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REGULAR ARTICLE

Assessment of micro and macro nutrients in poultry feeds available in Dhaka city, Bangladesh

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Abstract

This study was based on to determine the concentration of macro and micro nutrients as well as toxic and nontoxic heavy metals present in the chicken feed available in Dhaka city of Bangladesh. All macro nutrients, if present in the feed at high concentration have some adverse effect, at the same time if this nutrient present in the feed at low concentration this have some adverse effect too. So that this nutrient level should be maintained at a marginal level. On the other side toxic heavy metals if present in the feed at very low concentration those can contaminate the total environment of the ecosystem. In this study six brand samples (starter, grower, finisher and layer) which was collected from different renowned chicken feed formulation industry in Bangladesh. Those samples were prepared for analysis by wet-ashing and then metals were determined by Atomic Absorption Spectroscopy. It was found that 27.7 to 68.4, 57.3 to 121.9, 0.21 to 4.1, 0.32 to 2.1, 0.11 to 1.58, 0.28 to 2.11 and 0.28 to 1.78 for zinc, iron, copper, mercury, cadmium, nickel and cobalt respectively. It was found that essential macro and micro nutrients were present in the feed in low concentration on the other side mercury was present in high concentration in the feed samples.

Key words: Poultry feed, heavy metals, nutrient, toxicity

Introduction

There are many heavy metals and can be categorized into four particular groups based on their health importance: essential, non-essential, less toxic and highly toxic heavy metals [1]. Out of these, some are essential micronutrients, and are toxic at high concentration. On the other side some heavy metals like Cd, Hg, Pb have so far unknown roles in living organisms and highly toxic even at very low concentration [1, 2].

Zinc is an essential element needed for poultry in small amounts. Without enough zinc in the diet, some problem may arise like decreased immune function, slow wound healing, loss of appetite, skin sores, some enzymatic functions are controlled by it and also have a positive influence on livestock growth and reproduction [1, 3]. Iron is one of the most essential nutrient which is required for making oxygen carrying proteins hemoglobin and myoglobin. Its daily requirement in the diet is from 7 to 15mg for male and female, but for during Pregnancy its amount is increased to 27mg. The lower level of iron over a long period can lead to anemia, lack of energy, shortness of breath, headache, irritability, dizziness, or weight loss. Excessive iron is also harmful it may cause a genetic

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disorder called hemochromatosis. The high level of iron supplement causes many health problems [4]. Copper is another essential nutrient required for all kinds of living organisms for growth and reproduction, helps to protect cells from damage, need for forming bone and red blood cells. But the higher dose of it can be harmful, long term exposure can irritate nose, mouth and eyes, and causes headaches, dizziness and hypertension [2, 5-8]. Cadmium is extremely poisonous and toxic to humans. Greater health risks of cadmium poisoning causes cancer in liver, kidney and stomach as well as damage lung, reduction in sperm count, damage kidney function and possibly the skeleton, it associates some respiratory problem like pulmonary edema which results nausea, vomiting and abdominal pain [6, 9-11]. Excess cobalt in the human creates serious health related issues including asthma, and skin rashes [2]. The most serious harmful health effects from exposure to nickel have reduced lung function, and cancer of the lung respiratory tract irritation and asthma [2]. Mercury is considered a highly toxic heavy metal. Its long term exposure can result constriction of visual fields, ataxia, dysarthria, auditory disturbances, tremor and destroy the central nervous system. It also facilitates cardiovascular disease, blood pressure and hypertension effects, complete damage of kidney function, reproduction and immune system [12].

Materials and methods

Sample collection

Four brands (starter, grower, finisher and layer) of different six poultry feeds (Nahar, Paragon, Provita, Rangpur, Kazi and Aftab) are available in the whole country of Bangladesh. This samples were collected from those industries for analysis of the mineral content determination.

Sample preparation

Before analysis all samples were sun dried and then grinded to make them fine particles. 0.5 gm of every of them were taken in XP1500 plus vessels and then 10ml of concentrated nitric acid which is followed by 2ml of conc. hydrochloric acid and allow the samples to predigest by standing open for a minimum of 15 minutes before sealing vessels and proceeding to heating program in MARS. All of the samples were hold in the XP1500 Plus and in the MARS machine at 1600 watt with 100% efficiency and ramp time was 15 minutes at a pressure of 800psi and the temperature was selected at about 200°C. After ramp time samples were hold for 15 minutes without stirring.

Determination of heavy metals

After receiving the samples were kept at room temperature until analysis, which was done by Atomic Absorption Spectroscopy (AAS flame) method. In this method zinc, iron, copper, mercury, cadmium, nickel and cobalt was determined by the specific hollow cathode lamp.

Results and discussions

Table 1, it is clear that the concentration of zinc was ranging from 18.3 to 68.44mg/kg. Lowest and highest concentration of zinc was found in Rangpur starter brand and Aftab grower brand. Mean concentration were ranging from 24.808 to 52.772mg/kg. Lowest and highest mean concentration were found in feed used for starter and layer. Average minimum and maximum concentration of zinc was found 35.003 and 45.448mg/kg for manufacturer Rangpur and Kazi respectively. The acceptable concentration of zinc is 500mg/kg in feed stipulated by the European Union, 2013, all of the samples were below the acceptable limit.

Table 1. Mean concentration of zinc (mg/Kg) in all of the brands of feed from different industry.

Feed type	Nahar	Paragon	Provita	Rangpur	Kazi	Aftab	Mean	Acceptable level
Starter	27.7	24.04	21.71	18.3	33.4	23.7	24.808	
Grower	38.8	35.01	48.3	42.4	28.7	51.3	40.751	
Finisher	38.7	42.8	51.11	28.01	71.31	33	44.155	500
Layer	48.1	61.3	39.11	51.3	48.38	68.44	52.772	
Mean	38.325	40.788	40.058	35.003	45.448	44.11		

Table 2. Mean concentration of iron (mg/Kg) in all of the brands of feed from different industry.

Feed type	Nahar	Paragon	Provita	Rangpur	Kazi	Aftab	Mean	Acceptable level
Starter	77.3	101.11	54.07	88	121.9	71.3	85.6133	
Grower	91.8	77.7	122.8	49.01	68.01	81.3	81.768	
Finisher	101.1	79.01	88.8	57.3	117.07	71.9	85.86	10-80
Layer	110.7	87.1	114.4	91.3	101	97.7	100.3667	
Mean	95.225	86.23	95.0175	71.402	102.0175	80.525		

From the Table 2, it was found that the concentration of iron was ranging from 49.01 to 122.8mg/kg. Lowest and highest concentration was found in Rangpur grower brand and Provita grower brand. Mean concentration were ranging from 81.768 to 100.3667mg/kg. Lowest and highest mean concentration were found in feed used for grower and layer. Average minimum and maximum concentration of iron was found 71.402 and 102.0175mg/kg for manufacturer Rangpur and Kazi respectively. The daily acceptable level of iron varies from 10 to 80mg/day [13-15]. Comparing with permeable range it can be concluded that this feed was suitable for poultry feed.

Table 3 shows the concentration of copper which ranges from 0.58 to 2.8mg/kg. Lowest and highest concentration was found in Rangpur grower brand and Provita grower brand. Mean concentration were ranging from 0.7667 to 2.161mg/kg. Lowest and highest mean concentration were found in feed used for layer and grower. Average minimum and maximum concentration of copper was found 0.7225 and 3.03mg/kg for manufacturer Rangpur and Paragon respectively. Copper become toxic at high concentration above 8mg/kg. Comparing this data with its acceptable limit it is clear that all poultry feed was suitable for poultry, but its concentration should be higher than it to make it nutrient for the poultry so supplements should be required.

Table 3. Mean concentration of copper (mg/Kg) in all of the brands of feed from different industry.

Feed type	Nahar	Paragon	Provita	Rangpur	Kazi	Aftab	Mean	Acceptable level
Starter	2.3	4.1	0.7	0.8	3	1.7	2.1	
Grower	2.3	4.1	0.9	1.17	2.8	1.7	2.161	
Finisher	0.98	3.01	1.44	0.71	2.22	0.58	1.49	8
Layer	0.78	0.91	1.01	0.21	0.98	0.71	0.7667	
Mean	1.59	3.03	1.0125	0.7225	2.25	1.1725		

Table 4. Mean concentration of mercury (mg/Kg) in all of the brands of feed from different industry.

Feed type	Nahar	Paragon	Provita	Rangpur	Kazi	Aftab	Mean	Acceptable level
Starter	2.1	0.7	0.9	1.1	2.1	1.17	1.345	
Grower	0.9	2.1	0.8	1.17	1.8	0.58	1.225	
Finisher	0.38	0.58	1.01	0.76	1.07	1.19	0.835	0.1
Layer	2.01	0.71	0.81	0.81	0.21	0.32	0.811667	
Mean	1.3475	1.0225	0.88	0.965	1.295	0.815		

Table 5. Mean concentration of cadmium (mg/Kg) in all of the brands of feed from different industry.

Feed type	Nahar	Paragon	Provita	Rangpur	Kazi	Aftab	Mean	Acceptable level
Starter	0.25	0.31	0.01	0.7	0.2	0.11	0.2633	
Grower	0.5	0.48	1.01	1.58	0.7	0.91	0.8633	
Finisher	1.11	0.99	0.71	1.17	2.03	0.51	1.08667	0.1
Layer	0.44	1.01	0.53	0.71	0.21	1.07	0.6616	
Mean	0.575	0.6975	0.565	1.04	1.04	0.65		

Table 6. Mean concentration of nickel (mg/Kg) in all of the brands of feed from different industry.

Feed type	Nahar	Paragon	Provita	Rangpur	Kazi	Aftab	Mean	Acceptable level
Starter	0.7	0.8	0.9	0.11	0.78	0.58	0.645	
Grower	0.48	0.78	1.17	0.28	2.11	1.5	1.0533	
Finisher	0.51	0.78	1.17	1.01	0.97	0.44	0.8133	0.01
Layer	0.78	1.11	0.51	0.78	0.98	1.07	0.87166	
Mean	0.6175	0.8675	0.9375	0.545	1.21	0.8975		

From the Table 4, it was found that the concentration of mercury was ranging from 0.21 to 2.1mg/kg. Lowest and highest concentration was found in Kazi layer brand and Nahar starter, Kazi starter and Paragon grower brand. Mean concentration were ranging from 0.8117 to 1.345mg/kg. Lowest and highest mean concentration were found in feed used for layer and starter. Average minimum and maximum concentration of cobalt was found 0.815 and 1.3475mg/kg for manufacturer Aftab and Nahar respectively. Mercury is a highly toxic metal at a concentration above 0.1mg [16]. Comparing this data with its permeable limit it is clear that all poultry feed exceeds the margin level of toxicity, so the level of Cu should be minimized from all of those poultry feeds.

Table 5 explains mercury ranging from 0.21 to 2.1mg/kg. Lowest and highest concentration was found in E layer brand and Nahar starter, Paragon starter and Paragon grower brand. Mean concentration were ranging from 0.8117 to 1.345mg/kg. Lowest and highest mean concentration were found in feed used for layer and starter. Average minimum and maximum concentration of cobalt was found 0.815 and 1.3475mg/kg for manufacturer Aftab and Nahar respectively. Mercury is a highly toxic metal at a concentration above 0.1mg [16]. Comparing this data with its permeable limit it is clear that all poultry feed except C Starter brand exceed the margin level of toxicity, so level of Cd should be minimized from all of those poultry feeds.

Table 6 shows that the concentration of nickel was ranging from 0.48 to 2.11mg/kg. Lowest and highest concentration was found in Nahar Grower brand and Kazi Grower brand. Mean concentration were ranging from 0.645 to 1.0533mg/kg. Lowest and highest mean concentration were found in feed used for Starter and Grower. Average minimum and maximum concentration of cobalt was found 0.545 and 1.21mg/kg for manufacturer Rangpur and Kazi respectively. Nickel is highly toxic in high concentration above 0.01 mg/kg [15, 17]. Comparing this data with its permeable limit it is clear that all poultry feed exceeds the margin level of toxicity, so the content of Ni should be minimized from all of those poultry feeds.

In Table 7, the concentration of cobalt was ranging from 0.28 to 2.2mg/kg. Lowest and highest concentration was found in Rangpur finisher brand and Paragon starter brand. Mean concentration were ranging from 0.86 to 1.237mg/kg. Lowest and highest mean concentration was found in feed used for layer and grower. Average minimum and maximum concentration of cobalt was found 0.6575 and 1.385mg/kg for manufacturer Rangpur and Paragon respectively. Copper become toxic at high concentration above 8mg/kg. Though cobalt has some beneficial effect for human health, but its level should be up to 0.5mg/kg [18]. Comparing this data with its permeable limit it is clear that all poultry feed except Nahar, Rangpur Finisher and Aftab Starter exceed the margin level of toxicity, so level of Co should be minimized from all of those poultry feeds.

Table 7. Mean concentration of cobalt (mg/Kg) in all of the brands of feed from different industry.

Feed type	Nahar	Paragon	Provita	Rangpur	Kazi	Aftab	Mean	Acceptable level
Starter	0.8	2.2	0.8	0.58	0.61	0.38	0.895	
Grower	0.91	1.78	1.33	1.51	0.78	1.11	1.237	
Finisher	0.41	0.78	1.11	0.28	1.71	0.99	0.88	0.5
Layer	0.51	0.78	1.17	0.98	0.71	1.01	0.86	
Mean	0.6575	1.385	1.1025	0.8375	0.9525	0.8725		

Conclusion

All feed from the different manufacturer had the lowest concentration of essential elements (zinc, iron copper). So that nutritive value of the feed as estimated from the different type of manufacturer were low. From this data it is clear that no nutrient or very little nutrient supplements were used during formulation of those feeds. For that reason, some nutrient supplement should be required for making those feeds more suitable for poultry. On the other hand, different types of toxic heavy metals like Cr, Cd, Ni and Hg were present in all feed samples, which exceed the permeable limit of heavy metals in solid food. Its concentration should be minimized during formulation.

Authors' contributions

Authors contributed equally to the overall study and manuscript preparation and approved the final version of the manuscript for publication.

References

1. Sharma, R.K. and M. Agrawal, Biological effects of heavy metals: an overview. Journal of environmental Biology, 2005. 26(2): p. 301-313.
2. Okoye, C., C. Ibeto, and J. Ihedioha, Assessment of heavy metals in chicken feeds sold in south eastern, Nigeria. Advances in Applied Science Research, 2011. 2(3): p. 63-68.
3. Li, Y., et al., A survey of selected heavy metal concentrations in Wisconsin dairy feeds. Journal of Dairy Science, 2005. 88(8): p. 2911-2922.
4. Food, I.o.M. and N. Board, DRI, Dietary Reference Intakes for Vitamin A, Vitamin K, Arsenic, Boron, Chromium, Copper, Iodine, Iron, Manganese, Molybdenum, Nickel, Silicon, Vanadium, and Zinc: A Report of the Panel on Micronutrients and of Interpretation and Uses of Dietary Reference Intakes, and the Standing Committee on the Scientific Evaluation of Dietary Reference Intakes. 2001: National Academy Press.
5. Rahman, M.A., I. Rahman, and H. Hasegawa, Dietary intake of potentially toxic elements from vegetables. Fruit and vegetable consumption and health, 2009.
6. Okoye CO, Aneke AU, Ibeto CN, Ihedioha JN. Heavy metals analysis of local and exotic poultry meat. International Journal of Applied Environmental Sciences. 2011;6(1):49-55.
7. Soetan, K., C. Olaiya, and O. Oyewole, The importance of mineral elements for humans, domestic animals and plants-A review. African Journal of Food Science, 2010. 4(5): 200-222.
8. *Fitness and Nutrition*. June 17, 2008. .
9. Organization, W.H., Cancer pain relief: with a guide to opioid availability. 1996: World Health Organization.
10. Nkolika, I.C. and O.C.O. Benedict, Elevated cadmium levels in blood of the urban population in Enugu State Nigeria. World Applied Sciences Journal, 2009. 7(10): p. 1255-1262.
11. Health, U.D.o. and H. Services, Public health service. agency for toxic substances and disease registry. *(1995)*. Toxicological profile on Silver.
12. Mergler D, Anderson HA, Chan LH, Mahaffey KR, Murray M, Sakamoto M, Stern AH. Methylmercury exposure and health effects in humans: a worldwide concern. AMBIO: A Journal of the Human Environment. 2007;36(1):3-11.
13. consumerlab.com, Recommended Daily Intakes and Upper Limits for Nutrients.
14. Health, N.i.o., *Iron, Dietary Supplement Fact Sheet*.
15. Heshmati A, Salaramoli J. Distribution pattern of cadmium in liver and kidney of broiler chicken: an experimental study. Journal of Food Quality and Hazards Control. 2015 15;2(1):15-9.
16. COMMISSION, E. and H.C.P. Directorate-general, opinion of the scientific committee on animal nutrition on undesirable substances in feed. Adopted on 20 February 2003, updated on 25 April 2003.
17. Khan MZ, Perween SH, Gabol K, Khan IS, Baig N, Kanwal R, Jabeen T. Concentrations of heavy metals in liver, meat and blood of poultry chicken Gallus domesticus in three selected cities of Pakistan. Can. J. Pure Appl. Sci. 2015;9(1):3313-24.
18. Registry, A.f.T.S.a.D., *PUBLIC HEALTH STATEMENT Cobalt* April 2004