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Advance on development utilization of rich selenium fruits

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Abstract
The selenium is one kind of extremely important trace element in ecological environment, it has the important physiological function in the plant, the animal, the human body. This article summarized the selenium content, ingredient and shape in the fruit, dynamic distribution of accumulation selenium in fruit tree and its relations with the soil, research on enhancing selenium's contain in fruits and so on. According economic efficiency, existence questions in rich selenium fruit development, proposed further studies and development countermeasures.

1. Introduction

As a trace element in the human diet, Selenium (Se) affects all stages of human growth and development [1]. Se (appropriate level) intake could enhance the ability of oxidation resistance in the humans and prevent some diseases, including hepatopathy, tumor, cardiovascular and Kaschin-Beck disease [2, 3]. Se as an antidote to heavy metals, it detoxifies arsenic, lead, cadmium and mercury in the human body, and also can combine with these heavy metals to form compounds that be excreted from the body[4]. In addition, selenium can prevent and treat diseases, regulate human immunity, and inhibit the occurrence of tumors and cardiovascular diseases [2]. It has various biological effects on the human body, such as delaying aging [3]. Se has a good name as a protective agent of life [5]. Because selenium is a mineral that cannot be made by people themselves, it must be obtained from food. Therefore, how to supplement selenium safely and effectively becomes an urgent problem to be solved. There are mainly 2 forms of inorganic selenium and organic selenium in nature. Inorganic selenium is more toxic, and organic selenium can be safely absorbed by the human body [6]. In consequence, the conversion of inorganic selenium into organic selenium for human absorption and utilization has become an essential way of human safety selenium supplement. In the aspect of selenium transformation, plants have significant advantages because of their high selenium conversion rate and rich organic selenium content. Especially as human food sources, crops can be used as a simple and effective carrier of human safe selenium supplementation [7].

In recent years, with the improvement of national economic strength and people's living standard, the selenium enrichment industry has received extensive attention from all walks of life. Australia, Denmark, the United States, Sweden, Germany and other countries have developed a variety of selenium-containing health products, selenium-rich agricultural products [8]. In China, selenium enrichment tea oil, selenium enrichment rice, selenium enrichment potato, selenium enrichment wheat, selenium enrichment tea, selenium enrichment edible fungus and other products have also been marketed and enjoyed by a vast number of consumers [9]. However, selenium enrichment products and related research in the fruit field are still lacking. Therefore, it is particularly urgent to study the cultivation technology and regulation of selenium enrichment fruit trees, explain the mechanism of selenium enrichment fruit trees, process selenium enrichment fruit products and research and develop high-value selenium enrichment functional products.

2. Research status of selenium-rich fruits

2.1 Content, composition and occurrence form of Selenium in fruits

The selenium content in 64 fruits of 24 varieties on the market was determined by intermittent flow hydride atomic fluorescence spectrometry. The results showed that the highest selenium content in citrus was 45.6 ng/g, followed by gongpear and red Fuji apple with the highest selenium content of 38 ng/g, and the lowest selenium content in golden dragon fruit was 1.7ng/g. From the results of the determination, in the natural state, the amount of selenium in the general fruit is very low.

Selenium can exist in organisms in the form of low molecular weight compounds and high molecular weight compounds. In many plants, selenium is bound to proteins in the form of seleno-amino acids, and protein selenium is the substance with the highest selenium content in plants. In addition to protein selenium, part of organic selenium in plants exists in the binding states of RNA, methionine, polysaccharide, pectin and polyphenols. At present, there are more than 10 important selenium-containing compounds found in plants, which can be roughly divided into the following three categories: (1) Seleno-amino acids and their derivatives, low molecular compounds for selenium to replace sulfur, such as seleno-cysteine derivatives, seleno-homocysteine derivatives, seleno-methionine and its derivatives, etc. (2) Metabolites of selenium, refer to elemental selenium (Se) and volatile selenium compounds. (3) Life macromolecule material, including selenoprotein and RNA, etc. The state of selenium in fruits is also mostly protein selenium, such as in tomato fruit protein selenium accounts for 90.89% of organic selenium [10].

2.2 Dynamic distribution of selenium accumulation in fruit trees and its relationship with soil

The accumulation degree of selenium in plants is related to the maturity degree of plants and the selenium content tends to decrease with fruit ripening. Generally, the distribution rule of selenium content in different parts of plants is from more to less in roots, stems and leaves, while applying and equalization [10] through applying selenium to tomatoes, it was found that the selenium accumulation in various parts of tomato plants at flowering and fruiting stage is from strong to weak in roots, fruits, flowers, stems and leaves.

The selenium content in fruit trees is related to soil, and fruit trees can absorb and use selenium from soil, including partial organic selenium, selenite and selenite available selenium. The order of available selenium content in different types of soils is: lateritic red soil > red yellow soil > red soil and acid purple soil. At the same time, the content of water-soluble selenium in soil depends on the total selenium content in soil and the physical and chemical properties of soil, both of which are related to the upper parent rock. At present, there are about 50 kinds of selenium minerals, most selenium exists in sulfide minerals, in sedimentary rocks, especially shale, there is a high selenium content, so the soil formed by these parent rocks often contains a high selenium. The formation of low selenium zones in China is mainly due to leaching. Except for rain water, the higher the pH value of soil, the greater the activity of selenium and the more serious the leaching loss [11]. The amount of selenium in soil is positively correlated with clay content, and the higher the selenium content is when the soil is heavy, and the higher the selenium content is when the soil is organic soil > fine soil > coarse soil.

2.3 Study on improving selenium content in fruits

Many researchers have studied the increase the selenium content of fruit, some drugs containing selenium is studied, such as the main sales are sodium selenite and sodium selenate, experts also developed for fruit trees "fu xi" brand of selenium element selenium fertilizer, amino acid complex, and selenium compound fertilizer, etc., and the use method and some research are made to improve the effect of selenium. For example, Hu *et al*. [12] from the Department of Basic Science of Northwest Agricultural University applied different concentrations of selenium solution to Qinguan apples by spraying them at flowering stage, injecting them into trunks and applying them to the upper soil, and studied the characteristics of selenium absorption by apple trees and effective methods to improve selenium content in apples. The results showed that spraying 0.2 μg/mL, 1.0 μg/mL and 10.0 μg/mL at flowering stage could increase the selenium content of fresh fruit by 6.55 times, 7.11 times and 1.3 times compared with the control (0.09 μg/g). Applying selenium 20 μg/mL, 80 μg/mL, 200 μg/mL, 600 μg/mL in apple orchard soil increased the selenium content of fresh fruit by 66.67%, 77.77%, 77.77%, 111.11% compared with the control, respectively. By injecting 20 μg/mL, 50 μg /ml, 500 μg /ml selenium into apple trunk, the selenium content of fresh fruit increased by 287.5%, 175%, 121.5% compared with that of control (0.008 μg /g). The results showed that all the three selenium application methods could achieve the selenium content of apple, and the effect of spraying at flowering stage and injecting on tree trunk was more significant. However, it is not the case that the higher selenium application amount is, the higher selenium content is. For example, when the selenium application amount is 10 μg/mL, the selenium application amount is 600μg/mL in soil, and the selenium injection amount is 500 μg/mL in tree trunk, the selenium content in apple decreased, indicating that there is an optimal range or peak absorption of selenium in apple tree. Wang *et al*. [13] applied selenopyrosin to the root of apple tree, which also increased the selenium content of fruit by 20% to 26.4 times.

3. Development and utilization of selenium-rich fruits and its prospect

Selenium-rich products, such as selenium-rich rice and selenium-rich apples, are popular in the market because selenium has obvious anti-cancer and anti-cancer effects. It is understood that selenium-rich fruit in the southern market, its price is about 3 times that of ordinary products, and more popular, production and management benefit greatly improved. For example, Pingyin County in Shandong province is an old apple producing area, with an apple area of more than 6600 hm^2.In order to promote the healthy development of fruit production and increase farmers' income, the county Science and Technology Committee approved the project, the county forestry Bureau carried out the production and supporting technology research of selenium-rich apples, which lasted for 2 years and achieved obvious results. The average selling price of selenium-rich apples was 3.6 yuan /kg, while the control apples were 0.9 yuan /kg, and the income per hectare increased by 81000 yuan. The economic benefits are significant [14]. The se-enriched pear, obtained by scientists from Dangshan Fruit Farm in Anhui Province, contains 30-50μg of selenium per kilogram, 100 times of the selenium content of ordinary

dangshan pear. More than 30,000 kg of "selenium-rich pears" produced by the plant are sold to Beijing and Shanghai at a high price of 30 YUAN /kg, and the supply is in short supply. Grain plays an indispensable role in human diet, and there are many kinds of vegetables and fruits, and different people have different tastes and choices. Therefore, grain should be the preferred direction for the development of selenium-rich agricultural products, rather than promoting all vegetables and fruits as selenium-rich products. However, fruit as a supplement can effectively correct the problem of insufficient selenium intake in the diet, so the production of selenium-rich fruits can be organized in the production bases of apples, pears and oranges.

Grain plays an indispensable role in human diet, and there are many kinds of vegetables and fruits, and different people have different tastes and choices. Therefore, grain should be the preferred direction for the development of selenium-rich agricultural products, rather than promoting all vegetables and fruits as selenium-rich products. As a supplement, but fruit can effectively correct the problem of insufficient selenium intake in the diet, so I can in apple, pear, citrus production base in the three fruits systematically selenium-rich fruits production due to the rich selenium content in selenium fruit have strict standards, to selenium fruit production in strict accordance with the technical specifications for production, In the process of selling, consumers' recognition of selenium-rich fruits is mainly based on the reputation of the brand and the enterprise, which is difficult for farmers with decentralized management. Therefore, the development of selenium-rich agricultural products must go to the market through industrial development. Selenium content in fruits should be strictly controlled within the national food hygiene standards. Therefore, when producing selenium-rich fruits, it is best to cooperate with food inspection and agricultural research institutes, rather than blindly produce them.

4. Conclusion

Combined with the current research situation, the author believes that further effective work should be carried out in the following aspects: (1) Studies on the biology of fruit trees and the toxicity of selenium to fruit trees: studies on whether a fruit tree belongs to selenium accumulation plant or not accumulation plant, and studies on the toxicity of selenium to the fruit tree. (2) Study on the metabolic mechanism of Selenium in fruit trees: to study the biochemical process and mechanism of selenium absorption, operation, transformation, consumption, accumulation and decomposition of selenium in fruit trees. (3) The physiological effect of selenium on fruit trees and its function: to study the effect of selenium on the growth and development of fruit trees and the demand of some fruit trees for selenium, to determine the standard of selenium content in orchard soil and the critical threshold of physiological toxicity. (4) Screening the types of selenium compounds used in the production of selenium-rich fruit trees, and studying the dose, concentration, period and frequency of application of selenium compounds in certain fruit trees. (5) Production base construction standards and technologies of selenium-rich fruits; The establishment of selenium-rich fruit brand and product certification, registration, testing.

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