ISSN: 2230-9926

Available online at http://www.journalijdr.com

IJDR

International Journal of
DEVELOPMENT RESEARCH

International Journal of Development Research
Vol. 3, Issue, 12, pp.065-067, December, 2013

Full Length Research Article

NITRATE CONTAMINATION IN VEGETABLES FROM TWO SELECTED CITIES IN CHINA

***He, Jiang and Shi, Jianzhao**

College of Life Science, Hunan University of Arts and Science, Changde Hunan 415000, *PR* China

ARTICLE INFO

Article History:
Received 09th September, 2013
Received in revised form
20th October, 2013
Accepted 30th November, 2013
Published online 18th December, 2013

Key words:
Nitrate contamination;
Vegetables;
Changde;
Yangling

ABSTRACT

Nitrate contamination is one aspect of the safety issue about vegetables. A fast determination method of nitrite was used to access the nitrite contamination level of vegetables sampled form two selected cities in China (Changde and Yangling). The result indicated that the nitrate contamination level of vegetables from Yangling is higher than vegetables form Changde. The rood vegetables showed the highest contamination level and leaf vegetables and solanaceous vegetables showed lower. Most of test samples contaminated nitrate with level higher than they corresponding MRL. The nitrate contamination situation of vegetables in the select cities is less optimistic, more works were needed to be done for agricultural management department.

INTRODUCTION

Fresh vegetables are an important part of the food pyramid, as they provide vitamins and minerals essential to health and well-being. On the other hand, imperfect vegetables are often used as feed for domestic animals in China. However, the safety situation of vegetables is grim in recent years, especially in developing countries. Safety issues about vegetables including lots of aspects, such as pathogens (Amoah *et al.,* 2006; Liliane *et al.,* 2012), pesticide residues (Amoah *et al.,* 2006; Bhanti and Taneja 2007), heavy metals (Yang *et al.,* 2011; Mayuri *et al.,* 2012) and so on. These issues have been widely investigated in different countries by scholars, but the issue of nitrate contamination in vegetables has not paid enough attentions in recently years. Nitrate can turn into nitrite by the effect of nitrifiers in the stomach, and then nitrosamines, which are known to be mutagenic and carcinogenic, will be formed by the reaction of nitrite with various proteins in the digestive system. Vegetables readily accumulate nitrate, and about 80 percent of nitrate intake by people come from vegetables (Zhou *et al.,* 2000). Hence, the profile of nitrate contamination is very important for consumers selecting health vegetables and farmers selecting appropriate vegetables for animal cultivation. In the present work, two typical cities, one located at the central and southern of China (Changde) and one located at the northwest of China (Yangling), were selected for the study of nitrate contamination profile of vegetables.

Corresponding author: He, Jiang
College of Life Science, Hunan University of Arts and Science, Changde Hunan 415000, PR China

MATERIALS AND METHODS

Cities of Changde and Yangling were selected for the current investigation. The former (111.51° E, 29.02° N) is located at the central and southern of China, and the latter (108.09° E, 34.26° N) is located at the northwest of China. Different kinds of seasonal vegetables were collected from the local farmers market or supermarket and the nitrate contamination of these samples were analyzed in the same day at local place. For each vegetable, about 500 g original sample was collected and chopped, then about 50 g test sample was prepared. The method applied to analyze nitrate content was originated from a work published by Yu *et al.* (2005). The general principle of this method is nitrate nitrogen can react with salicylic acid to form nitrate salicylic acid under concentrated acid conditions, and nitrate salicylic acid will rearranged to form a yellow product under alkaline condition (pH higher than 12). Briefly, 5 g test sample was placed in test tube and 20 mL deionized water was added. After extracting in boiling water bath for 30 minutes, the sample was flitted and the filtrate was fixed to 50 mL. Then, 0.1 mL of the extract was transferred to 0.4 mL 5% salicylic acid-concentrated sulfuric acid solution. After reacting at room temperature for 20 minutes, 9.5 mL NaOH

solution (8%) was slowly added to the sample and cooled to room temperature again for colorimetric analyze under 410 nm by UV spectrophotometer (UV-1750, SHIMADZU). Potassium nitrate was used for standard curve developing and then for quantitative analyzing. The detect line range of nitrate is 0.5 mg/kg to 60 mg/kg. The solution was appropriately diluted when the absorbance is out of the line range. The recoveries of this method for nitrate determination in some selected vegetables samples were ranged from 88% to112% (Table 1). The results of nitrate determination were showed as Mean±SD, and the number of replications was nine, which is 3 sampling place multiply by 3 sampling time.

Table 1. Recoveries of nitrate in different vegetables

Vegetables	Testing laboratory	Recovery %
Chives	Yangling	102.3±4.7
Tomato	Yangling	92.2±5.3
Carrot	Changde	99.1±5.3
Tomato	Changde	104.0±8.2
Green cabbage	Changde	98.7±6.8

RESULTS AND DISCUSSION

Concentrations of nitrate in vegetables depend on a list of factors, such as the temperature and light in which they are grown and the concentrations of nitrate in the soil, fertilizers and water used to grow the vegetables. The detection results of nitrate contamination in vegetables from Changde and Yangling were presented in Figure 1.

of edible mushroom, and significant differences of nitrate contamination also displayed between shitake mushroom form Changde and pleurotus ostreatus from Yangling, agriculture water might also affect the nitrate contamination of vegetables significantly. Compared to other similar study, the nitrate contamination situation of vegetables in the select cities is similar to other cities in China (Zhou *et al.,* 2000) and more serious than other countries (Firdevs *et al.,* 2010).

In Figure 1, different profile of nitrate contamination also displayed by different vegetable types. The 71 rood vegetables showed the highest contamination level, and leaf vegetables and solanaceous vegetables showed lower. This result is in accordance with some previous work carried out in other cities in China (Zhou *et al.,* 2000). WHO, FAO and EU have indicated that the acceptable daily intake (ADI) of nitrate is 3.6 mg/kg. According to this value, China has established the Maximum Residue Limit (MRL) of nitrate in different type vegetables. The bad thing is that, the nitrate contamination levels of vegetables from Yangling are all higher than corresponding MRL, with the exception of spinach and Chinese cabbage. Slightly better situation was present in vegetables form Changde, where contamination levels of leaf vegetables, carrot and green pepper are lower than they corresponding MRL (3000 mg/kg, 2500mg/kg and 440mg/kg, respectively). In general, the nitrate contamination situation of vegetables in the select cities is less optimistic. For consumers, it is better to know how to select health vegetables. For example, leaf vegetables are contaminated with slightly less nitrate (relative to its MRL), and can as priority selection.

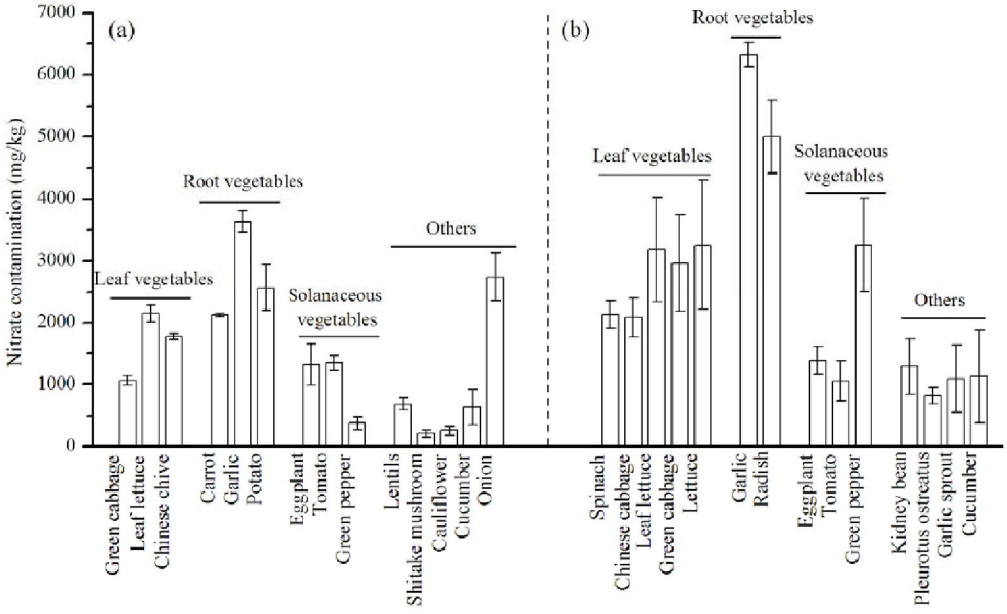

Figure 1. Nitrate contamination in vegetables form Changde (a) and Yangling (b)

Overall, the nitrate contamination level of vegetables from Yangling is higher than vegetables form Changde, especially for the root vegetables and green pepper. These significant differences might mainly owing to the differences between the soils of the two selected cities. Yangling is a city located at the northwest of China, where soil alkalization is more serious, hence more serious nitrate contamination status is displayed. As soil was not directly used for artificial planting

In addition, results have indicated that, different parts of vegetable contaminated with different level of nitrate. Specifically, for left vegetables, the nitrate content of petiole was higher than blade (Figure 2a). So, blade can preferentially selected for consumers. For agricultural producers, more scientific water and nutrient managements were recommended to control the nitrate contamination level and then provide more health vegetables. In the present study, nitrate

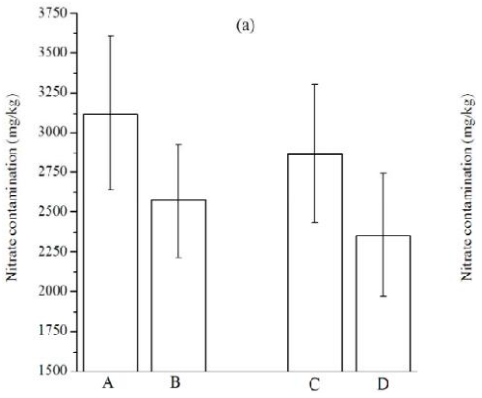

Figure 2. Nitrate contaminations in different part of vegetables (a) and vegetables from different planting condition (b). A: petiole of green cabbage; B: blade of green cabbage; C: petiole of spinach; D: blade of spinach; E: tomato from conventional planting condition; F: tomato from pollution-free vegetable produces condition

contamination level of same vegetable but growth under different condition was comparatively analyzed. Result indicated that, according to the requirement of pollution-free vegetable production, nitrate contamination level of vegetables would be greatly reduced (Figure 2b). Hence, agricultural management department should continue to strengthen the promotion of pollution-free vegetable production and ensure enough health vegetables can selected for consumers. People from western country prefer raw vegetables, while vegetables often consumed after cooking in China. The cooking process will certainly affect the nitrate content of vegetables. For example, Surendra and Adrian (2008) have indicated that boiling reduces nitrate content by 47–56%, whereas frying in Soya bean oil elevates nitrate content by as much as 159–307%, and no significant change was observed in nitrate content after baking. These results reminded us to select an appropriate cooking method for vegetables. On the other hand, the seasonal variations of climate also certainly affect the nitrate contamination level of vegetable. For example, Parks *et al.* (2008) have indicated that fresh leafy vegetables available during a 6-month period on the Australian market can range in nitrate-N from 12 to 1400 mg/kg fresh weight. For access the risk of nitrate, a more accurate vegetable-borne nitrate intake is urgently needed, and this is the further research interest of our group. For this, a lot of factors must take into account, such as the seasonal variation of nitrate contamination level in vegetables, the effect of cooking process to the nitrate content of vegetables and the amount of vegetable consumption.

Acknowledgements

This work was financial supported by scientific research project of the education department of Hunan (12C0828) and doctoral scientific research project of Hunan University of Arts & Science (2011).

REFERENCES

Amoah, P., Drechsel, P., Abaidoo, R. C. and Ntow, W. J. 2006. Pesticide and pathogen contamination of vegetables in Ghana's urban markets. *Archives of Environmental Contamination and Toxicology*, 50: 1–6.

Bhanti, M. and Taneja, A. 2007. Contamination of vegetables of different seasons with organophosphorous pesticides and related health risk assessment in northern India. *Chemosphere*, 69: 63–68.

Firdevs, M., Fatma, S. and Neslihan, E. 2010. Nitrate and nitrite contents of some vegetables consumed in south province of Turkey. *Journal of Animal and Veterinary Advances*, 9: 2013–2016.

Liliane, C. M., Norma, T. N. M., Anderson, S. S. and Jose, L. P. 2012. Microbiological quality and safety of minimally processed vegetables marketed in Campinas, SP-Brazil, as assessed by traditional and alternative methods. *Food Control*, 28: 258–264.

Mayuri, C., Arvind, K. N. and Sanjay, K. G. 2012. Metal contamination in market based vegetables in an industrial region, India. *Bulletin of Environmental Contamination and Toxicology*, 89: 129–132.

Parks, S. E., Huett, D. O., Campbell, L. C. and Spohr, L. J. 2008. Nitrate and nitrite in Australian leafy vegetables. *Australian Journal of Agricultural Research*, 59: 632–638.

Surendra, P. and Adrian, A. C. 2008. Nitrate-N determination in leafy vegetables: Study of the effects of cooking and freezing. *Food Chemistry*, 106: 772–780.

Yang, Q. W., Xu, Y., Liu, S. J., He, J. F. and Long, F. Y. 2011. Concentration and potential health risk of heavy metals in market vegetables in Chongqing, China. *Ecotoxicology and Environmental Safety*, 74: 1664–1669.

Yu, L. H., Kang, L. J., Yu, X. B. and Lv, X. L. 2005. Study on fast determination method of nitrite pollution in vegetable. *Journal of Jilin Agricultural University*, 27: 76-78.

Zhou, Z. Y., Wang, M. J. and Wang, J. S. 2000. Nitrate and nitrite contamination in vegetables in China. *Food Reviews International*, 16: 61–76.

****