Analysis on Present Situation of Vegetable Nutrition, Safety and Quality Detection

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Abstract Vegetables are essential and important foods in people's daily production, which are closely related to human health. Focusing on the present situation of vegetable nutrition and safety quality detection from detection indexes and detection methods, this paper discussed the selection of detection indexes and detection methods for vegetable nutrition and safety quality, and put forward the main research direction of vegetable nutrition and safety quality detection in the future, providing guidance and reference for improving vegetable nutrition and safety quality evaluation.

Key words Vegetable; Nutrition; Safety; Quality; Detection

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With the development of society and the improvement of people's living standards, people's requirements for vegetable quality tend to be diversified. People not only demand vegetables to eat, but also require that vegetables supplied all year round are diverse, nutritious, fresh and delicious, and pollution-free[1].

The internal quality of vegetables is nutritional quality, and the external quality is commodity quality. The former mainly refers to the contents of nutrients, such as vitamins, minerals, protein, fat, organic acids and aromatic substances. In addition, it also includes the existence and level of harmful substance residues that are of great significance to human health. The latter focuses on the appearance of goods as an important basis for commodity classification, such as size, shape, color and texture[2-3]. Based on a large number of research results, vegetable quality includes sensory quality, nutritional quality, hygienic quality and storage and processing quality. The sensory quality includes the size, shape, taste, color, taste, texture and flavor of vegetable products, and it is the direct factor affecting consumers' desire to buy vegetables and determines the commodity value of vegetables. The nutritional quality indicators include the contents of mineral nutrients, protein, vitamins, carbohydrates and other substances. The hygienic quality, also known as safety quality, mainly includes biological pollution such as bacteria, parasite eggs and chemical pollution such as nitrate accumulation, heavy metal enrichment and pesticide residues in vegetables. The storage and processing quality refers to the storage resistance of vegetables and the properties suitable for various special purposes. Among them, the nutritional quality and hygienic quality of vegetables are inseparable from the nutritional health of human body. With the continuous improvement of people's cultural quality and living standards, as well as the enhancement of health care awareness, the nutritional and safety quality of vegetables have increasingly become a hot concern of consumers and researchers.

Current Situation of Nutrition and Hygienic Quality Detection of Vegetables

The contents of crude protein, amino acids, soluble total sugar, vitamin C, crude ash, nitrate and nitrite in vegetables are important nutritional and hygienic quality indicators. However, there are dozens of common vegetables, and the nutritional and hygienic quality detection indexes of different vegetables are different. Therefore, tomatoes, chilli peppers and cucumbers of fruit vegetables, spinach and celery of leafy vegetables, and radishes of root vegetables were selected as representatives to classify and summarize the nutritional and hygienic quality detection indicators of vegetables at this stage[4].

Tomatoes and cucumbers are popular fruits and vegetables among consumers all over the world, and there is a wealth of research on the quality of these two vegetables. Zhang *et al.*[5] tested the quality indexes of tomatoes, such as vitamin C, lycopene, soluble solids, soluble protein, soluble sugar, sugar-acid ratio, amino acid, nitrate and nitrite, and thought that these nine quality indexes were important indexes for evaluating the nutritional quality of tomatoes, among which the contents of nitrate and nitrite seriously affect people's diet health. Reducing the contents of nitrate and nitrite in tomato fruits and increasing the contents of vitamin C, lycopene, soluble solids, soluble protein, soluble sugar, amino acids and sugar-acid ratio have become the first choice for vegetable researchers in breeding for quality. Wang *et al.*[6] selected six indexes to evaluate tomato quality in the multivariate statistical analysis of tomato quality traits, including soluble solids, lycopene, vitamin C, soluble total sugar, organic acid content and sugar-acid ratio, and considered that these indexes were significantly correlated with tomato quality.

Chili pepper is one of the most important vegetable crops in the world and deeply loved by people because of its seasoning

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function. Pepper fruit is rich in carotene and vitamin C besides capsaicin, and its nutritional quality has been widely concerned. Ding *et al.* [7] chose capsaicin, capsicine, vitamin C and soluble protein content as four indicators to investigate the changes of nutritional quality in peppers. In most studies on the effects of planting or fertilization methods on the quality of chilli peppers, capsaicin, capsicine, vitamin C, soluble protein and soluble total sugar are generally selected to evaluate the quality of pepper fruit. Therefore, the contents of capsaicin, capsicine, vitamin C and protein are important indexes for evaluating the nutritional quality of chilli peppers.

Spinach contains more protein, vitamins, dietary fiber, iron, calcium, magnesium and other minerals, and is one of the leafy vegetables with rich nutrition. However, spinach is also a kind of vegetable accumulating nitrate and oxalic acid, which seriously affect human health. Qi *et al.* [8] found in the process of evaluating the differences in nutritional quality of spinach varieties from different sources that increasing the contents of water, vitamin C, soluble sugar and crude fiber and reducing oxalic acid, tannin, and nitrate content are main technical indicators for spinach quality breeding, and also provide reference for high-quality cultivation. Xie *et al.* [9] also selected chlorophyll, vitamin C, nitrate, crude fiber, soluble sugar, soluble protein and titratable acid contents as quality indicators in the study on the effects of different storage conditions on spinach quality. Celery is an important vegetable with strong adaptability and special aroma, which is produced in spring, autumn and winter. However, because of its nitrogen-loving growth characteristics, nitrate content has always been an important index for quality detection.

Radish is one of the root vegetables originated in China. Its fleshy roots is not only rich in nutrients needed by human body, but also contains many natural active ingredients which are deeply loved by consumers. Because there are many kinds of radishes, different varieties differ in nutritional components and have their own characteristics. For example, carrots are rich in carotene and vitamins. Xinlimei radishes are rich in Fe, while carrots contain a lot of Zn. Although there are differences in the unique nutritional components of different kinds of radishes, most studies on the quality of radishes mainly take the contents of vitamin C, soluble solids, soluble protein and crude fiber as quality detection indicators[10].

Detection Methods of Nutritional and Hygienic Quality of Vegetables

In order to understand the nutritional and hygienic quality of vegetables, it is necessary to test the nutritional and hygienic quality indexes of vegetables according to scientific methods, and make an accurate evaluation of vegetable quality according to the test results. The detection methods of common nutritional and hygienic quality indexes in vegetables were summarized (Table 1). As can be seen from Table 1, two kinds of important health quality indicators, heavy metal contents and pesticide residue contents, are generally detected by the detection methods recommended by national standards. For routine detection indexes such as soluble solid content, total acidity, vitamin C content, soluble reducing sugar content, soluble protein content, crude fiber content and nitrate content, scholars often adopt colorimetry as a quick and convenient detection method. As for the specific nutritional quality indicators such as lycopene content, capsaicin content and capsicine content, with the progress of modern technology, scholars will apply high performance liquid chromatography to detect them in addition to conventional colorimetry. It can be seen that the methods used for detecting the nutritional and hygienic quality indexes of vegetables can be summarized in two categories: quick and simple detection methods (such as colorimetry and titration) and accurate detection methods (such as high performance liquid chromatography and gas chromatography). According to the principles for evaluation and selection of detection methods, when national standards, industry standards and reference methods have been listed for the same testing indicator, corresponding standard requirements should be followed. If there are two or more test methods for the same testing index, the laboratory can choose appropriate testing method according to its own equipment and other conditions. Therefore, researchers can select appropriate detection methods from Table 2 according to the above principles when testing nutritional and hygienic quality indexes of vegetables.

Table 1 Detection methods of common nutritional and hygienic quality indexes in vegetables

Detection index	Detection method
Soluble solids	Hand-held refractometer, Abbe refractometer
Lycopene	Extraction colorimetry, high performance liquid chromatography
Total acidity	Alkali titration
Vc content	2,6-Dichloroindophenol titration method
Soluble sugar content	3,5-Dinitrosalicylic acid colorimetry, anthrone colorimetry
Capsaicine	Sodium nitrite colorimetry, high performance liquid chromatography
Capsicine	High performance liquid chromatography, Kjeldah method
Protein	Coomassie brilliant blue G-250 staining method
Chlorophyll	Acetone reagent extraction spectrophotometry
Crude fiber	Acid-washing weight method
Nitrate content	Cadmium reduction-diazotization coupling spectrophotometry, salicylic acid colorimetry
Heavy metal content	ICP-MS
Pesticide residue content	Gas chromatography

Conclusions and Prospects

The nutritional and hygienic quality of vegetables are of great significance to human health, but there are many kinds of vegetables and complicated nutritional and hygienic quality indicators,

which makes it difficult for relevant staff to choose the detection indicators for nutritional and hygienic quality of vegetables. At present, there is little research on the index selection and method evaluation of vegetable nutrition and health quality in China, and there is a lack of a comprehensive, systematic and standard evaluation system. Therefore, it is urgent to carry out systematic research on the selection of indicators and evaluation methods for the nutritional and hygienic quality of vegetables, so as to ensure the nutrition, safety and hygiene of vegetables eaten by people and provide a theoretical basis for the substantial improvement of nutritional and hygienic quality of vegetables and the scientific and rational development and utilization of vegetable resources. In the future, the research work should be carried out in two aspects, of which the first is to formulate a comprehensive and scientific evaluation system, which will give a reasonable choice basis for vegetable nutrition and health quality indicators, and the second is to evaluate the nutritional and hygienic quality of different vegetable species and varieties, which will provide theoretical guidance for the evaluation of vegetable nutrition and safety.

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maltose and glucose by regulating amylase activity, and then participate in cell cycle regulation, energy metabolism reprogramming and other processes. In addition, the expression of cytoskeleton related genes may affect cell morphogenesis, cytokinesis and signal transduction efficiency. It is noteworthy that the root and leaf organs of *P. sibiricum* under continuous cropping showed significant stress adaptation characteristics, which can be attributed to the fact that plants build a multi-level stress defense system to cope with continuous cropping pressure by activating antioxidant genes such as APX and cat and metabolic regulatory genes such as HXK and Sus[8].

Conclusion

Through high-throughput sequencing technology, the root and leaf of *P. sibiricum* were sequenced to obtain 356 775 590 clean Reads without reference genome, and 400 854 unigenes were obtained after assembly. The analysis of differentially expressed genes showed that there were 21 916 differentially expressed genes in the leaves of *P. sibiricum* and 12 726 differentially expressed genes in the roots of *P. sibiricum*. The enrichment of go function and KEGG function found that continuous cropping may mainly affect the biological functions of *P. sibiricum* DNA binding transcription factor, glycosylhydrolase, glycosyltransferase, and other metabolic pathways such as plant hormone signal transduction, plant pathogen interaction, and biosynthesis of secondary metabolites. It provides a theoretical basis for further study on the molecular mechanism of Polygonatum continuous cropping obstacle.

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