Preliminary Study on the Standard of Selenium Content in Agricultural Products

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Abstract With the improvement of living standards, people pay more attention to the agricultural products with health protection function, and the selenium-rich agricultural products attract more and more consumers. The main biological role of selenium is to resist oxidation and inflammatory response, mainly focusing on resisting aging, preventing cardiovascular disease, protecting eyesight, counteracting or destroying the toxic properties, preventing cancer and thyroid disease. In most areas of China, there is a widespread shortage of selenium, thus producing selenium-rich agricultural products to provide natural selenium-rich health food to the areas in need of selenium, has gradually become a new hot spot of China's health food industry, but high content of selenium in food is detrimental to human body, even leads to selenium intoxication, and artificially adding inorganic selenium is difficult to guarantee that the selenium content of agricultural products is not exceeded. According to human body's daily demand for selenium in dietetics and the content of selenium in agricultural products in the Chinese food composition table, we put forward the recommendations on the standard of selenium in agricultural products, in order to provide the basis for China to formulate the health standard of selenium content in selenium-rich agricultural products.

Key words Selenium, Selenium-rich agricultural products, Selenium intoxication, Standard of selenium content

Selenium is a trace element, with the reputation of " the fire of life". Selenium is an indispensable trace element in human body, and only accounts for an infinitesimal fraction of the body weight, which can not be synthesized in the body, must be taken in from food. Although the content of selenium in the human body is very small, it plays an extremely important role in the functioning of the human body. Selenium is an important part of antioxidant enzymes and selenium-P protein in animal and human body, playing the role of balancing reduction-oxidation in the body[1]. Studies have shown that it has the function of increasing immunizing power of animals, and the research of selenium's impact on immunity and selenium's role of preventing cancer in the world is a hot issue in this field[2].

Selenium has been regarded as essential trace element for human body. At present, the recommended daily adult intake by the Chinese Nutrition Society is 50 -250 μg[3]. China is rich in selenium resources, but there are many regions in need of selenium, and the selenium intake in two thirds of China's regions is below the minimum recommended value. Therefore, producing selenium-rich agricultural products to provide natural selenium-rich health food for the regions lacking selenium, has gradually become a new hot spot of China's health food industry. However, selenium is a double-edged sword, that is, if the content is too low, the role of health protection can not be brought into full play; if the content is too high, it will cause selenium intoxication[4], doing serious harm to health. This problem of how to scientifically and safely enrich selenium will loom large before us. Intake of selenium-rich agricultural products is an important way to enrich selenium in our body, and the strict implementation of the selenium content standard of agricultural products can make selenium enter the body safely, truly playing a health effect on the human body.

1 China is a country short of selenium and the areas lacking selenium should strengthen selenium supplement

Selenium is an indispensable trace element, and it must be obtained from food. Selenium deficiency in the soil is widespread in the world. In China, with the exception of Enshi in Hubei and Ziyang in Shaanxi which are natural selenium-rich regions, 72% of the regions lacks selenium in the soil. From the northeast to the southwest, it forms a selenium deficiency belt involving 22 provinces[5].

The shortage of selenium in the soil results in a generally low selenium state in the food chain, making the human body lack selenium. (i) The selenium deficiency in human body will become prematurely senile. (ii) Serious selenium deficiency will lead to cardiomyopathy and cardiac failure. (iii) The selenium deficiency will cause Keshan disease, Kaschin - Beck disease. (iv) The selenium deficiency will make human spirit low, susceptible to cold, decrease sperm motility. The study shows that if the content of selenium in human blood is long lower than 0.1 mg/kg, it can lead to liver necrosis, myocardial damage, myocarditis, coronary heart disease, Keshan disease, Kaschin - Beck disease, hemolytic anemia, gastric cancer, liver cancer, colon cancer, pancreatic cancer and other diseases[6]. Thus, people in the regions lacking selenium must strengthen

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enrich selenium in the body.

2 Basic overview of the content of selenium in China's major agricultural products

After referring to the Chinese food composition analysis table, we summarize the basic information on the content of selenium in the major agricultural products[7], as is shown in Table 1 –4.

Table 1 The selenium content of cereal agricultural products

Unit: μg/kg

Species	Rice	Corn	Barley	Millet	Others
The lowest content	4	8	46	41	5
The highest content	69	49	98	30.5	121
The average content	36.5	28.5	72	17.3	63

Table 2 The selenium content of vegetable agricultural products

Unit: μg/kg

Species	Root vegetables	Fresh beans	Solanaceous fruits	Onion and garlic	Stems, leaves and flowers	Aquatic vegetables	Yam and taro vegetables	Wild vegetables
The lowest content	1.6	0.42	0.9	5.8	0.4	3.9	1	0
The highest content	40.6	56	4.4	193	131.4	9.2	31	85.3
The average content	21.1	28.21	2.65	99.4	65.9	6.55	16	42.65

Table 3 The selenium content of fruit agricultural products

Unit: μg/kg

Species	Pome fruit	Drupe	Berry	Citrus	Subtropical fruit	Melon and fruit
The lowest content	0	0	0	0.7	0	0
The highest content	84.3	43.2	5	7.6	14.4	11
The average content	42.15	21.6	2.5	4.15	7.2	5.5

Table 4 The selenium content of algae and fungi agricultural products

Unit: μg/kg

Species	Algae	Fungi
The lowest content	0	21
The highest content	5.5	49
The average content	2.75	35

3 The maximum allowable limit standard of selenium in food (national health standard GB13105 –91)

Table 5 The maximum allowable limit standard of selenium in food

Project	The content of selenium//mg/kg
Grain	≤0.3
Beans and soy products	≤0.3
Vegetables and potatoes	≤0.1
Fruits	≤0.5
Meat (livestock poultry)	≤0.5
Kidney	≤3.0
Fish	≤1.0
Eggs	≤0.5
Milk	≤0.03
Milk powder	≤0.15

The maximum allowable limit standard of selenium in food can effectively control selenium intoxication.

4 Human body's requirements on selenium

FAO (Food and Agriculture Organization of the United Nations), WHO (the World Health Organization), and IAEA (the International Atomic Energy Agency), adopt China's relevant standards on scientific content of selenium in human body. The daily adult intake of selenium is recommended at 50 –400 μg, as is shown in Table 6.

Table 6 The relevant standards of selenium content in the Chinese human body

The project standards	μg/d
The minimum amount of selenium needed by human body	17
Human physiological selenium demand	40
The supply of selenium from diet	50 –250
The safest intake of selenium from diet	400
The limit of human selenium intoxication	800

Studies have shown that human intake of excessive or inadequate selenium is hazardous to human health.

Based on the situation that there is a serous shortage of selenium in some regions of China, the main contradiction at present is to solve the problem of inadequate daily human intake of selenium. In recent years, in order to solve the problem of selenium deficiency in human body, various kinds of selenium supplement food emerge because of demand, opportunity, etc. A variety of selenium-rich agricultural products also appear in shopping malls and on the table. Some selenium-rich agricultural products overemphasize the content of selenium, and blindly increase the content of selenium in agricultural products, resulting in excessive selenium intake and even selenium intoxication.

5 Recommended range of selenium content of agricultural products

The recipe standard in Table 7 is cited from Nutrition and Diet. According to the food standard in Table 7, the human body can take in 34.495 μg of selenium from food every day, but the recommended adult intake by the Chinese Nutrition Society is 50 –250 μg every day, 15.505 μg less than the minimum recommended amount. The content of selenium in fish, meat and eggs is basically stable, so we can improve the content of selenium in cereals, fruits, vegetables and other agricultural products, to reach human body's daily demand for selenium. In accordance with the upper limit of daily intake of selenium at 150 μg for calculation, if only by raising the content of se-

lenium in single varieties to achieve the goal of selenium supplement, the content of selenium in cereals can reach 300 μg/kg. The rest may be deduced by analogy: the maximum content of selenium in fruits can reach up to 500 μg/kg; the content of selenium in vegetables can reach 100 μg/kg. In accordance with the minimum daily intake required at 50 g for calculation, the lowest content of selenium in cereals, fruits, and vegetables is 82.1 μg/kg, 91.4 μg/kg, and 54.4 μg/kg, respectively.

Table 7 Human daily intake of selenium from food

Species	Grain	Meat	Fish	Fruit	Vegetables	Eggs
Weight//g	400	75	75	200	500	50
Content//μg/kg	43.36	11.97	14.31	13.85	23.4	14.31
Total//ug	17.34	0.897	1.073	2.77	11.7	0.715

In summary, it can be derived that the recommended range of the content of selenium in cereals is 82.1 –300 μg/kg; the recommended range of the content of selenium in fruits is 91.4 – 500 μg/kg; the recommended range of the content of selenium in vegetables is 54.4 –100 μg/kg.

6 Conclusions

Selenium plays an important role in health protection for the human body. Developing selenium-rich agricultural products becomes a new bright spot of contemporary agriculture. The selenium-rich agricultural product industry brings certain economic benefits and provides selenium-supplement agricultural products for the regions lacking selenium, but excess selenium will have a negative effect on human health. We must pay equal attention to economic benefits and social benefits, strictly control the content of selenium in agricultural products, scientifically and safely supplement selenium, and protect the public health.

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