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Determination of heavy metals such as lead, nickel and cadmium in coastal range forage of Tangistan, Bushehr Province, Iran Province, Iran

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ABSTRACT
This study was done in order to determine heavy metals, lead, nickel and cadmium in coastal range forage of Tangistan, Bushehr Province, Iran in various development stages. For sampling, first two rangeland areas near to coast were selected and in each area, three rangelands were sampled by a square-meter quadrate through plot method during grazing season in three stages such as vegetative, blooming and fruiting from how each rangeland and in every phonological stage, the number of 20 Plot was harvested with 250m distance and as zigzag. Then samples related to each rangeland and each stage was combined and grinded and delivered to vitro and elements of lead, nickel and cadmium were measured by atomic absorption.Analyzing data was occurred based on factorial (two factors of area and sampling stage) in CRD by using SAS software. The results showed that the average of lead, nickel and cadmium metals is respectively 0.15± 0.04, 0.32± 0.02, 0.017± 0.007 ppm in coastal rangeland forages of Bushehr Province, Iran. There were no significant differencesin concentration of these metals in range forage between two studied areas while development stage was significant on concentration of nickel and cadmium metals how vegetative stage showed significant differences with blooming and fruiting stages ($p<0.05$) but development stage did not have significant effect on amount of lead. Concentrations of these metals were the most in vegetative stage. Totally, it was concluded that coastal range forage of Bushehr Province has no pollution on heavy metals and concentration of these metals does not exist in rangeland forage in poisoning domain of ruminants.
Keywords: Heavy metals, Coastal range forage,Bushehr Province, Iran.

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INTRODUCTION

The role of livestock is so important to producing healthy food, food safety and general health [11]. Microelements are transported to livestock through feed forages. Fodder plants are necessary sources of elements for livestock and the status of minerals of these ranges are so important for livestock because the performance of livestock is basically based on feeding these ranges [9]. Heavy metals are important among microelements because high consumption of these elements cause metabolic disorders due to cumulative effects and lead to reveal poisoning in plant, animals and human[8].Naturally, heavy metals exist in soil, vegetable and living organism but cause to pollute by activities such as mining, industrial and agricultural wastes, vehicles and oils [2]. Lead, nickel and cadmium are important heavy metals. Lead causes to poisoning in little amount how has high adverse effect on biochemical, physiological and even behavioral disorders. Sensitivity of different livestock to lead is not identical how cow and the next order sheep are the most sensitivity to lead poisoning among herbivora[18]. There are reports about occurring abortion in goats due to receiving the average amount of lead in their diets. Significant reduction is observed in production of egg in poultry by increasing the amount of receiving lead, as well [17]. Disease due to cadmium poisoning exists in human called Itai-Itai.Also the poisoning due to the cadmium acceleratesosteomalacia, osteoporosis, skeletal lesions and causes cancer[16]. Generally, food plant-based has more amount of nickel than food animal-based [12]. Nickel has adverse effect on lungs, kidneys and gastrointestinal tract that it can be referred to severe skin allergies, abortion, reducing the power of the immune system, weight loss and lung cancer [8]. Ration with low amount of nickel also leads to failed growth, development and normally reduce [12]. Studying heavy metal like lead and cadmium in forage

grasses of Ibadan of Nigeria having lead mine showed high concentration of these two elements how the amounts of lead and cadmium were obtained 425±79 and 0.94 ±0.23ppm in forage grasses, respectively [14]. In another studying about grasses Axonopusompressus, Panicum maximum and pennisetumpurpureum placing adjacent to iron mine of Itakpe, Nigeria, the amounts of cadmium were obtained 0.02± 0.01, 0.06± 0.04, 0.03± 0.01µg/g[11]. In studying the amount of heavy metals feed for dairy cows in Wisconsin State of America was determined that lead, zinc, copper, chrome, arsenic and cadmium metals with potential bioaccumulation was harmful and high amount of these metals in food of cows is detrimental. This research with studying 204 usual rations in 45 farms showed that the amount of lead and cadmium in homegrown alfalfa hay, Alfalfa haylage, corn silage and corn grain is 198 and 74, 271 and 74, 260 and 62, 134 and 181 mg/kg of dry mater, respectively that surely it was not higher than permitted limit [10]. The study of the effect of the amount of heavy metals on accumulation of these metals in two types of*AtriplexHortensis*and *A.Rosea* showed that the amount of lead in plant is associated with its concentration in soil and its accumulation is more in leaves and also type of plant is effective on the rate of absorption of lead [15]. Bushehr Province has 625 km maritime boundary and therefore there are extended rangelands in fringe of Persian Gulf that there is not precise and sufficient information about the status of these rangelands. The existence of oil pollutions in Persian Gulf has caused to pollute waters of this wide line to these heavy metals due to the existence of extended installations of oil, passing oil tankers and entry to urban wastewater. On the other hand, rainfall of acid rain during recent years in South of Iran has caused to pollute soils of Bushehr Province and especially coastal areas to heavy metals. In studying acid rains in Ahvaz, Dezfol, Shoshtar and Bushehr areas in south of Iran, it is determined that the amounts of lead and sodium has been higher than standard limit [2]. According to the existence of extended rangelands in this coastal strip and the probability of being infected grasses of these rangelands to heavy metals, studying lead, cadmium and nickel metals in grasses of these rangelands that are so important heavy metals, is the goal of this research.

METHODS AND MATERIALS

According to the extent of coastal rangelands and number of livestock related to each area, firstly, two rangeland areas (Bashi&Rostami) were selected in coastal strip of Tangistan of Bushehr Province (west south of Iran). In each area, three ranchers were randomly selected and their approximate limitations were determined. During grazing season that is winter in Bushehr Province that was sampled from plant of rangelandby using a square meter quadrate in three phonological stages such as vegetative, blooming and fruiting. Such that in each phonological stage from rangeland of each rancher, plants within 20 zigzag-established Plot and with 250meters distance from each other were harvested from one centimeter over collar [6]. Plants of each Plot were poured in paper pocket as mixed and recorded the specifications of sample on the pockets and then were separately dried in shadow and dusted. Samples related to each rangeland and each vegetative stage were combined with each other and milled and finally three samples were harvested from each stage, each rangeland and totally 18 samples were delivered to vitro for analyzing. Measuring lead, cadmium and nickel metals was done by using video furnace with Younglin AAS 8020 made in South Korea, model 2010. Analyzing obtained data was done by using SAS software in CRD based on factorial experiment, as well. Experimental factors included the effect of area with two levels and effect of sampling stages with three stages, therefore statistical model is given as following:

$Y_{ijk} = \mu + A_i + B_j + AB_{ij} + E_{ijk}$

In this model, Y_{ijk} is observing effect, μ is total average, A_i is area effect, B_j is effect of sampling stages, $AB_{ij}$is interaction effect of area and sampling stage and $E_{ijk}$is effect of experimental error. Comparison of averages was done by Duncan test and α was 5%level.

RESULTS

The average of lead, nickel and cadmium metals in coastal range forages of Tangistan, Bushehr Province, Iran is shown in tables 1 to 3. The least concentration of these heavy metals in grasses is related to cadmium and the most of them is associated to nickel. Also, significant differences were not observed for these metals in two studied areas. Sampling stages on the amount of lead of rangeland forages were not significant, although the amount of lead was the most in vegetative stage and reduced by increasing plant age. The amount of nickel and cadmium was the most in vegetative stage and showed significant differences with two blooming and fruiting stages. Fruiting stage showed the least amount of nickel and cadmium, therefore the amount of nickel and cadmium are affected by vegetative stage of plant.

DISCUSSION

Significant differences were not observed for lead, nickel and cadmium metals in rangeland forages in two areas. One of the most important effective factors on concentration of element in plants is their

concentrations in soil and type of plant. Naturally, soils have different concentrations of elements depending on type of soil [11] and [15]. Type of soil of studied coastal area is identical so that plants of these areas will have little variations, thereforenon-significant differences in concentration of elements of these plants explainable. Meanwhile, the effects of heavy metals on grasses depend on different factors like seasonal changes among seasons, type, transpiration rates, plant age, temperature, radiation, water supply, soil fertility, leaf area, organic constitutes, degree and rate of defoliation by rancher [11], that these factors are approximately identical in two studied area. Also, pH is one of the most important effective parameters on bio-sorption processes [5] that is usually identical in coats with sand context and therefore is one of the most important factors of non-significant differences in two areas. Plant age is effective on concentration of heavy metals [11], Vegetative stage of plant on the amount of nickel and cadmium in rangeland forage showed significant effect but was not significant for lead. The concentration of lead was the most in vegetative stage and slightly reduced by increasing age how it was the least in fruiting stage. This reducing process in concentration of nickel and cadmium of rangeland forages was the same of lead. The concentration of three elements was the most in vegetative stage. The concentration of nickel and cadmium showed significant differences in vegetative stage with blooming and fruiting stages ($p<0.05$) but blooming and fruiting stages did not show significant differences. The concentration was the most and the concentration of cadmium was the least in three sampling stages. The average of lead concentration, nickel and cadmium was obtained 0.15, 0.32 and 0.017 ppm, respectively in coastal range forages of Bushehr Province that is much less than computed amounts in rations of dairy cow in Wisconsin of United State of America. Recommended limits of lead are 0.5-10 ppm in normal plants. Lead levels which range from 30- 300 ppm have been considered phytotoxic toplants [4]. Therefore, the concentration of lead in coastal range forage of Bushehr Province, Iran is less than its amount in normal plants and will not be toxic for plants. According to normal concentration of lead is 1 to 6 mg/kg in ration of cow and the amount of its poisoning in ration occurs in higher concentration than 2000 ppm [18] and also, the amount of lead of coastal range forages of Bushehr Province is 0.15 ppm so it will not be dominant of poisoning for livestock. Concentration of nickel in rangeland plants is less than its concentration in soil but it is more in Legume like alfalfa. Totally, nickel concentration in grasses is reported 0.13-1.1 and it is reported in Legumes 1.2-2.7 and in cereals 0.22-0.34 mg/kg [18]. Also, there has not been already report about lack of this element in livestock of grazers on rangeland [18]. Some biochemical problems have been reported for goat in lack of state of ration nickel (less than 100 µg nickel in kg of dry mater) [3]. Underwood and Suttle[18] reported that concentration less than 0.01 mg/kg of dry mater of nickel is sufficient for ration in order to return normal activities of body. Ahmad et al[1] reported the concentration of nickel 0.03 to 0.06 in leaves of salt rangeland forages and 0.037 to 0.84 mg/g in cereals in Pakistan.

There is so different domain about the rate of necessity and toxic nickel in ruminant. The domain is different in this type of animals depending on rumen microflora and status of nickel composition solution. For example, nickel carbonate having little solution is tolerable up to 250 mg/kg of dry mater for ruminant [18]. Generally, Mc Dowell [12] the amount of necessity of ruminant to nickel is 0.03-0.3 mg/kg, the level of their strength 50 mg/kg and the amount of this element in rangeland forages0.5-3.5 mg/kg were reported. According to the medium of amount of nickel is 0.32 mg/kg in coastal range forages of Bushehr Province and even its concentration is not placed in poisoning domain of ruminant in different vegetative stages, so its amount is appropriate and beside provides the necessity of little ruminant and will not be at danger of poisoning. The amount of cadmium in forages and food stuff depending on types of plant is different in type of food and place[15] Li et al; 2005). The amount of cadmium in vegetables, hazelnuts and fruits that are poor sources of cadmium, often are placed in domain 0.04-0.08 mg/kg [12]. The normal amount of cadmium in ration of cow and sheep is 0.1-0.2 and its poisoning amount his higher than 50 ppm [18]. Maximum tolerable cadmium in rations of cows has been determined 0.5 mg/kg. Rations of ruminants containing more than 30 mg of cadmium in kg., have led anorexia and to reduce growth and milk production [13]. The amount of cadmium was obtained 0.017 mg/kg in coastal range forage of Bushehr Province that is not placed in poisoning domain for livestock.

CONCLUSION

Obtained results of this research showed that coastal range forages of Bushehr Province, Iran does not have pollution from point of view of heavy metals like lead, nickel and cadmium and their concentration is not placed in poisoning domain of ruminants although the concentration of these metals are the most in vegetative stage.

Table 1: Average (ppm) of some heavy metals of costal range forages of Bushehr Province, Iran

	Pb	Ni	Cd
Mean ± SE	0.15 ± 004	0.32 ± 0.02	0.017 ± 0.004
Coefficient of Variation	18	21	25

Table 2: Average (ppm) of some heavy metals of costal range forages in sampling area

	Pb	Ni	Cd
Bashi			
Mean ± SE	0.15± 0.00	0.30 ±0.03	0.01 ± 0.006
Min	0.12	0.18	0.01
Max	0.2	0.49	0.027
Rostami			
Mean ± SE	0.16 ±0.008	0.34 ± 0.02	0.01 ± 0.022
Min	0.097	0.27	0.01
Max	0.189	0.46	0.029

Table 3: Average (ppm) of some heavy metals of costal range forages in sampling stages

	Pb	**Ni**	**Cd**
Vegetative			
Mean ± SE	0.16 ± 0.01	0.39^{a} ± 0.03	0.022^{a} ± 0.002
Min	0.12	0.27	0.016
Max	0.20	0.49	0.029
Blooming			
Mean ± SE	0.15 ± 0.009	0.28^{b} ± 0.04	0.014^{b} ± 0.001
Min	0.12	0.18	0.01
Max	0.19	0.46	0.019
Fruiting			
Mean± SE	0.14 ± 0.029	0.30^{b} ± 0.022	0.015^{b}± 0.002
Min	0.012	0.24	0.01
Max	0.097	0.40	0.022

***Significant level = 0.05**

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