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Review of Nutritional Components and Health Benefits of Sweet Potato

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Abstract Sweet potatoes (*Ipomoea batatas*) have received increasing attention in recent years due to their high nutrition and the variety of active substances they contain. In this article, we have sorted out the main components of different parts of sweet potatoes, such as leaves and roots, and focused on introducing dietary fiber, beta-carotene, anthocyanins, vitamin C, minerals, etc., as well as the possible benefits they may bring to health. Nowadays, there are numerous in vitro experiments, animal experiments, and A small number of human studies, all of which show that eating sweet potatoes may have many benefits, such as improving vitamin A status, regulating blood sugar and lipid levels, antioxidation, anti-inflammation, protecting the cardiovascular system, anti-cancer, and even helping intestinal health. Generally speaking, sweet potatoes with orange flesh contain A lot of beta-carotene, which is helpful in preventing vitamin A deficiency. Purple sweet potatoes have a high content of anthocyanins and a stronger antioxidant effect. Sweet potato leaves themselves are also a good source of protein, minerals and polyphenols, and have high nutritional value. Although sweet potatoes have been regarded as a crop with high nutritional density and the ability to promote health, there are still not enough high-quality human clinical studies at present. The mutual influence among different genotypes, environmental conditions and processing methods also requires further research. In the future, cooperation among different disciplines should be strengthened to enable sweet potatoes to play a greater role in functional foods, nutritional intervention and breeding, and to promote more innovation.

Keywords Sweet potato (*Ipomoea batatas* L.); Nutritional components; Health benefits; Functional food; Antioxidant

1 Introduction

Sweet potato (*Ipomoea batatas* L.) is the sixth largest food crop in the world. It has strong adaptability, high yield and rich nutrition, so it is widely cultivated and consumed in many countries. China is the world's largest producer of sweet potatoes. The combined output of Asia and Africa accounts for more than 95% of the world's total. In the Americas, Africa, Asia and the Caribbean, sweet potatoes are particularly important to the locals (Behera et al., 2022).

Sweet potatoes are not only a staple food in tropical and subtropical regions, but are also often used as food for humans and animals worldwide (Otálora et al., 2023). The output and consumption vary in different regions, but Asia and Africa are the main planting and consumption areas. In these places, sweet potatoes provide important energy and nutrients for millions of people.

In many countries, sweet potatoes are not just common crops; they also have cultural and economic significance. It can ensure food security and also generate income through processing into starch, flour or fermented beverages, etc. In Africa, Asia and Latin America, sweet potatoes are often used as staple food or important side dishes. They can help alleviate malnutrition and also supplement some micronutrients. Because sweet potatoes have a wide variety and strong adaptability, they are also an important source of income for small-scale farmers and residents in remote areas.

In recent years, people have paid more and more attention to sweet potatoes, mainly because they contain many beneficial nutrients, such as dietary fiber, vitamin A, vitamin C, minerals, and some antioxidant substances, etc. Meanwhile, it may also be helpful in some chronic diseases, such as cardiovascular diseases, diabetes and cancer, etc. (Grebla-Al-Zaben et al., 2021). Sweet potatoes of different colors - such as orange, purple, and white - have

very different nutritional components, which has also driven more research on their health effects (Laveriano-Santos et al., 2022). Systematically organizing the nutritional and health benefits of sweet potatoes is conducive to public health, food development and sustainable agricultural development (Tedesco et al., 2023).

This review will provide a comprehensive overview of the global production and consumption of sweet potatoes, and also analyze their cultural, economic and dietary values in different regions. The following will focus on introducing the main nutritional components and health benefits of sweet potatoes, including their role in the prevention of chronic diseases. This review will also discuss the application prospects of sweet potatoes in the food industry and sustainable agriculture, and point out the shortcomings of current research as well as possible future development directions.

2 The Botanical Background and Variety Differences of Sweet Potatoes

2.1 Botanical classification of sweet potatoes

Sweet potato (*Ipomoea batatas* (L.) Lam.) belongs to the Convolvulaceae family and is a perennial herb of the Ipomoea genus. It mainly consists of tuberous roots as its edible part. Taxonomic studies have shown that sweet potatoes are closely related to some wild species. However, nowadays, the sweet potatoes grown by people no longer have the true wild type and mostly reproduce asexually through tubers or stem segments (Davis et al., 2024). More than 6 500 sweet potato varieties have been recorded worldwide, including traditional varieties, breeding materials and some wild relatives.

2.2 Overview of main sweet potato varieties: orange, purple, white, and yellow flesh types

The common flesh colors of sweet potatoes' tubers are orange, purple, white and yellow. Different colors indicate different types of pigments and nutritional components inside (Rosell et al., 2024). Orange-fleshed sweet potatoes usually contain A lot of beta-carotene and are an important source of vitamin A. They are also often used to prevent vitamin A deficiency. Purple-fleshed sweet potatoes have a high content of anthocyanins and polyphenols, and also have strong antioxidant and anti-inflammatory capabilities. White-fleshed sweet potatoes have very little pigment, with relatively low levels of beta-carotene and anthocyanins. Some varieties have a slightly higher protein content, but their overall nutritional level is relatively low. The composition of yellow-fleshed sweet potatoes lies between that of orange-fleshed and white-fleshed ones, containing a certain amount of carotenoids and polyphenols.

2.3 The influence of variety differences on nutritional components and bioactive substances

Sweet potatoes of different varieties vary greatly in terms of nutritional components and the content of bioactive substances, mainly reflected in the following aspects. Purple-fleshed sweet potatoes have the highest anthocyanin content, up to 18.35 mg/100 g, and also have higher contents of polyphenols, flavonoids and tannins. Therefore, they have the best antioxidant capacity (Jiang et al., 2022; Rahman and Nurdin, 2023). The orange-fleshed sweet potato has A particularly high content of carotenoids, with β -carotene reaching approximately 47.2 mg/100 g dry weight. It is an ideal source for supplementing vitamin A. Some white-fleshed sweet potatoes have slightly higher protein content, while purple-fleshed and orange-fleshed ones have more prominent dietary fiber content (Wan et al., 2024). There are also differences among different varieties in trace elements such as iron, zinc, calcium and vitamin C. Yellow and purple sweet potatoes perform better in certain mineral contents (Drapal et al., 2019; Ngcobo et al., 2024). The antioxidant activity of purple-fleshed sweet potatoes is the strongest, followed by orange-fleshed ones, while white-fleshed and yellow-fleshed ones are relatively weak.

3 The Nutritional Components of Sweet Potatoes

3.1 Carbohydrates and dietary fiber

The main component of sweet potatoes is carbohydrates, among which starch is the most abundant, generally ranging from 22.6 to 69.7 g per 100 g (dry weight). It also contains a certain amount of soluble sugar, ranging from 10.3 to 40.0 g/100 g (dry weight). Sweet potatoes are also rich in dietary fiber, approximately 7.99 to 26.0 g/100 g (dry weight), and most of it is insoluble fiber (Waidyarathna et al., 2021; Zhao et al., 2024). Dietary fiber is beneficial to the intestines and also helps control blood sugar.

3.2 Vitamins

Sweet potatoes contain A variety of vitamins, among which vitamin A is particularly abundant, mainly existing in the form of beta-carotene. The orange-fleshed sweet potato has the highest content of beta-carotene, reaching up to 133 mg/100 g (dry weight). It also contains vitamin C, ranging from 8.17 to 106 mg/100 g (dry weight). B vitamins (such as B1, B2, B6, niacin, pantothenic acid, biotin) and vitamin E can also be found in sweet potatoes (Abewoy et al., 2024). Orange-fleshed sweet potatoes are often used to help prevent vitamin A deficiency.

3.3 Minerals

Sweet potatoes are a good source of minerals. It contains potassium, calcium, phosphorus, magnesium, iron, zinc, copper, manganese and selenium, among which potassium has the highest content, and calcium and phosphorus are also relatively abundant. The mineral content varies greatly among different varieties. Some purple-fleshed and yellow-fleshed types show more prominent performance in certain minerals (Etim et al., 2024).

3.4 Proteins and amino acids

The protein content of sweet potatoes is generally between 2% and 12% (dry weight). Its amino acid composition is relatively balanced, containing essential amino acids such as lysine, threonine, and valine (Pasaribu et al., 2025). The protein content varies significantly among different varieties, and some varieties can serve as protein supplements to a certain extent.

3.5 Phytochemicals and antioxidants

Sweet potatoes are also rich in a variety of phytochemicals, including polyphenols, flavonoids, anthocyanins and carotenoids, etc. Orange-fleshed sweet potatoes have a high content of beta-carotene, while purple-fleshed ones contain more anthocyanins and polyphenols. Therefore, their antioxidant capacity is more prominent. These components can help with antioxidation, anti-inflammation, and lowering blood sugar, and may also play a role in fighting cancer.

4 The Health Benefits of Sweet Potatoes

4.1 Blood glucose regulation and diabetes management

Sweet potatoes contain components such as polyphenols, flavonoids and anthocyanins, which are believed to help regulate blood sugar and may also improve insulin sensitivity. Many animal experiments and in vitro experiments have found that sweet potato extract can lower blood glucose, improve glucose tolerance, and promote the recovery of pancreatic β cells (Arisanti et al., 2023; Hu et al., 2025). Some small-scale human studies have also shown that eating sweet potatoes may slightly reduce glycated hemoglobin (HbA1c), but the evidence is not strong enough and more clinical trials are needed for confirmation (Qin et al., 2022).

4.2 Antioxidant and anti-inflammatory effects

Substances such as polyphenols, anthocyanins and carotenoids in sweet potatoes all have antioxidant capabilities, which can help eliminate free radicals and reduce oxidative stress (Escobar-Puentes et al., 2022; Saenjum et al., 2025) (Figure 1). Purple sweet potatoes and orange sweet potatoes have particularly good antioxidant capacity. Studies also pointed out that the leaf and root extracts of sweet potatoes can reduce inflammatory responses by inhibiting inflammatory factors such as IL-6 and TNF-α through the Nrf2 pathway (Matsumoto et al., 2024; Yen et al., 2025).

4.3 Digestion and Intestinal Health

Sweet potatoes are rich in dietary fiber and resistant starch, which can promote intestinal peristalsis and help prevent constipation. They can also regulate the diversity of gut microbiota and improve the function of the intestinal barrier. Some studies have found that polysaccharides in purple sweet potatoes can improve the intestinal environment of mice with colitis models and reduce inflammation (Sun et al., 2022).

4.4 Enhanced immune function

Sweet potatoes and their leaves contain polyphenols, flavonoids and polysaccharides, which can affect the activity of the immune system. Studies have shown that they can increase the index of immune organs and enhance the

activity of immune cells, thereby making the body's disease resistance stronger. Some experiments have also found that sweet potato polysaccharides can improve the immune status in the intestine and reduce inflammation.

4.5 Cardiovascular health

The dietary fiber, polyphenols and flavonoids in sweet potatoes may be beneficial to cardiovascular health, such as lowering blood lipids, improving vascular endothelial function and reducing the risk of atherosclerosis. In animal experiments, purple sweet potato flavonoids can reduce LDL cholesterol, alleviate inflammation, and also improve cardiovascular problems related to diabetes (Laveriano-Santos et al., 2022). Some population studies have also found that eating sweet potatoes may increase HDL cholesterol, which can help reduce the risk of cardiovascular diseases.

4.6 Potential for cancer prevention

Sweet potatoes contain anthocyanins, polyphenols and carotenoids, which have antioxidant and anti-mutagenic capabilities. Therefore, they have shown potential to fight cancer in some experiments. Animal and in vitro studies have found that sweet potato extract can inhibit the growth of cancer cells, promote apoptosis of cancer cells, and act through multiple pathways (Grebla-Al-Zaben et al., 2021). However, there is currently a lack of large-scale clinical studies, so further verification is still needed.

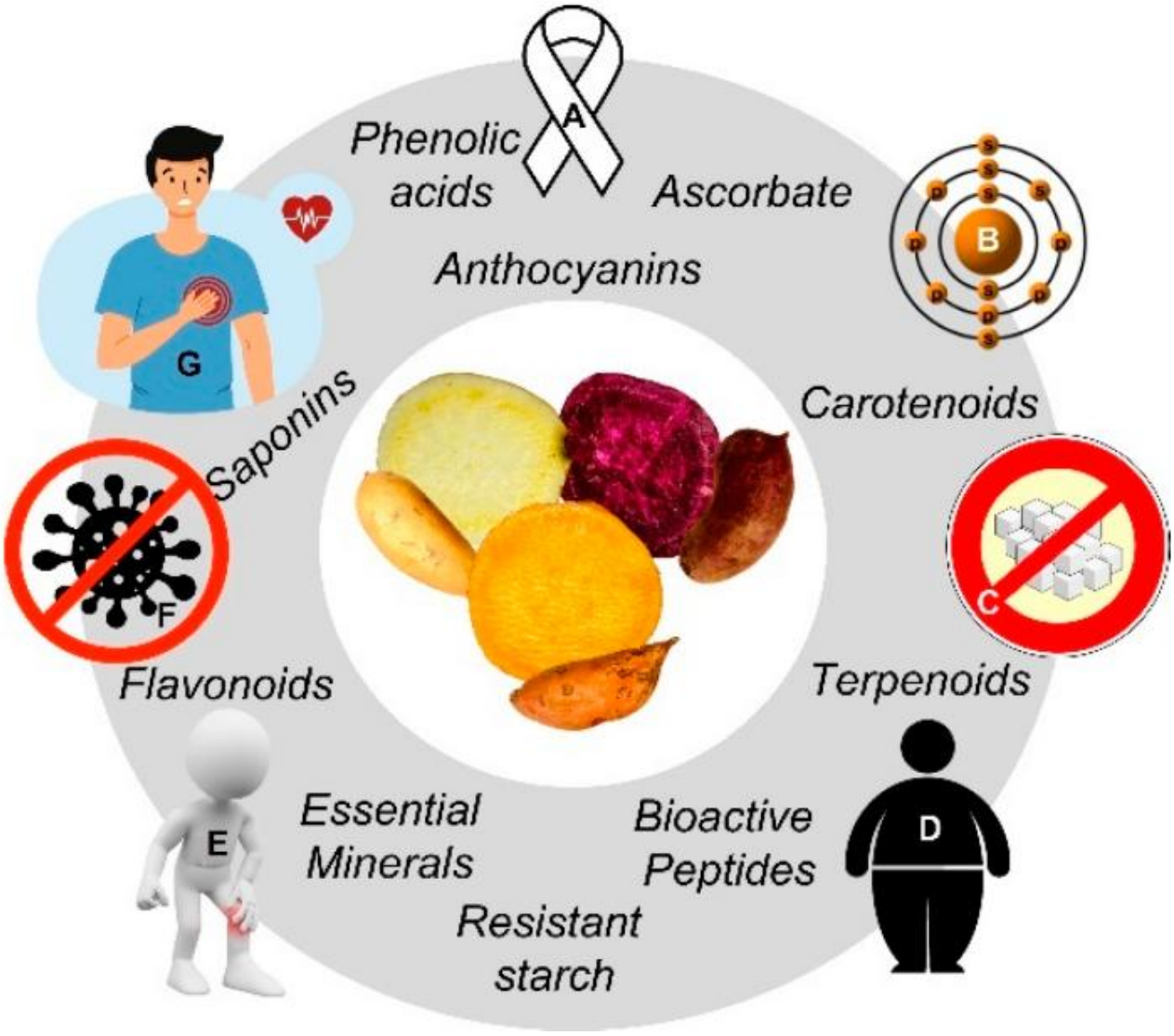

Figure 1 Sweet potato (SP; *Ipomoea batatas* L.) group of phytochemicals with associated health-promoting effects. Preventive actions (clockwise): Immunocompromise (A), prooxidant (B), diabetes (C), adiposity (D), inflammatory (E), infection (F), cardiovascular (G) diseases/metabolic rearrangements. Source: The authors (CC (by/nc/sa)-licensed clip art) (Adopted from Escobar-Puentes et al., 2022)

5 The Influence of Sweet Potato Processing and Cooking Methods

5.1 Retention and loss of nutrients (boiling, steaming, roasting, frying)

Different cooking methods can affect the nutrients in sweet potatoes. Generally speaking, steaming and boiling can better preserve beta-carotene and vitamin C. Especially steaming and microwave heating have the highest retention rate of vitamin C. Some studies can even reach 98.98%~102.36% (Eke-Ejiofor and Onyeso, 2019; Buratti et al., 2020; Yvonne and Pontsho, 2023). In contrast, frying and baking will cause more loss of these nutrients. Pressure cooking and boiling also have better retention of beta-carotene, while air frying and baking have the most severe loss (Fornazier et al., 2025). Cooking may also enhance polyphenols and antioxidant activity, among which steaming and microwave heating have the most obvious effects (Kamal and Golshany, 2024; Cao et al., 2025). Although frying is more popular in taste, it will increase a lot of fat and calories, so it is not very suitable as a daily healthy eating method.

5.2 The influence of different cooking methods on glycemic index

The glycemic index (GI) of sweet potatoes varies depending on the cooking method. Generally, the GI of boiled sweet potatoes is lower than that of baked and fried ones. This is because during the cooking process, the starch structure changes and more resistant starch is formed, thereby causing the blood sugar to rise more slowly (Freitas et al., 2023). Baking and frying make starch easier to digest, so the GI value will rise. Studies also show that the starch breakdown rate and blood sugar response of boiled sweet potatoes are both lower than those of roasted sweet potatoes. For diabetic patients, boiling water is a more appropriate choice.

5.3 Effects on anthocyanins, carotenoids and vitamin C

Anthocyanins and polyphenols are prone to loss during heating. However, steaming and microwave heating can retain them better. The anthocyanins in purple sweet potatoes have a relatively high retention rate when steamed or fried with the skin on. β -carotene retains its effect relatively well under steaming, boiling and microwave heating, but is significantly lost during frying and baking (Buratti et al., 2020). Vitamin C is highly sensitive to heat. The retention rate is the highest in steaming and microwave heating, while the loss is the greatest in baking and frying (Figure 2) (Cao et al., 2025).

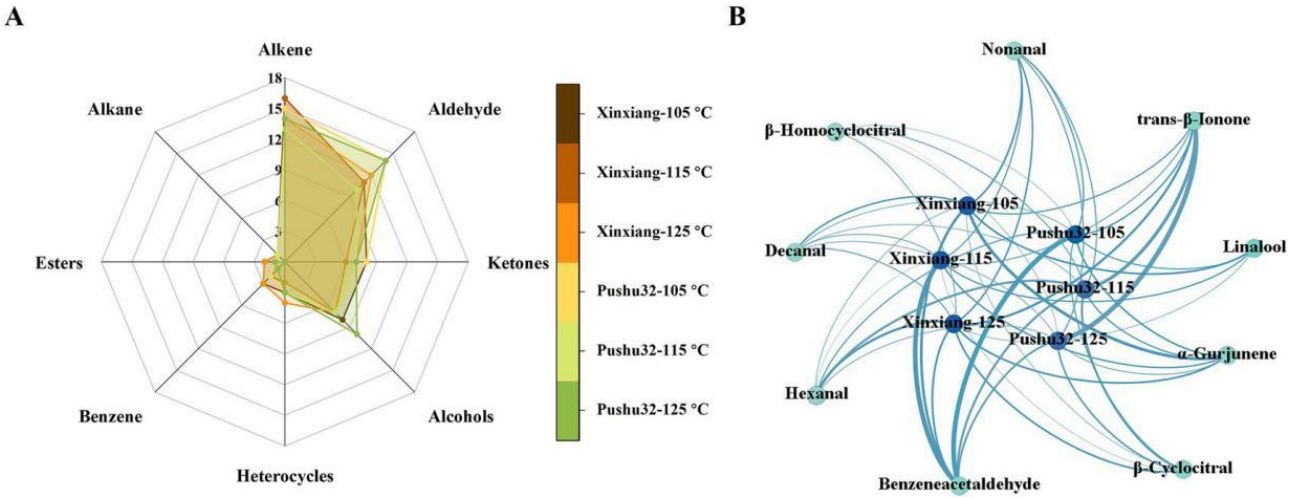

Figure 2 GC-MS analysis of volatile compounds in steamed sweet potato 'Xinxiang' and 'Pushu32' at different temperatures (A) Classes of volatile compounds. (B) Correlation network between different treatments and volatile compounds of steamed sweet potato. The inner nodes represent different treatments while the outer nodes represent volatile compounds. The thickness of the line is proportional to the content of volatile compounds. The color depth of the inner circle depends on the amounts of volatile compounds, while the color depth of the outer circle depends on the content of specific volatile components (Adopted from Cao et al., 2025)

6 Case Analysis: Examples of Sweet Potato Intake Promoting Health

6.1 Background

Sweet potatoes (*Ipomoea batatas*) are believed to be highly beneficial to health due to their high dietary fiber content, rich vitamins and minerals, as well as some active components. In recent years, the role of sweet potatoes

in chronic disease management, nutritional improvement and weight control has been increasingly discussed, especially among people with diabetes, obesity and malnutrition (Akomolafe et al., 2025).

6.2 Intervention measures

Many studies have used sweet potatoes or sweet potato products as dietary interventions. There was a randomized controlled trial in which overweight white-collar workers replaced two meals a day with a white-skinned sweet potato (WSP) formula for eight weeks. In another study, teenagers ate sweet potato leaves as vegetables twice a week for ten days to improve anemia. Furthermore, some animal experiments and population studies on diabetes have also used sweet potato extract or sweet potato dietary fiber for intervention (Arisanti et al., 2023).

6.3 Observed health outcomes

After eight weeks of intervention with white-skinned sweet potatoes, the participants' weight, body fat, BMI and blood glucose (HbA1c) all decreased significantly. The average weight loss was approximately 5%, and HbA1c decreased by about 3.5%, with no adverse reactions. In the research on improving anemia, after teenagers ate sweet potato leaves for ten days, the average increase in hemoglobin was 1.56 g/dL, and the effect was significantly better than that of the control group. In studies related to diabetes, sweet potatoes or their extracts can lead to better blood sugar control in patients, with an average decrease of 0.3% in HbA1c, and there are no serious side effects (Akomolafe et al., 2025). Animal experiments have also found that dietary fiber from sweet potatoes can improve blood sugar, blood lipid, liver and kidney functions, and also regulate intestinal flora (Hu et al., 2025). A systematic review also pointed out that eating sweet potatoes helps improve multiple health indicators such as vitamin A status, blood pressure, iron absorption, liver function and constipation (Qin et al., 2022).

6.4 Interpretation of results

From these studies, it can be seen that sweet potatoes and sweet potato leaves, as dietary interventions, can bring about significant health improvements in different populations. It is particularly outstanding in aspects such as weight control, blood glucose regulation, anemia improvement and intestinal function enhancement (Qin et al., 2022). Most of these improvements come from the rich dietary fiber, polyphenols, carotenoids and minerals in sweet potatoes. Although some studies have small sample sizes and some are animal experiments, the overall trend indicates that sweet potatoes play a positive role in chronic disease management and nutritional improvement. More large-scale and long-term human trials are still needed in the future to further verify these effects (Akomolafe et al., 2025).

7 Challenges, Knowledge Gaps and Future Directions of sweet potato Nutrition and Health Benefits Research

7.1 More human clinical trials are urgently needed

At present, most of the research on the health benefits of sweet potatoes comes from in vitro experiments, animal experiments, or smaller-scale and short-duration human intervention studies. Although systematic reviews have pointed out that eating sweet potatoes may improve indicators such as vitamin A status, blood glucose, blood pressure and iron absorption, these results are not sufficient to establish a clear causal relationship because the number of high-quality, long-term, randomized controlled human trials is very small. In the future, larger-scale, more center and longer-duration clinical studies will be needed to truly confirm the role of sweet potatoes and their active components in chronic disease management (Laveriano-Santos et al., 2022).

7.2 The interaction effect of genotype × environment × processing method

The nutritional components of sweet potatoes can be influenced by many factors, including the variety itself, the growing environment and the cooking method. The contents of β -carotene, anthocyanin and minerals vary greatly among different varieties (De Andrade et al., 2025). Environmental conditions, such as soil, rainfall and climate, can also affect the nutrient accumulation and quality of sweet potatoes (Rosero et al., 2020; Merga et al., 2025). Cooking methods (steaming, boiling, roasting, frying) also result in different nutrient retention rates. At present, the mutual influence among these three has not been studied deeply enough, and it is necessary to further explore the performance of different varieties under different environments and processing methods (Alam et al., 2024; Liao et al., 2025; Merga et al., 2025).

7.3 The potential of sweet potatoes as functional foods or nutritional interventions

Sweet potatoes contain a large amount of dietary fiber, antioxidants, vitamins and minerals. Therefore, they are very suitable for the development of functional foods or nutritional supplement products (Ngcobo et al., 2024). Purple sweet potatoes and orange sweet potatoes are particularly suitable for chronic disease prevention and nutritional fortification due to their higher anthocyanin and beta-carotene content. They are also suitable for some people who need additional nutrition. However, more studies are needed to explain how these active ingredients are absorbed in the body, how they are metabolized, and the long-term effects after continuous intake.

7.4 Breeding opportunities for enhanced nutrient density

The genetic resources of sweet potatoes are very rich, which provides a good foundation for breeding. By screening genotypes and combining with molecular marker technology, the contents of nutrients such as beta-carotene, vitamin C, iron and zinc in sweet potatoes can be increased (Merga et al., 2025). Meanwhile, if new varieties can simultaneously possess stress resistance (such as drought resistance and disease resistance) and high yield, it will be more conducive to addressing climate change and food security issues (Alam et al., 2024; De Andrade et al., 2025). In the future, the synchronous improvement of multiple traits should be strengthened to promote the promotion of new sweet potato varieties with high nutrition and strong adaptability.

8 Conclusion

Sweet potatoes (*Ipomoea batatas*) contain many health-beneficial components, such as starch, resistant starch, dietary fiber, protein, vitamins and minerals. It also has a rich variety of vitamins, including beta-carotene, vitamin C, B vitamins and vitamin E, etc. The content of minerals such as potassium, iron, calcium, zinc and magnesium in sweet potatoes is also not low. In addition, sweet potatoes also contain active components such as polyphenols, anthocyanins, carotenoids, phenolic acids and flavonoids. These components work together to endow sweet potatoes with multiple benefits such as antioxidation, anti-inflammation, blood sugar-lowering, lipid-lowering, anti-cancer, cardiovascular protection and improvement of intestinal health. Orange fleshy sweet potatoes have the highest content of beta-carotene and are suitable for improving vitamin A deficiency. Purple sweet potatoes have the highest anthocyanin content and the strongest antioxidant capacity.

Many studies have shown that sweet potatoes not only have a high yield and strong adaptability, but also are a food with a high nutritional density and obvious benefits to health. Its rich nutrients and active ingredients help prevent and improve various chronic diseases, such as vitamin A deficiency, diabetes, cardiovascular diseases and obesity. Sweet potato leaves are also rich in nutrients, containing a considerable amount of protein, minerals and polyphenols, and are excellent green vegetables. Because sweet potatoes have a wide variety and strong adaptability, they are of great value in global food security and public health.

Sweet potatoes can be eaten in many ways. It can be used as staple food, side dishes, snacks, and also as raw materials for functional foods. Sweet potatoes are suitable for various cooking methods such as steaming, boiling, roasting, stewing and stir-frying. They can be eaten alone or combined with grains, beans and vegetables to increase dietary diversity and enhance nutritional density. Sweet potatoes of different colors are suitable for different needs. For instance, orange sweet potatoes are rich in vitamin A, purple sweet potatoes are more antioxidant, and white sweet potatoes are high in starch and also contain a considerable amount of dietary fiber. You can choose according to your personal health goals. Sweet potato leaves are also worth adding to your daily diet as a high-protein and high-mineral vegetable. When cooking, try to choose steaming and boiling as much as possible to reduce nutrient loss. Avoid high-temperature methods like deep-frying. Children, pregnant women, the elderly and patients with chronic diseases can all eat sweet potatoes in moderation to supplement energy, vitamins and minerals and improve their overall nutritional status. Overall, sweet potatoes are a nutritious and healthy food, and are well worth promoting and using in daily diets.

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Conflict of Interest Disclosure

The author affirms that this research was conducted without any commercial or financial relationships that could be construed as a potential conflict of interest.

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