Development of Se-Enriched Starch and Prospect Analysis of The Industry

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Keywords: Selenium rich agricultural products, Functional agriculture, Cassava, Development, Application.

Abstract: Selenium (SE) is one of the 15 essential trace elements for human body, which plays an important role in maintaining human health. Scientific selenium supplement is one of the most effective measures to prevent and treat diseases caused by selenium deficiency, improve health and delay aging. Due to the important role of selenium rich agricultural products in human health, the development of selenium rich starch has important industrial value and market significance. In this paper, the industrial background, progress, development methods and application prospects of selenium-enriched cassava starch were summarized, and the problems faced in the development of selenium-enriched cassava starch were summarized, which provided guidance for the stable development and application of selenium-enriched cassava starch in the next step.

1. Value and significance of developing selenium rich starch

Selenium was first discovered by Swedish chemist J. J. Berzelius in 1817. In 1957, German scientist Schwartz officially identified selenium as an essential life element. In 1961, Yu Weihan, academician of Chinese Academy of Engineering and professor of Harbin Medical University, treated Keshan disease induced by selenium deficiency, which established the important position of Chinese scientific community in the world selenium research field. It has been proved that selenium (Se) is one of the 15 essential trace elements for human body, which has been identified by the World Health Organization as an essential trace element for human body, and has been praised by scientists at home and abroad as the "king of anti-cancer" and "longevity element" [1,2]. However, one third of the world's population is selenium deficient, and about two-thirds of China's population is selenium deficient to varying degrees. Scientific selenium supplementation is one of the most effective measures to prevent and control diseases caused by selenium deficiency, improve health and delay aging, which is highly valued by countries all over the world [2,3]. Since the successful application of sodium selenite in the treatment of Keshan disease, sodium selenite, selenided carrageenan, selenium enriched yeast, selenoprotein, selenided edible fungus powder, nano selenium, etc. have been used as effective selenium supplement products [4]. With the improvement of people's health concept, China's demand for scientific selenium supplement has developed to the stage of food selenium supplement after two stages: drug selenium supplement and health product selenium supplement. Selenium rich functional agricultural products are an important way to supplement selenium in food [2,3].

2. Industrial background of selenium rich starch development in China

According to the prediction of Academician Zhao Qiguo, the proportion of the population in need of functional agricultural products can rise to 1% in 2020, 10% in 2030 and over 50% in 2050. Calculated by static value, it will be 1 trillion yuan in 2030 and 5 trillion yuan in 2050. Compared with high-yield agriculture to solve "eat well" and green agriculture to solve "eat safely", functional agriculture mainly solves the problem of "eat healthily" [2]. Due to the lack of trace elements such as selenium, zinc, iron, calcium and iodine, the health of more than 1 / 3 of the global population is affected by the problem of "hidden hunger" [5]. The problem of "hidden hunger" in China is mainly the lack of selenium and iodine. The development, popularization and application of functional agricultural products rich in trace elements such as iodine and selenium are an important measure to eliminate "hidden hunger" in China [6]. Due to the important role of functional agriculture in human health, its development has also attracted great attention of scientific researchers. Among the series of selenium-rich agricultural products developed in China, selenium-rich starch occupies the largest proportion. Starch-based selenium-enriched products accounted for 65.32% of the total selenium-enriched products accepted by consumers, with the highest market acceptance. Cassava starch, together with sweet potato and potato, is called the world's three major potato crops. It has the advantages of high amylopectin content, high molecular polymerization degree and low price, and can be used in cosmetics, medicines, textiles, food processing and other industries. The development of selenium-enriched starch has important industrial value and market significance [7].

3. Development methods of selenium rich agricultural products

According to different selenium sources, selenium rich agricultural products can be divided into natural selenium rich agricultural products and exogenous biological enhanced selenium rich agricultural products. The development of natural selenium rich agricultural products mainly improves the natural accumulation of selenium in agricultural and animal husbandry products through the activation of natural selenium [8], screening of crops with strong selenium enrichment capacity [9], extraction and enrichment of selenium active components of natural selenium rich agricultural products [10]. As an important supplement to natural selenium rich agricultural products, exogenous bioaugmentation technology can controllably increase the effective selenium content in edible parts of crops, livestock or edible microorganisms, and produce high-quality selenium rich agricultural products. It is one of the most effective implementation ways for the development of selenium rich functional agriculture [11,12].

Professor Wu Wenliang of China Agricultural University, as the chief scientist, undertook the special research project of public welfare industry (agriculture) of the Ministry of Agriculture in 2013, and achieved a key breakthrough in organic selenium-enriched plant products by exploring and developing related basic issues such as selenium-enriched planting, single technology of processed products, nutrition evaluation and quality tracking [13]. The National Research and Development Center for Processing Technology of Selenium-enriched Agricultural Products has similarly constructed the selenium-enriched nutrition enhancement technology system related to hyperselenium plants. Hrouzek team [14] prepared selenium-enriched Chlorella, and identified the forms of selenium-containing amino acids accumulated in it. It was proved that the biological accessibility of selenium-enriched Chlorella (49%) was higher than that of selenium yeast (21%), selenium supplement (32%) and selenium food. Wong et al. [39] successfully extracted selenoprotein from selenium enriched Spirulina, which proved that it had good antioxidant and antiproliferative activities in vitro. Ruiz [15] and Oliveira [16] have successfully enriched lettuce plants with selenium by using selenite, selenite and other nutritional enhancers. In addition, researchers systematically studied the selenium nutrition enhancement law of mushrooms [17], rice [18], strawberries [19], corn [20], etc., and produced selenium rich agricultural products meeting the selenium enrichment standard through process optimization. In addition to the processing of plant selenium rich agricultural products, researchers have also successfully developed selenium rich agricultural products such as selenium rich rabbit meat [21], selenium rich earthworm [22], selenium rich egg [23], selenium rich pork [24] Based on exogenous strengthening technology, enriching the types of selenium rich agricultural products.

In conclusion, for the large-scale development of large quantities of selenium rich agricultural products, the selenium nutrition enhancement technology using exogenous organisms is the most effective measure to ensure the quality of selenium rich agricultural products.

4Development and application prospect of selenium rich starch

Because various modification technologies can endow cassava starch with unique solubility and rheological properties [25, 26], the modified cassava starch has been widely used in membrane materials [27], biological materials [28], functional feed [29], etc. The planting area and yield of cassava in Guangxi account for more than 60% of the whole country, and it is the largest cassava planting area in China. Deep processing of cassava starch has a good industrial base in Guangxi. It is of great significance to explore new technologies for stable development of selenium-enriched cassava starch and solve the problems of planting and industrialization of selenium-enriched cassava starch.

At present, the development of selenium-enriched cassava starch still faces many industrial problems, such as: the problem of disorderly competition among regions is prominent, the national level lacks unified standards and norms, the price is too high, the market is chaotic, the deep processing products with high added value are lacking, the selenium content is unstable, and the awareness of consumers needs to be improved. Among them, disorderly competition, standard setting and market management belong to the policy management of industrial promotion. In addition, due to the limitations of natural selenium rich areas, unstable selenium content, environmental pollution by selenium activators and high cost in the implementation of selenium quality assurance system, how to efficiently realize the quantitative selenium enrichment of agricultural products is still the technical bottleneck of the development of selenium rich industry.

4. Conclusions

The demand for scientific selenium supplement has gone through two stages: drug selenium supplement and health care product selenium supplement, and now it has developed to the stage of food selenium supplement. Selenium-enriched functional agriculture mainly solves the problem of "eating healthily" and plays an important role in maintaining human health. Developing selenium-enriched starch has important industrial value and market significance. Exogenous bioaugmentation technology can controllably increase the effective selenium content in edible parts of crops, livestock or edible microorganisms. For the large-scale development of large quantities of selenium-enriched agricultural products, selenium nutrition fortification technology using exogenous organisms is the most effective measure to ensure the quality of selenium-enriched agricultural products. In the future, it is of great significance to explore new technologies for the stable development of selenium rich cassava starch and solve policy problems such as market chaos and technical problems such as unstable selenium content in the development of selenium rich cassava starch.

Acknowledgements

Financial support from National Natural Science Foundation of China (51663020), Natural Science Foundation for Distinguished Young Scholars of Guangxi Province (2017GXNSFFA198007) and Project of Guangxi Colleges and Universities for the Promotion of Foundation Ability of Young Teachers (2019KY0469). The authors also acknowledge Guangxi Colleges and Universities Innovation Research Team.

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