**Nitrite Contents in Fresh Vegetables of Different Families and Genus**

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**Abstract:** The aim of this study is firstly aimed at investigating the contents of nitrite in common consumed vegetables according to families and genus classification. The vegetables were randomly collected and analyzed in quartile sampling according to GB5009.30-2016. The vegetables were analyzed by the software of Spss20.0 and statistically significant Duncan multiple comparisons. The data indicates that the nitrite contents in different families and different genus vegetables in same family were significant (P<0.01). A relatively high nitrite concentration was observed in Chenopodiaceae which is 0.5920mg/kg dry weight. A relatively low nitrite concentration was observed in Dioscoreaceae that concentration is 0.0032mg/kg dry weight. The nitrite contents of different genus are large, in which the relatively high concentration samples were red beet root (0.886mg/kg dry weight), peanut (0.7485mg/kg dry weight), corn kernels (0.7119mg/kg dry weight), Lotus root (0.592mg/kg dry weight).

1. **Introduction**

The different nitrite contents in vegetables are resulted from the type of vegetables, and environmental factors such as cultivate type, composition of soil, light intensity, temperature and moister, growth density, duration of growth period, harvesting time, storage time, edible plant portion and use of nitrogen fertilizer [1]. Vegetables can also produce nitrite by oxidation of endogenous nitrogen oxides, and nitrate can be reduced by nitrite reductase to produce nitrite [2]. Nitrite itself is relatively non-toxic but as precursor material of nitrosamines poses a threat to human health. Nitrite in the acidic environment can form a strong carcinogenic nitrosamine [3]. Nitrosamines have a strong carcinogenic effect, which can cause esophageal cancer, stomach cancer, liver cancer and colorectal cancer [4]. This study describes the nitrite contents in vegetables of 15 families and 46 genus.
2. Material and Method

2.1. Chemicals and Reagent
Sodium Nitrite (CAS:7632-00-0), Potassium Ferrocyanide, Zinc Acetate Dihydrate, Aceticacid, Sodium Borate, Chlorane, p-aminobenzene sulfonic acid, N-1-Naphthylethylene diamine dihydrochloride, All of the chemical reagents were obtained from China National Accord Medicines.

2.2. Samples
A total of edible vegetable samples was freshly collected from Supermarket. They were cleaned in tap and deionized water three times. The edible portion were cut into small pieces and then were placed in the homogenizer (JT-C). Fresh vegetables were placed in a refrigerator at -4°C and detected in 12 hours.

2.3. Nitrite Extraction
Homogenized sample (5g) was weighed out and placed into 50mL beaker, 12.5mL 50g/L saturated Borax solution was added in the sample. Later the sample was transferred to the conical flask in 70°C water and mixed. The mixed solution was heated for 15mins in water bath kettle. After 15mins, the flask was transformed to the cold-water bath so as to let the solution cool to room temperature. Potassium ferrocyanide solution (5mL) was added to the flask, Zinc Acetate solution (5mL) was added followed by to precipitate the protein. The solution constant volume to scale line in water. Finally, the solution with shaking stand for 30 another mins. After removing the upper fat, the extracts were filtered through φ18cm filter-papers. The first zone of filtrate was discarded in order to overcome possible nitrate contamination from the filter-papers.

2.4. Determination of Nitrite
Absorbance was measured at 538 nm using a UV/VIS Spectrophotometer (TU-1810) with digital readout screen where absorbance of the sample was displayed. Absorbance reading for each sample was taken three times and the average of the reading recorded.

2.5. Data Processing Method
The original data was entered into Excel and analyzed statistically with SPSS software for windows Version 20.0 and drewed with Excel later.

Table 1. Nitrite content of vegetables in different families (mg/kg wet weight).

| family       | Genus | Mean±standarddeviation |
|--------------|-------|------------------------|
| Chenopodiaceae | 3     | 3.856±0.002            |
| Amaranthaceae  | 1     | 3.754±0.162            |
| Convolvulaceae | 3     | 3.856±0.002            |
| Nymphaeaceae   | 1     | 3.036±0.000            |
| Umbelliferae   | 5     | 2.856±0.002            |
| Zingiberaceae  | 4     | 2.456±0.007            |
| Gramineae      | 3     | 2.356±0.003            |
| Cruciferae     | 11    | 2.271±0.010            |
| Leguminosae    | 9     | 2.246±0.003            |
| Compositae     | 6     | 2.094±0.0020           |
| Cucurbitaceae  | 8     | 2.012±0.010            |
| Liliaceae      | 9     | 1.320±0.0090           |
| Solanaceae     | 8     | 1.302±0.0010           |
| Araceae        | 1     | 0.122±0.003            |
| Dioscoreaceae  | 1     | 0.021±0.0030           |
### Table 2. Nitrite content of vegetables in different families (mg/kg dry weight).

| family            | Genus | Mean±standarddeviation |
|-------------------|-------|------------------------|
| Nymphaeaeae       | 1     | 0.5920±0.0007          |
| Chenopodiaceae    | 3     | 0.5205±0.0004          |
| Gramineae         | 3     | 0.3602±0.0000          |
| Convolvulaceae    | 2     | 0.3300±0.0000          |
| Leguminosae       | 7     | 0.315±0.0000           |
| Zingiberaceae     | 2     | 0.263±0.0000           |
| Umbelliferae      | 3     | 0.2463±0.0000          |
| Araceae           | 1     | 0.2401±0.0010          |
| Amaranthaceae     | 1     | 0.162±0.0020           |
| Liliaceae         | 8     | 0.158±0.0010           |
| Cruciferae        | 3     | 0.134±0.0000           |
| Compositae        | 3     | 0.108±0.0010           |
| Solanaceae        | 3     | 0.108±0.0010           |
| Cucurbitaceae     | 5     | 0.101±0.0010           |
| Dioscoreaceae     | 1     | 0.0032±0.0000          |

3. Results and Discussion

The contents of nitrite (Wet Weight) in 15 family vegetables in are shown in table 1. The result is different significantly in 15 family (P<0.05). The limit standard nitrite content in vegetable is less than or equal to 4.0mg/kg (fresh weight). The data in table 1 indicates that exceeding standard nitrite content vegetables are beans (4.602mg/kg wet weight) in Leguminosae, endive (4.151mg/kg wet weight) in Compositae, spinach (4.691mg/kg wet weight) in Chenopodiaceae, swamp cabbages (4.080mg/kg wet weight) in Convolvulaceae.

In order to eliminate the nitrite content difference caused by the different water content in the different family vegetables, the fresh weight of all the vegetables is changed to dry weight. The contents of nitrite (Dry Weight) in 15 family vegetables are shown in table 2.

3.1. Nitrite Content in Liliaceae

The low levels of nitrite of onion and garlic found in this study could be as a result of chemical components (figure 1). Organic sulfides in onion and garlic can block the formation of Nitrosamines [5] Sulphydryl and nitrite can form nitrous esters to remove nitrite effectively. The nitrite content of onion in early growth period was 0.1279mg/kg dry weight, while late growth period onion was 0.0408mg/kg dry weight in the same variety. which is due to the high absorption and transformation intensity of nitrogen in the plant growth and development period.

3.2. Nitrite Content in Leguminosae

In the oxidation conditions and the participation of soil microorganisms, ammoniums produce...
nitrification and transform to nitrate ions, in which part of nitrate ions are assimilated and part of nitrate ions in the shape of denitrification in the soil, the formed nitrite ions are also absorbed by the plant. In the same leguminous plants, significant differences (figure 2) in content are caused by different breeds genotype, bean king (0.3012 mg/kg dry weight), white not old (0.1442 mg/kg dry weight). One of the main reasons may be different genotypes caused by genetic variation in the long-term cultivation and breeding process [6].

3.3. Nitrite Content in Cruciferae
The results (figure 3) showed that the nitrite content of brassica and radish in Cruciferae exist significant difference (P=0.194). The consequence of Cabbage mustard’s quality deteriorated arising from high nitrogen treatment and content decrease of Vitamin C and sugar [7]. The fresh radish nitrite content is below 1 mg/kg wet weight, because the amount and activity of nitrite reductase is much more than nitrate reductase in vegetable tissues and more stable and inactive. It’s also related to the process that the nitrite nitrogen is reduced to NH+4 in time [8].

3.4. Nitrite Content in Compositae
In the Asteraceae (figure 4), the endive is high because it’s suitable for fertilizer and more nitrogen [9]. The reason of nitrite content in Chrysanthemum coronarium and Lobular Chrysanthemum is different is that the environment and nitrate reductase activity [10].

3.5. Nitrite Content in Cucurbitaceae
The result (figure 5) showed that the nitrite contents of three different cucumber were significantly affected by genotype and environmental factors followed by (P<0.05). Nitrite nitrogen compounds formed by free nitrate nitrogen in the action of nitrate reductase conversion cannot completely convert to ammonium salts into the nitrogen metabolism cycle, resulting in more nitrite accumulate in the fruit [11]. The nitrite in the Loofah and Wax gourd were not detected almost because the nitrate reductase is little in the fruit and nitrate will be reduced to nitrite under the action of nitrate reductase and NADH most in the leaves [8].

![Figure 3. Nitrite Content in Cruciferae](image1)

![Figure 4. Nitrite content in Compositae](image2)
3.6. Nitrite Content in Solanaceae

In the Solanaceae, the highest nitrite content is potato (0.2151 mg/kg dry weight, figure 6), Round eggplant (0.185 mg/kg dry weight) followed by, the lowest is pepper (0.0638 mg/kg dry weight) and tomatoes (0.0216 mg/kg dry weight). The nitrite content in Solanaceae is relatively little because of antioxidant active ingredients such as polyphenols and flavonoids in pepper [12] and lycopene, vitamin C and various antioxidant enzymes in Tomato. The mechanism of action is mainly to inhibit the radicals [13].

3.7. Nitrite Content in Gramineae

Bamboo shoot (figure 7) is the kind of vegetable of low accumulation in nitrite which are associated to reduction of sugar and vitamin C. The results showed that Maize is 0.7119 mg/kg dry weight. It’s attributed to contained reductase and the absorbing of nitrogen [14]. The nitrite content of wild rice stem is related to the change of reducing sugar whose content has a trend of rise first then fall in its growing season, so the nitrite content of it change with reducing sugar [15].

3.8. Nitrite Content in Umbelliferae

Celery (figure 8) is a nitrate-accumulating vegetable [16]. The higher nitrate content in celery stems may be the propagation of nitrate-reducing bacteria in celery [17]. The dry matter content of nitrite in celery is relatively low because it contains a lot of antioxidant component such as volatile oil and flavonoids [18]. The relatively high nitrite content in Coriander is attributed to the strong ability of absorbing fertilizer.

3.9. Nitrite Content in Zingiberaceae

Although ginger (figure 9) has diarylheptanoids as the antioxidant substance [19], Ginger is a kind of plant that require high nitrogen. In this paper, Ginger nitrite is 0.4651 mg/kg dry weight, while the Tender ginger is only 0.0732 mg/kg dry weight. The fact indicates the Tender ginger contains much more antioxidant activity.
3.10. Nitrite content in Convolvulaceae

Purple potato and sweet potato are suitable for potassium fertilizer condition (figure 10). The potassium as an activator of nitrate reductase, so as to significantly improve the activity of nitrate reductase and accelerate the reduction of nitrate into nitrite though increasing the supply of potassium [20].

\begin{figure}
\centering
\includegraphics[width=\textwidth]{figure9.png}
\caption{Nitrite content in Zingiberaceae}
\end{figure}

\begin{figure}
\centering
\includegraphics[width=\textwidth]{figure10.png}
\caption{Nitrite content in Convolvulaceae}
\end{figure}

3.11. Nitrite Content in Chenopodiaceae

Spinach (figure 11) could accumulate higher content of nitrite with the higher nitrate reductase activity [21]. The activity of nitrate reductase was increased with the increase of nitrogen application rate. The content of nitrite in beet leaves is higher than that of beetroot, which is related to the early transport of fertilizer from root to leaf [22].

\begin{figure}
\centering
\includegraphics[width=\textwidth]{figure11.png}
\caption{Nitrite content in Chenopodiaceae}
\end{figure}

4. Conclusion

The average content of nitrite in different families was different. The highest content was Nymphaeaceae (0.5920mg/kg dry weight), the lowest was the Dioscoreaceae (0.0032mg/kg dry weight). The different genus concentrations are large, in which the relatively high concentration include red beet root (0.886mg/kg dry weight), peanut (0.7485mg/kg dry weight), corn kernel (0.7119mg/kg dry weight), Lotus root (0.592mg/kg dry weight).

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