

# **A Survey on the Heavy Metal Contents of Water and Rice in the Jeon-buk Area of Korea**

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### **Abstract**

This study was performed to investigate the levels of cadmium (Cd), copper (Cu), lead (Pb), and zinc (Zn) in water and rice samples taken from five sites on a stream used for agricultural water in the Jeon-buk area, Korea. The water samples were collected by the recommendation methods of the World Health Organization, and rice samples were randomly selected from the paddy rice. The water and rice samples were analyzed by the recommendation methods of Food Code of Korea and using ICP. Although there was variation between sampling sites, the levels of the metals of rice were on average much higher than those of water. The ratios of metal levels of rice to water were: Cd 8.0~35.4; Cu 2.2~7.2; Pb 5.9~18.3; and Zn 10.6~75.7. These results indicate that there was transfer of the metals from the water to the rice. This study also suggests that there might be another pathways for the transfer of the metals to the rice.

### **Introduction**

Some micronutrient elements may be toxic to both animals and humans at high concentrations, for example copper (Cu), chromium (Cr), fluorine (F), molybdenum (Mo), nickel (Ni), selenium (Se) or zinc (Zn), although they are essential for plant growth and/or human nutrition. Other trace elements, for example arsenic (As), cadmium (Cd), mercury (Hg) and lead (Pb), may also inadvertently enter the food chain and pose health risks to humans and animals. The sources of these elements vary, and the propensity for plants to accumulate and translocate them to edible and harvested parts depends to a large extent on soil and climatic factors, plant genotype and agronomic management.

Of the elements listed above, the elements that have most commonly given rise to health concerns about food safety are the heavy metals Cd and Pb, together with Cu and Zn. The objectives of this study were to investigate the extent and degree of the four heavy metal contamination of paddy rice and irrigation waters in Jeon-buk area Korea, and to find a possible link between the heavy metal contents of rice and water sources in these areas.

## **Materials and Method**

### *Sampling area*

Paddy rice and waters were sampled at five sites along a stream used for agricultural water in Iksan and Wanju, Jeon-buk area, Korea.

### *Sampling of water and rice*

The water samples were collected by the recommendation methods of the World Health Organization. Rice plants were harvested in the middle of September. Mature grains were randomly selected for the measurement of the heavy metals. The grain was hulled by hands to make samples for analysis. Once the hull was removed the brown rice was then dried in an oven. The dried rice was ground in a high-speed vibrating sampling mill (Heiko, TI 200, Japan) to a fine powder (to pass a no. 100 sieve). The water and ground rice sample were used for the heavy metal assay.

### *Sample preparation and analysis of heavy metals*

Sample preparation of the water and rice was done according to the Food Code of Korea. The analyses of the samples were carried out using ICP for Cd, Cu, Pb and Zn.

### *Data analysis*

The data from samples were compared by means of analysis of variance. Significant differences among means were determined by using Duncan's multiple range test.

## **Results and Discussion**

The results showed no significant difference of metal levels of water samples collected from the five sites. However, significant differences of metal levels of rice between sampling sites were observed ( $p < 0.05$ ), although the study did not find relationships in the metal levels between sampling sites. The Cd levels were 0.04~0.12 ppm in water samples, and 0.50~3.89 ppm in rice samples. The Cu levels were 0.38~0.83 ppm in water samples, and 1.42~2.58 ppm in rice samples. The Pb levels were 0.49~1.97 ppm in water samples, and 5.12~10.59 ppm in rice samples. The Zn levels were 1.67~3.28 ppm in water samples, and 80.42~126.38 ppm in rice samples.

## **Conclusion**

The results of this study indicate that there was transfer of the heavy metals from the water to the rice. This study also suggests that there might be some pathways for the transfer of the metals to the rice through other environmental media besides the water course. There should also be a long-term monitoring of the water quality in this area.

## References

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