

PIXE analysis of Japanese black cattle continuously kept in the former evacuation zone

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Abstract

On March 11th 2011, the Great East Japan Earthquake occurred, which led to large amounts of radioactive substances being released into the environment, due to the Fukushima Daiichi Nuclear Power Plant (FNPP) accident. In this study our main objection was to use PIXE analysis to measure trace elements in serum and hair samples, from the Japanese black cattle that have been kept continuously in the former evacuation zone. We investigated on the correlation between continuous low-dose exposure and vitiligo to the trace elements found in the serum samples, and also compared the amount of each trace element in the hair samples provided to the already reported amounts in beef and dairy cattle. From the PIXE analysis of serum samples collected from the Japanese black cattle, we found out that there was no trace element concentration disparity in different sex and age. When we compared the serum samples between the Japanese black cattle kept at Kitasato University (in Towada city, Aomori, in the area that is said to have not been affected by the power plant accident) and the cattle in former evacuation zone, Cu concentration from Fukushima was significantly lower and Na and S concentration from Fukushima was significantly higher than those taken from Towada campus. This was supposed to be due to the difference in forage or diet that they have been taken. Also, there was no significant correlation between the dose rate exposure and vitiligo. The Cu concentrations from the serum was significantly lower in the ranch where cattle with multiple white spots were frequently found. This may suggest that vitiligo and low Cu may have some correlation. However, Cu deficiency normally causes other symptoms, but in these vitiligo cattle there was no symptoms. The Cu deficiency is not solely the direct cause, but this might have contributed one of the multiple stressors after the severe environmental changes after the earthquake. In 77 hair samples collected, the trace elements that were frequently found were 18 elements namely Mn, Ga, Br, Sr, Hg, Ti, Cu, Na, Mg, Al, Si, P, Cl, K, Fe, Zn, Ca, and S. The trace elements levels greatly differ in each cattle, and may have also varied with how the samples were treated and the samples by breed. The Japanese black cattle hair samples had lower Cl and K and higher Al than those from the dairy cattle. This was supposed to be the difference of the breed and in the forage they ingested. The Fe concentration was lower in the hair from daily cow. This was most likely due to the Fe is transferred into the milk from the dairy cow.