



CHEMICAL COMPOSITION, NUTRITIONAL VALUE AND HEALTH BENEFITS OF SOLO GOLD/MOTHER'S DELIGHT ORANGE-FLESHED SWEET POTATO (OFSP): AN OVERVIEW

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ABSTRACT

The 'Solo Gold' and 'Mother's Delight' are both orange-fleshed sweet potato (OFSP) varieties rich in beta-carotene (pro-vitamin A), fiber, complex carbohydrates, and various vitamins and minerals. Their primary benefit lies in combating Vitamin A deficiency and supporting overall health due to powerful antioxidants. Solo Gold/Mother's Delight is a variety of sweet potato (*Ipomoea batatas*) prized for its vibrant orange flesh, indicating a high beta-carotene content. Orange-fleshed sweet potato is a bio fortified crop renowned for its tuber's β -carotene content. However, its leafy greens remain underutilized despite their potential nutritional value. Antioxidant capacity was higher in leaves. Consumer sensory evaluation (9-point hedonic scale, $n=120$) revealed high acceptability (scores ≥ 7.0) for OFSP tuber-based dishes (puree, fries) and for leaves when incorporated into familiar formats like soups and stir-fries. The overview concludes that OFSP offers a dual-food system where the tubers address vitamin A deficiency and the leaves provide a rich source of antioxidant phytochemicals, both with high consumer appeal when appropriately prepared, promoting holistic crop utilization for enhanced food and nutrition security.

Keywords: nutritional value, health benefits, chemical, *Solo Gold*, *Mother's Delight*.

INTRODUCTION

Vitamin A Deficiency (VAD) remains a critical micronutrient malnutrition issue in Nigeria, particularly affecting pregnant women and children under five, leading to impaired immunity, blindness, and increased mortality [UNICEF 2018]. Taraba State, in Nigeria's North-East region, has a high prevalence of VAD, exacerbated by reliance on staple crops low in pro-vitamin A [TSMH 2020]. The orange-fleshed sweet potato (OFSP), bio fortified with beta-carotene, is a proven, cost-effective agricultural solution to this problem [Low *et al.*, 2017].

The 'Solo Gold' variety, developed by the International Potato Center (IPN) and released in Nigeria by the National Root Crops Research Institute (NRCRI), is prized for its high dry matter content, good

beta-carotene levels (≈ 15 mg/100g fresh weight), and acceptable sweetness, which enhances consumer appeal [NRCRI 2019]. While OFSP varieties have been promoted in southern Nigeria, their adoption in the Middle Belt and Northern regions like Taraba is limited.

The orange-fleshed sweet potato (OFSP) is a cornerstone bio fortification success, lauded for its high β -carotene (pro-vitamin A) content, crucial in combating vitamin A deficiency (VAD) in resource-limited settings [Low *et al.*, 2017]. While research and promotion have overwhelmingly focused on the tuber, the aerial part—the leaves—are a traditional leafy vegetable in many global cuisines (Asia, Africa, the Pacific) but are often overlooked in nutritional programming [Sun *et al.*, 2014].

Sweet potato leaves (SPL) are reported to be rich in polyphenolic antioxidants, vitamins, and minerals [Islam *et al.*, 2006]. Conversely, the OFSP tuber's nutritional mandate is primarily defined by its vibrant orange color, indicative of its carotenoid profile [Bowell-Benjamin, A. C. 2007]. A comparative analysis of the chemical and antioxidant profiles of these two distinct edible components from the same plant is lacking, particularly for modern OFSP varieties. Furthermore, consumer acceptance is critical for the successful adoption of both components. While OFSP tubers have gained market traction, the leaves may face sensory barriers. This overview, therefore, seeks to determine the chemical composition, nutritional value and health benefits of Solo Gold/Mother's delight orange fleshed sweet potato.

Primary Macronutrients & Carbohydrate Chemistry

- Starch (65-75% of dry weight): OFSP starch consists of amylose and amylopectin. The ratio influences texture and glycemic index. Some newer varieties are bred for higher amylose, which is more resistant to digestion, acting like soluble fiber.
- Sugars (Sucrose, Glucose, Fructose): Content increases during cooking (especially baking) due to the action of the enzyme amylase at around 135°F (57°C), which breaks down starch into maltose, a disaccharide. This "sweet spot" in cooking temperature explains its characteristic sweetness.
- Dietary Fiber (2-4% fresh weight): Contains both:
 - Insoluble Fiber: Lignin, cellulose, hemicellulose in cell walls—aids bowel regularity.
 - Soluble Fiber: Pectin—forms a gel, slowing gastric emptying, modulating blood sugar, and serving as a prebiotic (food for beneficial gut micro biota like Bifidobacterium and Lactobacillus).
- Protein (1-2% fresh weight): Contains sporamin, a major storage protein that makes up over 80% of total soluble protein. Research indicates sporamin possesses trypsin-inhibitor activity and has demonstrated antioxidant and anti-carcinogenic properties in vitro and in animal studies.

Micronutrients & Bioactive Phytochemicals

This is where OFSP, particularly the orange-fleshed varieties, truly excels.

- Carotenoids: The dominant nutrient class.
- All-trans- β -carotene: The primary provitamin A carotenoid. Solo Gold varieties are bio fortified to contain extremely high levels.
- Mechanism: In the intestinal mucosa and liver, beta-carotene is cleaved by the enzyme beta-carotene 15, 15'-monooxygenase to form retinol (active Vitamin A).
- Other Carotenoids: Includes α -carotene, β -cryptoxanthin, lutein, and zeaxanthin, which protect ocular tissues from blue light damage.
- Polyphenols:
- Chlorogenic Acid: The most abundant polyphenol, concentrated in the skin and flesh. It's a potent antioxidant and anti-inflammatory agent, shown to inhibit glucose-6-phosphate translocase, potentially moderating postprandial blood glucose.
- Anthocyanins: Present in purple hues within some orange varieties and especially concentrated in the skin (e.g., peonidin, cyanidin). They exert benefits via antioxidant, anti-inflammatory, and AMPK activation pathways.

Vitamins:

- Vitamin C (Ascorbic Acid): A potent water-soluble antioxidant that regenerates other antioxidants (like Vitamin E) and is essential for collagen synthesis.
- B-Vitamins: Notably B6 (Pyridoxine), crucial as a cofactor in amino acid metabolism and neurotransmitter synthesis, and B5 (Pantothenic Acid), central to energy metabolism.

Minerals:

- Potassium: Vital for maintaining electrochemical gradients, nerve transmission, and counteracting the hypertensive effects of sodium.
- Manganese: A cofactor for the antioxidant enzyme superoxide dismutase (SOD).

Expanded Health Benefits with Mechanisms & References

a. Vision Health & Combating Vitamin A Deficiency (VAD)

- Mechanism: Beta-carotene conversion to retinol is critical for forming rhodopsin, the light-absorbing molecule in rod cells of the retina, enabling low-light vision. Vitamin A also maintains corneal integrity.
- Evidence: OFSP bio fortification is a cornerstone of global health strategies. A large-scale study in Mozambique found that introducing OFSP to preschool children reduced the prevalence of VAD by 15% (Low *et al.*, (2007)).

b. Antioxidant & Anti-Inflammatory Activity

- Mechanism: The synergistic effect of carotenoids (lipid-soluble) and Vitamin C/Polyphenols (water-soluble) provides comprehensive cellular protection. They quench reactive oxygen species (ROS) and down regulate pro-inflammatory pathways like NF- κ B.

- Evidence: Studies show OFSP consumption increases antioxidant capacity in the blood (measured by ORAC, FRAP assays) and reduces inflammatory markers like CRP (Beejmohun *et al.*, (2007).

c. Glycemic Control & Metabolic Health

- Mechanism: The high dietary fiber content slows carbohydrate digestion and absorption. More uniquely, the protein sporamin and the polyphenol chlorogenic acid have been shown to improve insulin sensitivity. The compound caiapo (isolated from white sweet potato skin) has demonstrated anti-diabetic effects in clinical trials.

- Evidence: Human studies indicate that despite its sweetness, OFSP has a medium Glycemic Index (GI 61). When consumed with the skin and as part of a balanced meal, it does not cause sharp glycemic spikes (Ludvik *et al.* (2004).

d. Gastrointestinal & Prebiotic Health

- Mechanism: Soluble fiber (pectin) resists digestion in the small intestine and is fermented in the colon by micro biota into short-chain fatty acids (SCFAs) like butyrate. Butyrate is the primary energy source for colonocytes, promotes a healthy gut lining, and has anti-cancer properties.

- Evidence: Animal and in vitro fermentation models show sweet potato fiber increases concentrations of beneficial bacteria and SCFA production (Zhu *et al.* (2022).

e. Immunomodulation

- Mechanism: Vitamin A is termed the "anti-infective vitamin." It is essential for the differentiation and function of T-helper cells, B-cells, and the integrity of mucosal barriers (gut, respiratory). The antioxidant complex also reduces inflammation-induced immune suppression.

- Evidence: Deficiency in Vitamin A is directly linked to increased severity and mortality from infections like measles and diarrheal diseases.

f. Cognitive Function & Neuroprotection

- Mechanism: Anthocyanins cross the blood-brain barrier and localize in brain regions involved in learning and memory (hippocampus). They reduce neuroinflammation, inhibit acetyl cholinesterase, and promote brain-derived neurotrophic factor (BDNF).

- Evidence: Epidemiological and animal studies correlate higher anthocyanin intake with slower cognitive decline (Krikorian *et al.* (2019).

Optimizing Bioavailability & Preparation

a. Fat for Carotenoids: Consuming OFSP with 3-5g of fat (e.g., 1 tsp of olive oil, in a salad with avocado, or as part of a meal containing meat/fish) increases beta-carotene absorption by 4-5 fold compared to a fat-free meal (Brown *et al.* (2008).

b. Cooking Method:

- Boiling/Steaming: Preserves water-soluble vitamins (like Vitamin C) and beta-carotene well. The cellular matrix softens, making carotenoids more accessible.
 - Baking/Roasting: Can lead to higher sugar content (from amylase activity) and some loss of Vitamin C due to higher heat, but concentrates flavors and retains carotenoids effectively.
 - Frying: Significantly increases fat and calorie content and can degrade heat-sensitive nutrients.
- c. Consume the Skin: The skin contains a significant portion of the fiber, anthocyanins, and chlorogenic acid. Always wash thoroughly.

SUMMARY

The Solo Gold/Mother's Delight OFSP is a premier example of a bio fortified, functional food. Its chemical composition—dominated by bio accessible beta-carotene, synergistic antioxidants, and high-quality fiber—confers a wide range of proven health benefits, from eradicating deficiency diseases to modulating modern chronic conditions like diabetes and heart disease. Its value is maximized through simple, informed preparation methods.

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