose health risks to both animals and people. Cow dung, a type of manure, is a cheap and easily available resource for agriculture. The present study emphasized on quantitative analysis of heavy metals in 120 cow dung samples collected from different locations in Hanumangarh district, Rajasthan. The quantitative assessment of nine heavy metals (Zn, Pb, Cu, Cd, Fe, Ni, Cr, Mn and Co) using Atomic Absorption spectrophotometer was done under this investigation. The results showed that the average levels of contamination of heavy metals was found in the order of the Iron>Copper>Manganese>Zinc>Chromium> Lead>Nickel>Cobalt>Cadmium.

Keywords: Cow dung, heavy metals, agriculture, crops and atomic absorption spectrophotometer.

Introduction

India is the second leading rural country on the earth with farming area of 179.9million hectares and it adds to 61% of aggregate land[1]. A major population of India depends on farming for production and livelihood. The aggregate livestock population comprising of Cow, Buffalo, Sheep and Goat etc. in the nation was 512.05million. The quantity of ruminants has expanded from 77.04million to 80.50million, demonstrating a development of 4.51% in Livestock census[2].

India being the world's biggest manufacturer of dairy products by volume, representing holds about 13% of world's aggregate milk production and also accounts the world's largest dairy group. The white revaluation in India began in 1970 with the arranging of small holder dairy cultivates under a three level co-operative system for sorted out creation, obtainment, preparing and marketing of milk[3]. About 70% population of India lives in rural area[4], where cow (*Bos Indicus*) is the most common domestic animals and it generates 9-15kg excreta/day[5-6].

Dung of cattle have been utilized as manure and it can add organic matter to the soil, enhance water holding limit, enhance soil tilth, increment crop yield and enhance soil productivity[7-8]. Cattle dung can be unambiguous material for study of heavy metal contamination as because it may contain residue of devoured sustenance material being discharged by these herbivorous bovine animals. The domesticated animals industry produces colossal amount of fertilizers which contain critical nutrients, organics, heavy metals and pathogens[9-11]. The application of pesticides in agriculture has boost up the pollution level of heavy metals in the significant amount[12-14]. The presence of inorganic pollutants for example metal particles in the ecosystem causes major environmental issues. India is second biggest manufacturer of pesticides in asia with yearly generation of Ninety thousands tons of which 2-3% is used and the rest stay in soil causing natural issues[15-16].

Study area: Hanumangarh District situated in the northern most part of Rajasthan State. It was carved out of Sri Ganganagar District in 1994. Geographically, the district is located at 29°35'N Latitude and 74°20'E Longitude. It is located in Thar Desert region with arid and dry climate, scanty rainfall, high infiltration and low water bearing capacity of soils with dominance of sand dunes. There are no any natural forests present in Hanumangarh. The advent of canal water however slowly, but considerably, changed the landscape.

Materials and methods

Collection of samples: The samples of cow dung were collected from selected locations in the study area during each season (2016-17) for assessment of heavy metals (Figure-1). Due to availability of Indira Gandhi Canal water for irrigation, the area is extensively explored for agricultural activities and enhanced dairy industry in the region.

The samples were collected from various locations and kept in polyethylene bags carried to the lab for further analysis. The samples were then kept for drying in lab for 7 days. Collected samples were finely powdered utilizing pestle and mortar. The 100 cm^3 of the air dried and sieved sample was weighed by weighing balance and dried in hot air oven at 110°C for one hour until the point when a steady mass got[17].

Sample treatment: 0.5gm of cow dung samples were weighed and taken in the conical flask. Con. HNO_3: $HClO_4$ (4:1) solution was added to each sample. Samples were kept in water bath until when the point when the samples turned out to be clear, 3-4 drops of Hydrogen peroxide (30%) added for neutralizing the fat content. Each sample was then diluted with 10 ml after cooling and transferred disinfected glass vial & kept at room temperature before examination[18].

Analytic determination: Concentrations of different heavy metals were determined using Atomic Absorption Spectrophotometer ECL-AAS-4141[19].

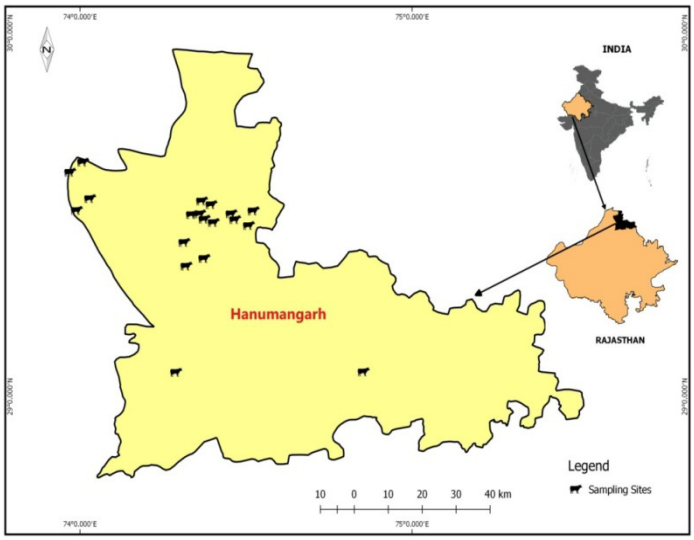

Figure-1: Location of Sampling Sites in Hanumangarh.

Results and discussion

The level of various heavy metals like Zn, Pb, Cu, Cd, Fe, Ni, Cr, Mn and Co etc. in minute quality in cow dung is a natural phenomenon but the excessive amount of such contamination are an indicator of pollution in that particular region. The contamination of water, soil, crops etc by heavy metals based pesticides, fertilizers and other agrochemicals are common scenario in study area. To access the level of contamination in food chain, the excretory material of herbivores may play a significant role. Therefore, cow dung was selected for present study to determine level of heavy metals in it. The selection of cow dung was based on its population and availability among all herbivores in the region. It is important to make clear analysis of the concentration level of heavy metals in cow dung. Total 120 samples of dung were tested for the present study. The average contaminated levels of the heavy metal (ppm) in cow dung during were assessed for year 2016-17.

The seasonal variations of in the heavy metal contamination in cow dung samples are summarized in Table-1. It was noticed that the average level of Zn was found highest in samples collected during winter season (0.350ppm) followed by rainy season (0.288ppm) and summer season (0.175ppm). Zn is an essential element for growth of plants to certain level. However, accumulation due to mobile nature, Zn might be translocated to animals through grazing, which in turn reflected on elimination through cow dung[17]. It was noticed that the contamination level of Pb was found in the order of winter samples (0.388ppm) > rainy (0.175ppm) > summer (0.113ppm). The results of the present investigation are significantly different from the findings in which it is reported that the Pb concentrations in sediments of Niger delta, analyzed during dry season ranged from 13.67 to 18.11ppm with mean levels of 15.75±1.49ppm and 14.92 to 19.08ppm with mean Pb concentrations of 16.96±1.45ppm during the wet season for same study area in Nigeria[20]. Similarly, the findings of the present study are negatively correlated with the results assessed the Pb concentrations in the sediments of Bonny River System, Niger Delta, Nigeria. They found that the Pb level was higher in the wet season (0.003-0.027ppm) than dry season (0.01ppm)[21]. However, the results of the present study are in linearity with the outcomes of the study carried out on lead contamination in buffaloes in Cooum river belt region of Tiruchirapalli, India. The study reveled that the accumulation of Pb in buffalo dung was high, which might be due to ingestion of Pb contaminated fodder[22]. The results of present study revealed that Cu concentration was higher in summer (0.550ppm) as compared in the samples collected during winter (0.077ppm) rainy (0.070ppm) seasons. However, the findings of the present study are not supported by the results obtained in similar study for assessing the level of heavy metal in Kucuk Menderes river of Turkey. The author reported that the level of copper contamination in surface water was found constant for all three seasons during the study period. Cu is one of the major components of pesticides, pigments and coloring agents. When such compounds containing Cu are used, they may absorbed by soil, plant and simultaneously consumed by grazing cattle, could be the possible reason for higher concentration of Cu eliminated by cow dung[23].

The level of Cd contamination in cow dung was also assessed in the study and it was reported in all the samples collected during different seasons. The contamination level Cd was found almost constant during all seasons and its average values were 0.006ppm in winter, 0.005ppm in rainy season while it was found 0.004ppm in samples collected in summer season. The results of the present research showed that the Cd level is very low in cow dung as compared to the surface sediment samples were analyzed. They found that the mean concentration of Cd in was 0.48±0.75ppm obtained for dry season and 0.46±0.741ppm during wet season around major tributaries in Ibeno coastal Area of Niger Delta, Nigeria[24]. It is noticed that the heavy metals in dung samples of cattles are directly proportional to the metals in the fodder consumed by cattles[25]. The Fe concentration in dung sample was significantly higher during winter season (6.139ppm) and lower in summer season (5.151ppm) while, its average concentration in rainy season was found as 6.096ppm. The results of the present investigation are much lower than the findings of similar study carried out for

detection of Fe contamination in the soil of the Abattoir dump site, Nigeria. They found the mean concentration of Fe during dry season was much higher than in the wet season[26]. Although, the contamination of soils by Fe may be due to discharges from industries and sewage water etc, but it may also occur naturally in soils in abundance due to different metabolic processes and enzymatic reactions in the environment[27]. It is important to notice that the level of Ni concentration in dung samples in the different seasons had no significant variations. The lowest concentration was recorded in summer season (0.053ppm) followed by winter seasons (0.070ppm) and rainy season (0.075ppm), respectively. The anthropogenic sources of Ni contamination in the natural ecosystems may be due to discharge from industries of plates and coin minting, burnt oil, detergents and fertilizers used in agricultural fields[28].

The level of Cr concentration in dung samples was significantly higher in winter (0.275ppm) and rainy season (0.225ppm). It was comparatively lower in samples collected during summer season (0.125ppm). It may be due to less agricultural activities in summers as compared to rainy and winter seasons in the region. Since inputs of pesticides, fertilizers and other agrochemicals are main source of contamination of Cr in soils and water. The present investigation is in corroboration with the higher levels Cr during rainy season (0.06ppm) in 2010[29]. A study examined Cr in feces and also provided information on dietary intake, organic digestibility and the total fecal excretion of other minerals and nutrients. Cr has an affinity with fibrous particles, which was exploited by the impregnation of fibrous feed with Cr in the study of ruminant fiber digestion[30-31]. The level of Mn in cow dung was also assessed in present investigation. The source of Mn in cow dung can be correlated to the fact that Mn is a key component for plant metabolism and it enters in to the ruminants through food chain[32]. The Mn concentration in dung was comparatively higher in winter season (0.478ppm) followed by rainy season (0.434ppm) and summer season (0.369ppm). Similar observations were reported in the Puyango River Basin of Ecuador[33]. Cobalt (Co) concentration in cow dung was slightly higher in rainy season (0.051ppm) as compared to the winter season (0.046ppm), whereas it was found lower in summer season (0.020ppm). The results of the present study are much lesser as compared to the findings which indicated the average level of Co as 10.3ppm in dry season and 1.4ppm in wet season, respectively in sediments of urban surface water in Nigeria[34].

It can be concluded that although the concentration of different heavy metals in the cow dung are quite lower but continuous use of synthetic fertilizers, pesticides and other agrochemicals with formulation containing heavy metals may accumulate on soil, water, fodder etc. The ingestion of such contaminated matter may leads to bioaccumulation of such heavy metals in cattle and finely they may reach in food chain and harm the consumers[35]. It is reported that animal can retain 5-15% of metal they ingested through contaminated food and water[17]. Therefore, it is very serious issue for policy makers and governments to ensure regular monitoring of food, water, soils etc to check the contamination heavy metals them so that environment its components kept healthy and contamination free from pollutants, especially from heavy metals and such non-biodegradable contaminants.

Table-1: Average seasonal concentration of different heavy metals in cow dung samples.

Heavy Metal (µg/ml)	Avg. Concentration of Heavy Metals 2016-17 (ppm)		
	Summer	Rainy	Winter
Zn	0.175	0.288	0.350
Pb	0.113	0.175	0.388
Cu	0.550	0.070	0.077
Cd	0.004	0.005	0.006
Fe	5.151	6.096	6.139
Ni	0.053	0.075	0.070
Cr	0.125	0.225	0.275
Mn	0.369	0.434	0.478
Co	0.020	0.051	0.046

Conclusion

The contamination of heavy metals in any ecosystem, more than their natural level are serious indicators of environmental pollution. The present study was carried out for detection of nine major heavy metals found in the region. It was noticed that concentration of Fe was highest in cow dung while Cd was found lowest. It is important to note that the major source of contamination of these in agricultural industry, in which pesticide and synthetic fertilizers are used since long time. The regular monitoring of these heavy metals in different ecosystems gives an idea for effective management and control over heavy metal toxicity.

References

1. World Bank Report (2013). Agriculture land (percentage of land area). http://data.worldbank.org/indicator/AG.LND.AGRI.ZS. Accession date: 19.08.2014
2. Government of India (GOI). (2014). Basic Animal Husbandry Statistics. Ministry of Agriculture, Department of Animal Husbandry, Dairying and fisheries. New Delhi.
3. Deka R., Lindahl J., Randolph T. and Grace D. (2015). The White Revolution in India The end or new beginning?. International Livestock Research Institute.

4. The Hindu (2011). About 70 per cent Indians live in rural areas: Census report. http://www.thehindu.com/news/national/about70percentindiansliveinruralareascensusreport/article2230211.ece. Accessed 24 Jul 2015.

5. Warner U., Stöhr U. and Hees N. (1989). Biogas plants in animal husbandry. 153 ref.19.

6. Brown R.C. and Brown T.R. (2003). Biorenewable resources—engineering new products from agriculture. Lowa state press, London.

7. Asiriuwa O.D., Ikhuoria E.G. and Ilori E.G. (2013). Myco-Remediation Potential of Heavy Metals from Contaminated Soil. *Bulletin of Environment, Pharmacology and Life Sciences*, 2(5), 16-22.

8. Coconut Research Institute (CRI) (1994). Report of Soils and Plant Nutrition Division. Annual Report, Coconut Research Institute, Lunuwila, Sri Lanka, 83-85.

9. Tiquia S.M., Tam N.F.Y. and Hodgkiss I.J. (1997). Composting of spent pig litter at different seasonal temperatures in subtropical climate. *Environ. Pollut.,* 98, 97-104. PMID: 15093349.

10. Hsu J. and Lo S. (1999). Chemical and spectroscopic analysis of organic matter transformations during composting of pig manure. *Environ. Pollut,* 104, 189-196.

11. Nicholson A.F., Groves S.J. and Chambers B.J. (2005). Pathogen survival during livestock manure storage and following land application. *Bioresour. Technol,* 96, 135-143. https://doi.org/10.1016/j.biortech.2004.02.030 PMID: 15381209.

12. Atreya Kishore (2007). Pesticide Use in Nepal: Understanding Health Costs from Short- term Exposure. Working Paper No. 28-07. South Asian Network for Development and Environmental Economics (SANDEE), Nepal.

13. Devi P.I. (2010). Pesticidesin agriculture—A boon or a curse? A case study of Kerala. *Economic and Political Weekly*, 45, 199-207.

14. Shetty P.K., Hiremath M.S. and Sreeja K.G. (2010). Farmer seducation and perception on pesticide use and crop economies in Indian Agriculture. *Journal of Experimental Sciences*, 1(1), 3-8.

15. World Health Organization (1990). Report on TBEE. Environmental Health Criteria. *International program on chemical safety*.

16. Randhawa G.K. and Kullar J.S. (2011). Bioremediation of pharmaceuticals, pesticides, and petrochemicals with gomeya/cow dung. *ISRN Pharmacol*., doi:10.5402/2011/362459

17. Nuti N.T., Hassan U.F. and Ushie O.A. (2014). Determination of Heavy Metals Concentration in Bauchi Urban Area, Nigeria. *International Journal of Modern Analytical and Separation Sciences*, 3(1), 13-19.

18. Gupta V. and Bakre P.P. (2012). Heavy metal contamination in ranthambore national park: Feces as bioindicators. *Universal Journal of Environmental Research and Technology*, 2(6), 545-550.

19. Charan P.D., Singh M. Rakhecha P., Jakhar A.K., Bithoo K.S. and Meena M.K. (2015). Study of Heavy Metals Concentration in ground water samples collected from Bikaner city, Rajasthan. *International Journal of Engineering Research & Management Technology,* 2(5), 14-18.

20. Olatunji O.S. and Osibanjo O. (2012). Distribution and temporal variation of selected heavy metals in sediment of River Osara mainstream drainage in North Central Nigeria. *African Journal of Pure and Applied Chemistry*, 6(13), 188-194.

21. Chindah A.C., Braide S.A., Amakiri J. and Chikwendu S.O.N. (2009). Heavy Metal Concentrations in Sediment and Periwinkle –Tympanotonus fuscastus in the Different Ecological Zones of Bonny River System, Niger Delta, Nigeria. *The Open Environmental Pollution & Toxicology Journal,* 1, 93-106.

22. Sahayaraj P.A. (2006). Lead contamination in buffaloes reared in the Cooum river belt. Ph.D., Thesis, submitted to Bharathidasan University, Tiruchirapalli, India.

23. Turgut C. (2003). The contamination of organochlorine pesticides and heavy metals in surface water in Ku¨c¸u¨k Menderes River in Turke. *Environ. Inter.,* 29, 29-32.

24. Nwadinigwe C.A., Udo G.J. and Nwadinigwe A.O. (2014). Seasonal variations of heavy metals concentrations in sediment samples around major tributaries in Ibeno coastal area, Niger Delta, Nigeria. *International Journal of Scientific and Technology Research*, 3(11), 254-265.

25. Mor F. (2005). Cadmium and lead in livestock feed and cattle manure from four agricultural areas of Bursa, Turkey. *Toxicol. Environ. Chem*, 87, 329-334.

26. Yayaha M.I., Mohammad S. and Abdullahi B.K. (2009). Seasonal Variations of heavy metals concentration in Abattoir Dumping Site Soil in Nigeria. *J. Appl. Environ. Manage.*, 13(4), 9-13.

27. Omar H.E.D.M. (2013). Seasonal variation of heavy metals accumulation in muscles of the African catfish *Clarias gariepinus* and in river Nile water and sediments at assiut Governorate, Egypt. *Journal of Biology and Earth Sciences*, 3(2), 236-248.

28. Sanleandro P.M., Navarrro A.S., Pereira E.D., Zuniga F.B., Munoz M.R. and Iniesta, M.J.D. (2018). Assessment of Heavy Metals and Color as Indicators of Contamination in Street Dust of a City in SE Spain: Influence of Traffic

Intensity and Sampling Location. *Sustainability*, 10(11), 4105.

29. Jameel A.A., Sirajudeen J. and Vahith R.A. (2012). Studies on heavy metal pollution of ground water sources between Tamilnadu and Pondicherry, India. *Advances in Applied Science Research*, 3(1), 424-429.

30. Udén P., Colucci P.E. and Van Soest P.J. (1980). Investigation of chromium, cerium and cobalt as markers in digesta. Rate of passage studies. *Journal of the Science of Food and Agriculture*, 31(7), 625-632.

31. Colerman S.W., Evans B.C. and Horn G.W. (1984). Some factors influencing estimates of digesta turnover rates using markers. *J. Anim. Sci.*, 58(4), 979-986.

32. Egrinya Eneji A., Yamamoto S., Wen G., Inanaga S. and Honna T. (2005). A comparative evaluation of wet digestion and dry ashing methods for the determination of some major and minor nutrients in composted manure. *Toxicological & Environmental Chemistry*, 87(2), 147-158.

33. Gracia M.E., Betancourt O., Cueva E. and Gimaraes J.R.D. (2012). Mining and Seasonal Variation of the Metals Concentration in the Puyango River Basin-Ecuador. *Jouranl of Environmental Protection*, 3, 1542-1550.

34. Abata E.O., Aiyesanmi A.F., Ayodele O., Olasehinde E.F., Adebayo A.O., Takeda K. and Sakugawa H.I. (2016). Distribution and Seasonal variation of heavy metals in sediments of urban surface water, South-West Nigeria. *International Journal of Scientific & Engineering Research*, 7(1), 870-898.

35. Ogri O.R., Ibok U.J. and Offem O.J. (2003). Ecological risk assessment of heavy metals in Great Kwa River estuary, South Eastern Coast of Nigeria. *African Journal of Environmental Pollution and Health*, 2(1-2), 1-10.