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Nutritional and Medicinal Qualities of Sweetpotato Tops and Leaves

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Sweetpotato [*Ipomoea batatas* (L.) Lam] is the sixth most important food crop in the world, and new uses for this crop have been identified. Sweetpotato is one of the crops selected by the U.S. National Aeronautics and Space Administration (NASA) to be grown in a controlled ecological life support system as a primary food source. Recent studies show that sweetpotato contains such functional components as polyphenols, anthocyanins and dietary fiber, which are important for human health.

Sweetpotato roots are a good source of carbohydrates, while sweetpotato tops (leaves and stems) contain additional nutritional components in much higher concentrations than in many other commercial vegetables. Sweetpotato leaves are cooked as a vegetable in many parts of the world. They are rich in vitamin B, ß-carotene, iron, calcium, zinc and protein, and the crop is more tolerant of diseases, pests and high moisture than many other leafy vegetables grown in the tropics. Because sweetpotato tops can be harvested several times a year, their annual yield is much higher than many other green vegetables.

Sweetpotato is one of the most important summer food crops in the southern United States. It is a versatile plant. For example, it is used as food, as livestock feed and for starch and alcohol production. The tips can be cooked together with other ingredients in various dishes, or they can be dried and stored for later use as a boiled or fried vegetable. Researchers in North Carolina, Louisiana, Mississippi, California, Texas and Alabama are contributing to the value of sweetpotato by finding new uses.

Arkansas is not a major sweetpotato-growing state. Although soil and climate are favorable for production, Arkansas growers cannot compete economically with neighboring producer states North Carolina,

Sweetpotato leaves

Leaves with stem

Louisiana and Mississippi. Only recently have some small-scale farmers in south Arkansas become interested and have planted about 5,000 acres of sweetpotato, mostly for fresh market.

Sweetpotato may become a profitable leafy vegetable crop in Arkansas if appropriate varieties were available or could be developed. Several researchers report that sweetpotato leaves are an excellent source of antioxidative polyphenolics, among them anthocyanins and phenolics, and are superior to other commercial vegetables. The nutritional value of sweetpotato leaves is gaining recognition, as the understanding between diet and health increases. Sweetpotato leaves with their high nutritive value and antioxidants may become an excellent leafy vegetable.

Cultivation for Sweetpotato Tip Production

Usually, sweetpotato roots are planted 2 inches deep and about 2 inches apart (density of 5 cm × 5 cm) in a greenhouse/polyethylene house in late winter/early spring (i.e., during late February until early March in the southern United States). After two months, harvest tips every 10 to 15 days. In the southern United States, generally all greens (tops) may be harvested at least six times a year – the end of April, the end of May, the end of June, the end of July, the beginning of September and the end of October.

Fertilizer

Apply chemical fertilizer (N-P-K = 8-8-8) at a rate of 500 lb/A, and use compost at a rate of 8,000 lb/A in volume. After each harvest, apply 150 lb/A ammonium sulfate as an additional fertilizer.

Yield

The average tip (average of 10 genotypes) yield is 11,000 lb/A (Villareal et al., 1982).

Chemical Composition

Sweetpotato roots and tops possess a variety of chemical compounds relevant to human health. About 80 to 90 percent of sweetpotato dry matter is made up of carbohydrates, consisting mainly of starch and sugars with lesser amounts of pectins, hemicelluloses and cellulose. On average, starch constitutes 60 to 70 percent of the dry matter, but the proportion of starch to other carbohydrates varies greatly. Sweetpotato also contains protein (0.46% to 2.93%), dietary fiber (0.49% to 4.71%), lipid (0.06% to 0.48%) and ash (0.31% to 1.06%). It contains essential mineral nutrients such as Ca, P, Mg, Na, K, S, Fe, Cu, Zn, Mn, Al and B. Sweetpotato is also an important source of vitamin A, thiamin, riboflavin, niacin, ascorbic acid and many other functional compounds (Woolfe, 1992).

Nutritional Value

Depending on varieties and growing conditions, sweetpotato leaves are comparable to spinach in nutrient content. The average mineral and vitamin content in a recently developed cultivar, Suioh, is 117 mg calcium, 1.8 mg iron, 3.5 mg carotene, 7.2 mg vitamin C, 1.6 mg vitamin E and 0.56 mg vitamin K/100 g fresh weight of leaves. Levels of iron, calcium and carotene rank among the top, as compared with other major vegetables. Sweetpotato leaves are also rich in vitamin B, ß-carotene, iron, calcium, zinc and protein. Studies have shown that sweetpotato leaves contain as many vitamins, minerals and other nutrients as spinach. The content of these nutrients differs according to harvesting period and variety. Oxalic acid poses a problem when using sweetpotato leaves as food, but its content does not change greatly according to the harvesting time and is less than one-fifth that of spinach. For these reasons, the use of sweetpotato leaves as a vegetable and for food processing should definitely be encouraged. As a crop, sweetpotato is more tolerant of diseases, pests and high moisture than many other leafy vegetables grown in the tropics. Sweetpotato leaves are an excellent source of antioxidative polyphenolics, among them anthocyanins and phenolic acids such as caffeic, monocaffeoylquinic (chlorogenic), dicaffeoylquinic and tricaffeoylquinic acids, and are superior in this regard to other commercial vegetables (Ishiguro et al., 2004).

Polyphenols Compositions

Sweetpotato leaves represent at least 15 anthocyanin and 6 polyphenolic compounds. These biologically active compounds possess multifaceted action, including antioxidation, antimutagenicity, anti-inflammation and anticarcinogenesis. Sweetpotato leaves contain more total polyphenols than any other commercial vegetables, including sweetpotato roots and potato tubers.

Antioxidative and Antimutagenicity

Cancers occur through such processes as initiation, promotion and progression in body cells. Initiation is a kind of mutation that occurs in cancer and anticancer genes. Thus, controlling the gene mutation brought about by the carcinogens leads to cancer prevention. Sweetpotato leaves are a good supplementary resource of antioxidants and antimutagenic compounds. An investigation was conducted to examine the effects of 82 kinds of vegetable juice and plant components on the division and multiplication of cancer cells, and it was found that sweetpotato has especially high cancer checking rates.

Anti-Diabetes

The latter stage of noninsulin-dependent diabetes mellitus (NIDDM), one of the major diseases of adults, is caused by the decrease in the secretion of insulin by the pancreatic Langerhans cells. Prevention of NIDDM and inhibition of its serious side effects such as retinopathy, neuropathy and cataracts are important subjects for researchers. The current diabetes mellitus population in the United States is increasing and is estimated at more than 18 million persons. Diabetes contributes to the death of more than 213,000 Americans each year and is also a leading cause of heart disease, blindness and kidney failure. Foods with anti-diabetic effect are desired for diet therapy. Several researchers report that sweetpotato leaves have anti-diabetic compounds that reduce blood glucose content significantly in model rats.

Antibacterial Activity

Lyophilized sweetpotato leaf powder from the variety 'Simon-1' strongly suppressed the growth of O-157, and its effect was detectable even after autoclave treatment. The antibacterial extract revealed that the main components were polysaccharides. Furthermore, the water extracted from the leaves suppressed effectively the growth of other food-poisoning bacteria such as *Staphylococcus aureus* and *Bacillus cereus* as well as pathogenic *E. coli*.

Preparation of Sweetpotato Tops for Consumption

Prepare sweetpotato tops by boiling, steaming or stir-frying to preserve nutrients. While cooking vegetables leads to slight nutrient losses, heat also helps activate some plant enzymes, vitamins and antioxidants. Get the most from your sweetpotato leaves by storing them properly and cooking them for short periods of time while reserving cooking liquids for later use. Food also loses vitamins to air, so use sweetpotatoes immediately for the best results. Choose sweetpotatoes with dark flesh and deep green leaves to get the most nutrients. Use a plastic bag with holes for ventilation, and refrigerate in the crisper drawer. Rinse and chop sweetpotato leaves into large chunks before cooking. Use a small amount of water to prevent nutrient loss. Keep the soft stems to enhance fiber content. Heat oil in a saucepan over medium-high heat. Add the greens and stir to coat with oil to prevent sticking. Add a small amount of water to the pot and stir briefly. Simmer just until the leaves wilt, approximately 5 to 7 minutes, depending on your altitude and type of sweetpotato leaves. Drink the fluids if you prefer, but wait until they cool to a comfortable temperature. Broth from sweetpotato greens is slightly bitter but also savory due to the leftover vegetable oil. Eat the leaves immediately to get the most nutrients. Serve them over rice or whole grain pasta and with protein for a meal.

Uses of Sweetpotato

Sweetpotato has many uses in addition to that of a food crop. It is also an important industrial raw material for producing starch, sugar and alcohol. These processes produce wastes, and the cost of disposing of these wastes is a main cause of lowering profitability in food processing. In such circumstances, finding ways to reuse these wastes effectively is important. The Toyota Motor Company, in cooperation with Mitsui Company, has begun production of biodegradable plastics from sweetpotatoes. Toyota plans to replace nearly 30 percent of its plastic automobile parts with biodegradable ones within ten years. Toyota Motor Company also envisions its use in the future as an energy source, such as alcohol and hydrogen. This shows that sweetpotato is a crop with great potential. To exploit this potential further, large-scale studies should be promoted on all related spheres from genetic resources to processing techniques.

People have a general belief that sweetpotato is good for maintaining and improving health. It contains vitamins, minerals and many other nutrients in favorable ratios. In the recent past, research has been conducted to determine health-promoting functions of sweetpotato (Table 1). The following aspects of these functions are important when considering new uses of sweetpotato storage roots and leaves.

Table 1. Certain health beneficial functions of sweetpotatoes (Islam et al., 2003, and Islam, 2006)

Health Beneficial Function	Components
Antioxidative activity	Polyphenol, vitamins, anthocyanin
Reduction of liver injury	Anthocyanin, ß-carotene
Antimutagenicity	Polyphenol, vitamins, anthocyanin
Anticarcinogenesis	Ganglioside
Antihypertension	Polyphenolics, vitamins, anthocyanin
Antimicrobial activity	Dietary fiber, polysaccharide
Anti-inflammation	Dietary fiber
Promotion of bowel movement	Dietary fiber, jalapin
Anti-diabetic effect (WSSP)	Acidic glycoprotein
Anticaries effect	Dietary fiber
Ultraviolet protection effect	Polyphenolics, vitamins

Conclusions

Sweetpotato leaves, served as a vegetable, may become Popeye's new food *de resistance*. The leaves, which grow abundantly in poor soil, wet soil and rich soil, can be continuously cropped until the root vegetables are harvested. Some varieties of plants have naturally occurring phytochemicals that offer protection against certain dangerous diseases. Sweetpotato genotypes with tops with a high polyphenolic content and used as a vegetable, food ingredient and as a nutritional supplement promote good health. Sweetpotato leaves contain high concentrations of polyphenolics when compared with the major commercial vegetables such as spinach, broccoli, cabbage and lettuce. Thus, sweetpotatoes offer the possibility of adding greatly to the available food supply and to the available supply of bioactive compounds for human health.

Sweetpotato leaves are a physiologically functional food that offers protection from diseases linked to oxidation such as cancer, allergies, aging, HIV and cardiovascular problems. Sweetpotato leaves used as a vegetable, a tea, in noodles, in breads, in confectioneries and as a nutritional supplement can be a beneficial food source. Sweetpotato cultivars can be developed for multiple uses, especially for special nutritional purposes of protecting human health against the diseases mentioned above. Thus, the vegetable sweetpotato has the potential to become a new alternative crop. But to the processing segment, they offer more promise. The high level of phyto - nutrients in sweetpotato leaves provides promise of a new food additive product for use as a functional food enhancer.

Sweetpotato tops, able to survive adverse conditions, could serve as an additional leafy green vegetable. Acceptable sweetpotato tops should be tender, glabrous and purplish. Those eating sweetpotato tops prefer the top 4 inches (10 cm) of tips including both stem and leaves. These are the parts generally eaten in many countries. This preference for 4-inch (10 cm) tops is logical, since a large proportion of the leaves in the top 10 cm are new and tender. Tips with the largest number of leaves with petioles less than 4/10 of an inch (1 cm) long are considered desirable because they are tender and good for the table. Researchers and extension workers could help make this vegetable's tops more appealing and acceptable. Therefore, with its tuberous roots, stems and leaves that can be consumed totally, sweetpotato is a crop that may solve food, energy, resource and environmental problems in the 21st century.

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