Detection and Analysis of Heavy Metals in Vegetables in Xinzhu Vegetable Base

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***Abstract*—In order to study the pollution of heavy metals and the safety of vegetables in Baqiao district, Xi'an, the contents of Cu, Zn, Cr and Pb in 8 fresh vegetables were determined. The results show that:(1)Most of the contents of heavy metals in vegetables in Xinzhu vegetable base did not exceed the standard, while Pb is higher than national standards, which should be addressed; (2)The contents of heavy metals in eggplant vegetables was low, and the contents of heavy metals in leafy vegetables were higher; (3)By single factor pollution index evaluation method, 8 kinds of vegetables were not polluted by Cu, Zn, Cr, three kinds of heavy metals, Cr content should be monitored; Pb content is very high, and it caused a serious pollution. Pepper and tomato can be obtained by Nemerow index method, the both of vegetables in the cordon, the index of eggplant, cucumber, chrysanthemum, romaine lettuce, Oilseed rape, tomato and leek belongs to light pollution, the relevant departments should immediately carry out pollution prevention and pollution treatment and corresponding action.**

Keywords-Xinzhu vegetable base; Heavy metal; Single factor pollution index method; Nemero pollution index method.

I. INTRODUCTION

In recent years, Chinese agricultural environmental monitoring stations in Liaoning Province survey results show that heavy metals have caused some pollution to a variety of vegetables, exceeding the rate of up to 36.1%, the area of pollution reached 3600hm2[1]. In the southern region of China, the main pollution of vegetables in Nanning city is from the Cr.

Xinzhu vegetable base is located in the Northern District of Baqiao, Xi'an, Shaanxi Province. The base is located next to the Xi'an Beltway and Port Road, vehicle exhaust emissions may increase the content of Pb in vegetables. Secondly, the new building street near the construction of four major heavy metals Cu, Pb, Zn, Cr, has the potential to build a vegetable base in Cu, Pb, Zn, Cr content has a great impact.

II. MATERIALS AND METHODS

A. Materials

Vegetables were taken from Baqiao District, Xi'an City, the new town of vegetable base, a one-time acquisition of two categories of 8 varieties of 70 vegetable samples (Table I).

B. Methods of Analysis

The contents of heavy metals Cu, Zn, Cr, Pb in cucumber, eggplant, tomato, pepper, romaine lettuce, leek, oilseed rape and chrysanthemum were measured by ultraviolet spectrophotometer. The experiment was divided into 5 steps, the collection of vegetable samples, the pretreatment of vegetable samples, the drawing of Cu, Zn, Cr, Pb standard curve, the detection of vegetable sample digestion solution, the processing of the experimental data.

TABLE I. COLLECTION OF VEGETABLE VARIETIES AND THE NUMBER OF SAMPLES

Vegetable varieties	vegetable type	Number of samples(unit)
Eggplant	*eggplant*	2
	Tomato	4
	Pepper	8
	Cucumber	3
Leafy	*Chrysanthemum*	14
	Romaine Lettuce	12
	Leek	14
	Oilseed rape	13

III. EXPERIMENTAL RESULTS AND ANALYSIS

A. Data Processing

According to the People's Republic of China international standard, "the safety and quality of agricultural products pollution-free vegetable safety requirements" (GB18406.1-2001), the experiment is to determine the limit of heavy metals in vegetables in the following Table II. After the samples were collected, the experiment was done, and every kind of heavy metal was measured three times, and the results were as Table III[2,3].

TABLE II. CONTENTS OF HEAVY METALS IN VEGETABLES

Heavy metal	**Cu**	**Zn**	**Cr**	**Pb**
Maximum Limited (mg/kg)	10	20	0.5	0.2

B. Results Analysis

From the table we can see that the base of vegetables in the Pb content exceeded, and Cu, Zn, Cr content in the national standard below the normal range. Through the analysis of vegetable sampling sites, the concentration of Pb in vegetables was higher because the collection sites were near the highway and the traffic flow was large. Highway operation will cause heavy metal pollution in roadside soil and crops even if in rural areas which highway traffic is low, for some crops and farmland on both sides also produced pollution, Wang Chu[4] reported, in the premise of long-term operation under low traffic on both sides of the road in vegetable farming soil heavy metal pollution will occur in different degrees. The soil heavy metal pollution on both sides of the road in the range of 50m is more obvious.

TABLE III. DETECTION RESULTS OF HEAVY METALS IN VEGETABLES WITH

Vegetable	**Project**	**Content (mg/kg)**	**Detection rate%**	**Exceeding standard rate%**	**Average content(mg/kg)**
eggplant	*Cu*	0.5~0.9	100	0	0.667
	Zn	3.2~3.5	100	0	3.4
	Cr	0.2~0.34	100	0	0.257
	Pb	0.19~0.31	100	80	0.25
tomato	*Cu*	0.6~1.1	100	0	0.9
	Zn	3.9~4.3	100	0	4.133
	Cr	0.22~0.36	100	0	0.3
	Pb	0.18~0.20	100	20	0.193
pepper	*Cu*	1.0~1.1	100	0	1.033
	Zn	2.3~3.5	100	0	2.833
	Cr	0.15~0.20	100	0	0.173
	Pb	0.11~0.21	100	40	0.153
Cucumber	*Cu*	0.5~1.5	100	0	1.067
	Zn	2.8~3.0	100	0	2.933
	Cr	0.20~0.22	100	0	0.207
	Pb	0.22~0.40	100	100	0.283
Chrysanth-emum	*Cu*	1.7~2.0	100	0	1.867
	Zn	4.5~5.0	100	0	4.733
	Cr	0.29~0.35	100	0	0.323
	Pb	0.30~0.34	100	100	0.323
romaine lettuce	*Cu*	1.5~1.9	100	0	1.633
	Zn	4.7~4.8	100	0	4.733
	Cr	0.22~0.40	100	0	0.29
	Pb	0.22~0.40	100	100	0.323
leeks	*Cu*	1.9~2.1	100	0	2.067
	Zn	4.4~5.1	100	0	4.833
	Cr	0.33~0.37	100	0	0.347
	Pb	0.28~0.34	100	100	0.317
Oilseed rape	*Cu*	1.3~1.8	100	0	1.633
	Zn	3.9~4.6	100	0	4.167
	Cr	0.34~0.34	100	0	0.34
	Pb	0.25~0.37	100	100	0.307

The average Cd and Pb concentrations in vegetable soils were 21.0% and 2.9% (moderate and severe pollution), respectively. The average Pb exceeded standard of roadside vegetables was 43.2% and that of Cd was 18.6%. The average content of heavy metal in roadside dust was significantly higher Roadside soil, roadside soil and vegetables is a potential source of pollution. This can be learned that the new vegetable base of vegetables in the Pb content exceeded the surrounding road vehicle exhaust gas caused by the Pb. Baqiao new vegetable base near the Bahe River, there is no heavy industry around, so the rest of the heavy metal content less[5].

The results showed that the heavy metal contents in leafy vegetables were higher than those in eggplant fruits and vegetables, mainly due to the distance of the vegetables from the roots and the migration of heavy metals. Therefore, the content of heavy metals in the vegetables was lower than that of the leafy vegetables Class vegetables, which Wang Lifeng study consistent with the results[6].

1) Single factor evaluation analysis

The results of Table IV show that the content of Cu and Zn is very low, and the Pi value is much lower than 1, indicating that these two kinds of heavy metals have not been polluted. The Cr value of Pi does not reach 1, indicating that there is no pollution, but its value relative to the former two large, should be monitored. The content of Pb in the table is more than 1, indicating that the eight kinds of vegetables by the Pb pollution, the maximum value of

1.85, indicating that has been at a relatively high level, by the pollution is very serious[7,8].

TABLE IV. EVALUATION OF SINGLE POLLUTION INDEX

Vegetable species	Cu	Zn	Cr	Pb
Eggplant	0.05	0.16	0.4	1.55
	0.09	0.175	0.46	0.95
	0.06	0.175	0.68	1.25
Tomato	0.11	0.215	0.64	0.9
	0.1	0.21	0.44	1
	0.06	0.195	0.72	1
Pepper	0.1	0.175	0.3	1.05
	0.1	0.115	0.34	0.55
	0.11	0.135	0.4	0.7
Cucumber	0.15	0.14	0.4	1.1
	0.12	0.15	0.4	1.15
	0.05	0.15	0.44	2
Chrysanthemum	0.17	0.225	0.7	1.7
	0.19	0.235	0.66	1.65
	0.2	0.25	0.58	1.5
Romaine Lettuce	0.15	0.235	0.44	2
	0.15	0.24	0.5	1.75
	0.19	0.235	0.8	1.1
Leek	0.19	0.25	0.74	1.4
	0.22	0.255	0.68	1.65
	0.21	0.22	0.66	1.7
Oilseed rape	0.18	0.23	0.68	1.25
	0.18	0.2	0.68	1.5
	0.13	0.195	0.68	1.85

2) Multi-factor evaluation analysis

In this paper, the Nemerow index method is used. Pi is the average pollution index of heavy metals in vegetables, Pi max is the maximum pollution index of heavy metals in vegetables, and P_{neomei} is the pollution index of Nemero.

The Nemerow index was calculated to be 0.7, 0.7 to 1.0, 1.0 to 2.0, 2.0 to 3.0, and 3.0, respectively, for heavy metal content in vegetables: safety, cordon, light pollution, heavy pollution and heavy pollution.

It can be concluded from Table V that the Nemerow index of tomatoes and peppers is 0.780064 and 0.780326, respectively, in the range of 0.7 to 1.0 in eggplant, tomato, pepper, cucumber, and chrysanthemum, lettuce, leek and oilseed rape. Two vegetables in the cordon, should be sustained attention, and do the appropriate preventive measures. While the eggplant, cucumber, chrysanthemum, lettuce, Oilseed rape, leek, Nemerow index were 1.15, 1.16, 1.29, 1.29, 1.48, 1.38, in the range of 1.0 to 2.0, belonging to mild pollution, the relevant departments should be carried out immediately Pollution control and pollution treatment and other corresponding actions[9,10].In general, the Nemerow index of heavy metals in vegetables is lower than that of the heavy metals in leafy vegetables, which indicates that the pollution of eggplant vegetables is less than that of leafy vegetables.

TABLE V. NEMERO INDEX OF POLLUTION EVALUATION TABLE

Vegetable species	Nemerow index	Vegetable species	Nemerow index
Eggplant	1.151629	Chrysanthemum	1.292505
Tomatoes	0.780064	Leek	1.29501
Cucumber	1.161381	lettuce	1.486845
Pepper	0.780326	Oilseed rape	1.385666

IV. CONCLUSION

- Baqiao new building vegetable base, most of the heavy metal content of vegetables did not exceed the standard, only the content of Pb higher than the national standard should be addressed.
- Solanaceous vegetables in the low content of heavy metals; leafy vegetables, high levels of heavy metals in vegetables.
- Eight kinds of vegetables were not contaminated by Cu, Zn and Cr, Cr content should be monitored; Pb content was very high, and the pollution was serious.

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