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**Research Article**

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# Analysis on the characteristics of the heavy metal content of wheat grain in Xiaoxian County, China

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**ABSTRACT**

*In order to analyze the characteristic of the heavy metal content in wheat grain in Xiaoxian County, 23 samples were collected and done statistics by SPSS software. The results show that the average heavy metal content of lead(Pb),cadmium(Cd), chromium(Cr), zinc(Zn), copper(Cu) in the wheat grain is respectively 0.08565mg/kg, 0.002228 mg/kg, 0.8413 mg/kg, 29.9798 mg/kg, 5.5786 mg/kg. The quality of wheat grain is in good health. The coefficient variation of lead (Pb) is 84.36% which shows the content is not stable and the other elements have a little regional difference. Correlation analysis shows that the correlation coefficient of Zn and Pb is 0.617 at the 0.01 significance level. It shows that Zn and Pb have the same or similar pollution sources. System cluster analysis show that Yanji town and Shengquan town belong to the same category where the mining production behavior is distinguished from other region of sampling point.A*

**Key words:** Heavy metal; Wheat grain; Xiaoxian County; Correlation

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## INTRODUCTION

Wheat which is Gramineae has the first crop planting area in the world. The yield and quality of wheat has an important significance for food security. Heavy metals in soil and irrigation water can be absorbed into the wheat grain, due to the characteristics of heavy metals content which is cumulative and toxicity; it can affect the yield and quality of wheat grain [1]. At the same time, heavy metals can enter into the body by wheat food chain, it bring about serious harm to human health [2, 3]. This paper discusses the characteristics of heavy metal content of wheat grain in Xiaoxian County, the conclusions can provide technical support for food security.

## EXPERIMENTAL SECTION

Xiaoxian county is located at between 33°56'~34°29' north latitude and 116°31'~117°12' east longitude, with a total area of 1885 km2.And it is located in the northeast of the Huaibei plain and has an area of 973.4km2 of cultivated land. The main food crops are wheat in Xiaoxian County that is the national important planting base of high quality wheat. Xiaoxian County has been designated as a special high-quality strong gluten wheat area by the Ministry of agriculture. The total area of wheat is about 786.7km2, the average single yield can reach 604500kg/km2, the total yield is up to 475540000 kg. The production base of high-quality wheat which is 200km2 has been identified as the national standardization of green food production base by the Ministry of agriculture. Xiaoxian County is a typical temperate continental climate and has distinctive seasonal characteristics. The average annual temperature is 14.4℃ and the average annual rainfall is 811.2 mm.

There are 23 towns under the Xiaoxian County. In each town, typical wheat grain about 500g is selected as a sample, there is a total of 23 samples which is denoted as XZ1, XZ2, XZ23. Wheat grains are peeled and cleaned, then dried and full digestion using HCl-HNO3-HF-HClO4. The heavy metals content of Pb, Cd, Cr, Zn, Cu in wheat grains is

detected by ICP-AES [4]. In order to ensure the accuracy of results, all the samples is detected 3 times that the detection value is averaged for the results .All data was processed with SPSS software.

## RESULTS AND DISCUSSION

There is statistics on heavy metal content in wheat grainhe using SPSS software; the results can be seen in Table1.

**Table1 the heavy metal content in wheat grain**

| Sample | Pb | Cd | Cr | Zn | Cu |
|---|---|---|---|---|---|
| XZ1 | 0.0703 | 0.00183 | 0.761 | 28.328 | 5.530 |
| XZ2 | 0.0107 | 0.00200 | 0.779 | 30.814 | 5.825 |
| XZ3 | 0.0048 | 0.00107 | 0.909 | 24.128 | 4.448 |
| XZ4 | 0.0386 | 0.00186 | 0.926 | 23.186 | 7.338 |
| XZ5 | 0.1833 | 0.00319 | 0.825 | 26.857 | 5.266 |
| XZ6 | 0.2247 | 0.00103 | 0.845 | 46.135 | 6.337 |
| XZ7 | 0.1047 | 0.00209 | 0.979 | 38.423 | 6.171 |
| XZ8 | 0.0415 | 0.00109 | 0.512 | 35.094 | 5.311 |
| XZ9 | 0.0842 | 0.00192 | 0.780 | 25.708 | 4.369 |
| XZ10 | 0.0781 | 0.00421 | 0.955 | 28.439 | 4.580 |
| XZ11 | 0.0820 | 0.00670 | 0.976 | 30.352 | 6.528 |
| XZ12 | 0.1997 | 0.00287 | 0.857 | 32.924 | 5.704 |
| XZ13 | 0.0010 | 0.00109 | 0.833 | 21.714 | 4.439 |
| XZ14 | 0.0633 | 0.00218 | 0.740 | 29.619 | 5.151 |
| XZ15 | 0.0100 | 0.00198 | 0.816 | 29.335 | 6.190 |
| XZ16 | 0.0049 | 0.00109 | 0.825 | 21.573 | 4.796 |
| XZ17 | 0.0371 | 0.00183 | 0.905 | 24.151 | 7.108 |
| XZ18 | 0.1833 | 0.00287 | 0.793 | 25.069 | 4.583 |
| XZ19 | 0.2345 | 0.00106 | 1.004 | 44.600 | 6.717 |
| XZ20 | 0.0918 | 0.00196 | 0.969 | 36.156 | 6.173 |
| XZ21 | 0.0430 | 0.00091 | 0.591 | 30.675 | 5.994 |
| XZ22 | 0.0983 | 0.00220 | 0.906 | 29.522 | 5.133 |
| XZ23 | 0.0804 | 0.00424 | 0.866 | 26.734 | 4.619 |
| mean | 0.08565 | 0.002228 | 0.8413 | 29.9798 | 5.5786 |
| minimum | 0.0010 | 0.00091 | 0.512 | 21.573 | 4.369 |
| maximum | 0.2345 | 0.00670 | 1.004 | 46.135 | 7.338 |
| standard deviation | 0.07226 | 0.001352 | 0.1191 | 6.5441 | 0.8957 |
| coefficient variation(%) | 84.36 | 60.67 | 14.16 | 21.82 | 16.06 |

*Concentrations of the all elements are in mg/kg.*

The average heavy metals content of Pb, Cd, Cr, Zn, Cu in wheat grain is 0.08565mg/kg, 0.002228mg/kg, 0.8413mg/kg, 29.9798mg/kg, and 5.5786mg/kg respectively. The range heavy metals content of Pb, Cd, Cr, Zn, Cu is 0.0010~0.2345 mg/kg, 0.00091~0.00670 mg/kg, 0.512~1.004 mg/kg, 21.573~46.135 mg/kg, 4.369~7.338 mg/kg respectively. On the basis of the national food health standards in China(Pb is 0.50,Cd is 0.10,Cr is 1.0,Zn is50.00,Cu is10.00), all the data of heavy metals is in the standards limits that only one kind of heavy metals(Cr) in just one sample beyond the standard limits. So the quality of wheat grain in Xiaoxian County is good as a whole and is not influenced by heavy metals.

The maximum content of Pb is in XZ19 (Shengquan town), minimum is in XZ13 (Zhangzhuangzhai town). The maximum content of Cd is in XZ11 (Baitu town), minimum is in XZ21 (Shilin town). The maximum content of Cr is in XZ19 (Shengquan town), minimum is in XZ8 (Wangzhai town). The maximum content of Zn is in XZ6 (Yanjji town), minimum is in XZ16 (Qinlong town). The maximum content of Cu is in XZ4 (Liutao town), minimum is in XZ9 (Zulou town). The maximum content of Pb and Cr is both in the XZ19 (Shengquan town), it shows that the XZ19 (Shengquan town) region influenced by heavy metals is serious that may be related to the regional mining activities. The content of Pb has remarkable regional different characteristics. The coefficient variation is 84.36%, there is strong external interference of the content of Pb .The coefficient variation of Cd is 60.67% that it has a slight outside disturbance. The coefficient variation of Cr, Zn,Cu is respectively 14.16%, 21.82%, 16.06%,it shows the regional difference is not obvious.

Correlation analysis that refers to the analysis of two or more related elements can be used to measure the elements among closely related [5]. Using Pearson correlation coefficient, correlation analysis was carried out on the heavy metal elements in wheat grain. In 99% confidence interval, significant correlation between Zn and Pb is 0.002, it indicates that Zn and Pb can be carried out correlation analysis. The correlation coefficient of Zn and Pb is 0.617, it shows that Zn and Pb may have the same or similar pollution sources and may have the same migration path caused by production activities. In 95% confidence interval, significant correlation between Zn and Cu is 0.043; it indicates that Zn and Cu can be carried out correlation analysis. The correlation coefficients of Zn and Cu is 0.426, related

degree is not strong. The remaining elements are not significantly correlated; these elements may come from different sources or different geochemical behavior.

According to the same or similar characteristics of the sample as a class, cluster analysis can be used for classification on a number of sample point's area of classifying and grading. There are a total of 23 sampling points in the whole research region. Selecting the square Euclidean distance for sample classification basis, the clustering results of the heavy metals of Pb, Cd, Cr, Zn, and Cu in wheat grain is shown in Fig.1.

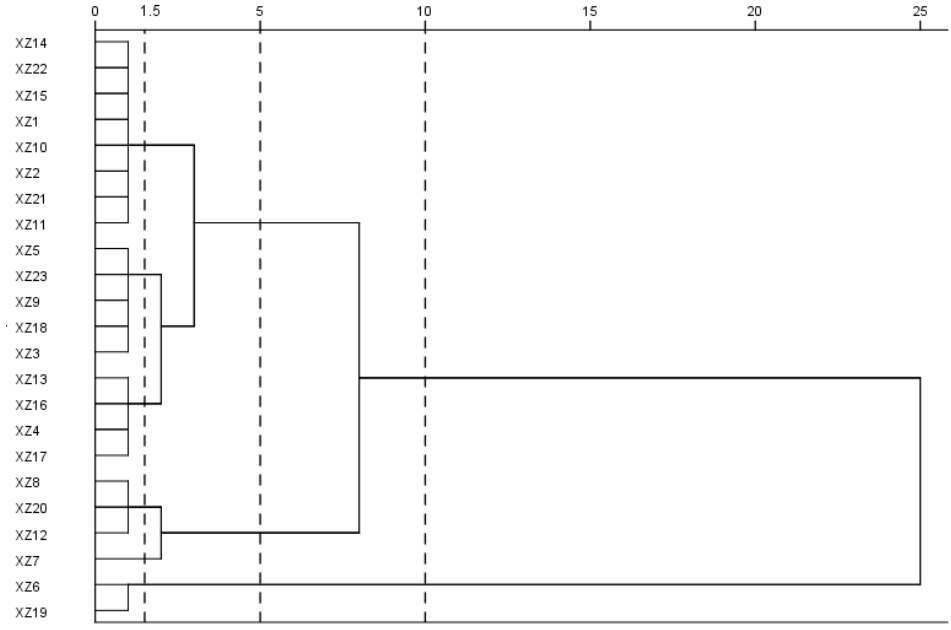


**Fig.1 Cluster analysis of heavy metal samples**

At a distance of 1.5 level, the study area can be divided into 6 categories, the first category contains XZ14, XZ22, XZ15, XZ1, XZ10, XZ2, XZ21, XZ11, sampling number accounts for the largest proportion that it is 34.78%, this indicates that regional differences of the heavy metal content in wheat grain in Xiaoxian county is small as a whole. The sample XZ7 (Dulou town) is a single point in a class; this is because the heavy metal content in Dulou town soil is significantly higher than the other area samples. At a distance of 5 level, the study area can be divided into 3 categories, the sample XZ6 (Yanji town) and XZ19 (Shengquan town) is just 2 samples which belong to the same category. At a distance of 10 level, the study area can be divided into 2 categories on the whole, the sample point XZ6 (Yanji town) and XZ19 (Shengquan town) is just 2 samples which belong to the same category again, this is because the Yanji town and Shengquan town are important mining area in Xiaoxian county, the mining industry is much higher than other regions.

## CONCLUSION

This paper is the first time about the characteristics of heavy metal content in wheat grain in Xiaoxian county. The average heavy metals content of Pb, Cd, Cr, Zn, and Cu is respectively 0.08565 mg/kg, 0.002228 mg/kg, 0.8413 mg/kg, 29.9798 mg/kg, and 5.5786 mg/kg. Wheat grain quality is good as a whole, the contents of heavy metals are within the scope of the national food health standards. There are significant correlations between Zn and Pb that they may have the same or similar source or migration pathway. Clustering analysis shows that XZ6 (Yanji town) and XZ19 (Shengquan town) belong to the same category where the mining production behavior is distinguished from other region of sampling point.

The conclusions of this paper can be planted to provide basic data and technical guidance for wheat in Xiaoxian County.

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