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# An Assessment on Nutritional, Phytochemical, Pharmacological and Toxicological Properties of *Ipomoea Batata L.*

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***ABSTRACT***

An overview of the *Ipomoea* genus, namely *Ipomoea batatas* L., is given in this article. Its traditional uses, nutritional values, phytochemical, pharmacological, and toxicological properties are all covered in the review. Many nations have for long been utilizing sweet potatoes (*Ipomoea batatas*) for traditional purposes including curing allergies, managing patients with diabetes mellitus and as a source of dietary fiber. *Ipomoea batatas* is mostly composed of carotenoids, flavonoids, anthocyanins, and phenolic substances. A number of nutritional components may be found in sweet potatoes, including minerals, β-carotene, protein, fiber, and vitamin C. Pharmacological properties of sweet potatoes include; anti-inflammatory, anti-cancer, aphrodisiac, and antioxidant properties. Every portion of the plant has a distinct sort of phytochemical component and each pharmacological effect and mechanism is dependent on the phytochemical compounds, part and variety of the plant, and also extraction solvent used.

**Keywords:** Ipomoea Batata; Phytochemicals; Nutritional; Antioxidants; Antidiabetic

## 1.0 INTRODUCTION

Ipomoea batatas (L.) Lam. is the largest species in the Convolvulaceae family and belongs to the Ipomoea genus (Srisuwan *et al*. 2018). It has various colors (Fidrianny *et al*., 2018) and is native to tropical America, China, India, the Philippines, and the South Sea Islands. It is ranked as the sixth most significant food crop worldwide grown in China, Malawi, Tanzania, Nigeria, and Indonesia (Srivastava and Rauniyar 2020) (FAO 2021).

Sweet potatoes have a variety of phytochemical s and vital nutrients in their roots, tubers, leaves, and stems, including flavonoids, anthocyanins, carotenoids, tannins minerals, β-carotene, protein, fiber, carbs, vitamin C, amylose, and amylopectin (Vishnu *et al*., 2019; Abong *et al*., 2020) (Senthilkumar *et al*., 2019; Obomeghei *et al*., 2020; Dinu *et al*., 2021).

Numerous studies demonstrated the pharmacological properties of the bioactive compounds found in sweet potatoes, including their anti-inflammatory, genoprotective, anti-cancer, antibacterial, anti-inflammatory, antihypertensive, hypolipidemic, antidiabetic, antidepressant, wound healing, prebiotic qualities, immunostimulant, anti-fatigue, diuretic effect, and hepatoprotective properties. Prior researches equally demonstrated that sweet potatoes have a long history of use in medicine. According to Panda and Sonkamble (2012), the plant contains a variety of phytochemical substances, each of which has unique pharmacological characteristics. Expanding on these discoveries, the current study aims to offer a current and thorough summary that includes traditional applications, nutritional worth, phytochemical components, pharmacological actions, and toxicity investigations carried out between 2013 and 2022. Additionally, this study contrasts the pharmacological properties and phytochemical makeup of many sweet potato cultivars' distinct portions.

### 1.1 Botanical and Morphological features of *I. Batatas*

*I. batatas* (L.) Lam. Commonly known as sweet potato (Figure 1) belongs to *Ipomoea* genus, and *Convolvulaceae* family (Srisuwan *et al.*, 2018). Within *I. batatas*, there are numerous varieties distinguished by the color of both peel and flesh, such as purple-purple, purple-orange, yellow-yellow purple, and yellow-yellow orange (YYO) (Fidrianny *et al*., 2018). This plant, typically grown as an annual, features tuberous roots (Figure 1a) and trailing vines up to 4 meters long, with slender stems producing milky juice (Srisuwan *et al.*, 2018). The leaves (Figure 1b) which vary in shape and color depending on the variety, are borne on lengthy petioles (Fidrianny *et al*., 2018). The Flowers (Figure 1c), infrequent and funnel-shaped, may be white or pale purple and grow in clusters. Pods contain 1–4 hard-coated seeds and are round in shape (Fidrianny *et al.*, 2018). Native to tropical regions like America, India, China, the Philippines, and the South Sea Islands (Srivastava and Rauniyar 2020), *I. batatas* holds significant economic importance worldwide. Despite originating in the Americas, its primary cultivation areas now include China, Malawi, Tanzania, Nigeria, and Indonesia (FAO, 2021).

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**(a) *I. batatas* tuber**

**(b) *I. batatas* leaves**

**(c) Different parts of *I. batatas***

**(d) *I. batatas* in natural habitat**

**Figure 1: Pictures of *I. batatas***

### 1.2 Ethnomedicinal uses of *I. Batatas*

Traditional uses of *I. batatas* range from a dietary fiber source to allergy and anemia treatment and energy provision for individuals with diabetes mellitus (Abe and Ohtani 2013; Khan *et al*., 2013; Peter *et al*., 2014; Akhter *et al*., 2016; Roué and Molnar 2017; Silalahi *et al*., 2021).

Traditional medicine practitioners assert that the leaves of *I. batatas* possess haematinic effects and are utilized in various folkloric remedies for ailments (Duke, 1985; Imafidon *et al*., 2015). Historically, *I. batatas* has been recognized for its diverse medicinal properties, serving as an aphrodisiac, antiprostatic, anti-inflammatory, antidiabetic, cardiotonic, and anticancer agent (Majid *et al*., 2019). Furthermore, its leaf decoction is a traditional remedy for asthma, bug bites, burns, catarrh, diarrhea, fever, and tumors (Duke, 1985). In the treatment of sickle cell disease, *I. batatas* has also demonstrated efficacy as a haematinic (Ilondu and Enwa, 2013).

The utilization of plants and herbs as food supplements and medicinal additives is rapidly gaining recognition worldwide, particularly in Africa (Osime *et al*., 2009). *I. batatas* are commonly employed in decoctions as a folk remedy for various ailments including asthma, bug bites, burns, catarrh, diarrhea, fever, nausea, stomach distress, and tumors (Osime *et al*., 2009). Additionally, *I. batatas* exhibits haematinic effects and has been used in the treatment of anaemia and related conditions (Osime *et al.,* 2009).

### 1.3 Nutritional Values

*I. batatas* is renowned for its nutritional benefits, with its tubers, roots, and leaves serving as rich sources of proteins, carbohydrates, minerals, and vitamins. While extensive research has focused on the nutritional composition of these parts, less attention has been paid to the stems (Amagloh *et al*., 2022).

### 1.4 Bioactive Compounds

*I. batatas* contain various bioactive compounds, including phenolic compounds (Fig 3.4 and 5), flavonoids (fig 2), anthocyanins, carotenoids, and tannins (Amagloh *et al*., 2022), all of which contribute to human health benefits. These compounds confer *I. batatas* with high medicinal potentials (Ali *et al.,* 2018).

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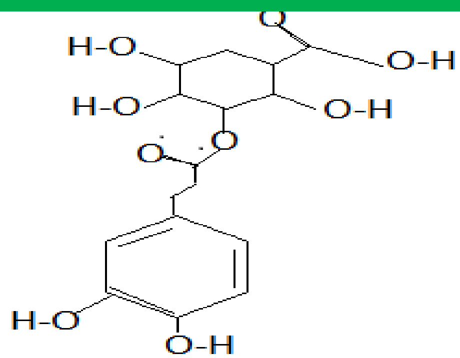

**Figure2: The structure of 4-O caffeoylquinic acid**

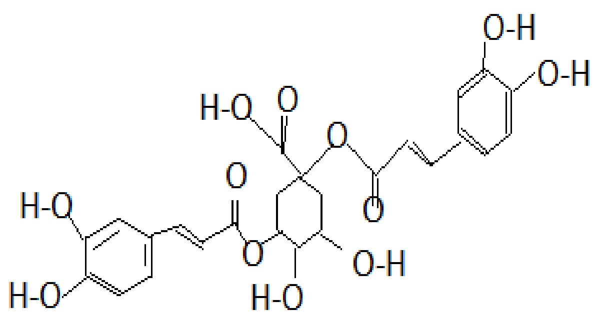

**Figure 3: The structure of 1,3-di-O-caffeoylquinic**

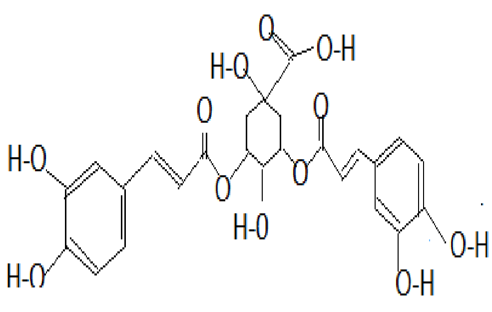

**Figure 4: The structure of 3,5-di-O-caffeoylquinic acid**

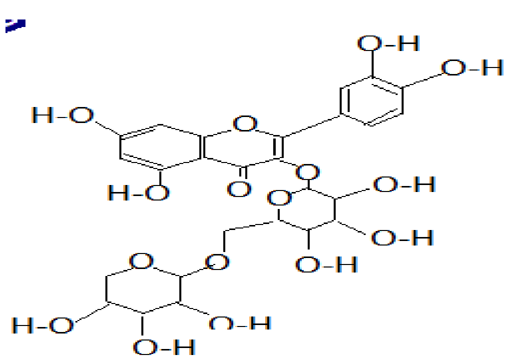

**Figure 5: The structure of Rutin**

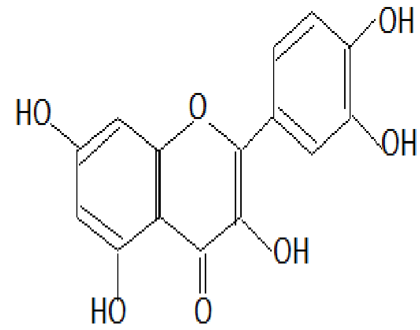

**Figure 6: The structure of quercetin**

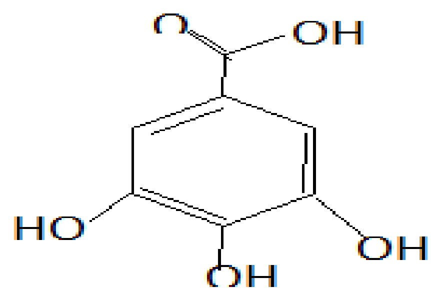

**Figure 7:The structure of Gallic Acid**

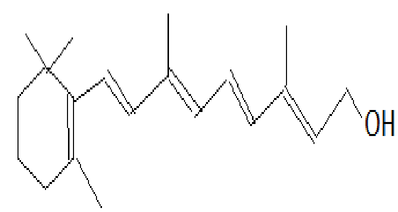

**Figure 8 The structure of Vitamin A**

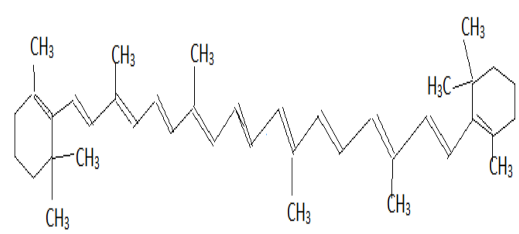

**Figure 9: The structure of β-carotene**

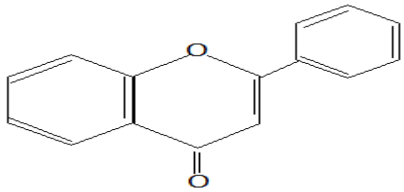

**Figure 10: Structure of Flavonoid**

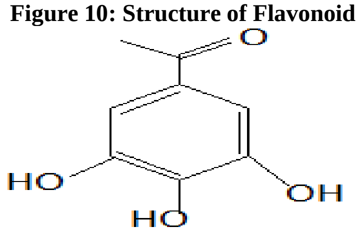

**Figure 11: structure of Tannins**

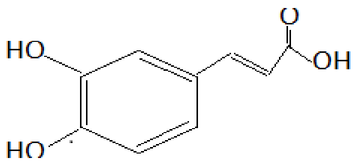

**Figure 12: Structure of Caffeic acid**

### 1.5 Pharmacological Activities

Numerous studies highlighted their pharmacological activities, including antioxidant, aphrodisiac, genoprotective, anticancer, antibacterial, anti-inflammatory, antihypertensive, hypolipidemic, antidiabetic, and hepatoprotective effects, among others (Tan 2015).

### 1.5.1 Antioxidant Activity

*I. batatas* tubers and roots show antioxidant capacity (Majid *et al*., 2019), with ethyl acetate extract being the highest. Polyphenols (Figure 3,4 and 5) in these extracts normalize enzyme levels and histopathological changes (Revathy *et al*., 2017; Zhang *et al*. 2018; Trifonova *et al*., 2021; Zhou *et al*., 2021; Savych *et al.*, 2022). Flavonoids (Figure 2) could prevent Pb-caused reproductive toxicity and inhibit oxidative stress (Mishra *et al.*, 2013; Naz *et al.*, 2016; Fidrianny *et al.*, 2018; Dirgantara *et al.*, 2022; Kumar *et al.*, 2022). In vivo studies show aphrodisiac and gonadoprotective properties (Jung *et al*., 2011). Secondary metabolites like rutin (Figure 9), quercetin (Fig 6), and gallic acid (fig 7) also play important role (Abarikwu *et al.*, 2017).

### 1.5.2 Genoprotective Activity

*I. batatas* extracts have been found to possess genoprotective properties, as their polyphenols, tannins, and terpenoids scavenge free radicals, bind to $Fe^{+2}$ sites, and prevent oxidative damage to pBR322 DNA, thereby decreasing reactive oxygen species levels and increasing cell viability (Majid *et al.*, 2019).

### 1.5.3 Provitamin A Activity

*I. batatas*, particularly orange-fleshed varieties, are rich in provitamin A, carotenoid (Koua *et al.*, 2018), which can be converted into vitamin A (Figure 8). These orange-fleshed varieties are promising for addressing vitamin A deficiency in children, particularly in rural areas (Kammona *et al*., 2015; Koua *et al.*, 2018; Mutuku *et al.*, 2019).

### 1.5.4 Anticancer Activity

*I. batatas* tubers contain compounds that inhibit breast cancer cell proliferation, potentially counteracting MCF-7 development in mice.

It has been possible to isolate three compounds: caffeic acid (CA) (Figure 12), caffeoylquinic acid (4,5-diCQA) (Figure 2), and 3,4,5-tri-O-caffeoylquinic acid (3,4,5-triCQA) (Figure 4). (Dini *et al*., 2006) These compounds show antimutagenic effects. They were also found to suppress the proliferation of human cancer cells derived from the colon, stomach, and promyelocytic leukemia cells (Basnet *et al*., 1996).

### 1.5.5 Antibacterial Activity

*I. batatas* tubers' methanolic extract has antibacterial properties against Staphylococcus aureus, Escherichia coli, Streptococcus pyogenes, and Serratia marcescens. Cold extracts show better activity. Flavonoids in *I. batatas* peels and pulp prevent bacterial cell division. Leaf ethanol extracts contain flavonoids, tanninn, steroid, and polyphenolic compounds (Naz *et al*. 2016; Kusuma *et al.* 2017: Tagousop *et al.* 2018; Mincheva *et al.* 2019; Angelina *et al.* 2021; Satria *et al.* 2022; Obum-Nnadi *et al.* 2022; Suhendy *et al*., 2023).

### 1.5.6 Anti-inflammatory Activity

*I. batatas*, including its tubers and roots, has been found to possess anti-inflammatory properties, reducing oxidative stress and inflammation. Experimental models show significant anti-inflammatory activity, with the IPR-EA extract showing highest edema inhibition. Its leaves also show anti-inflammatory properties (Majid 2018; Artini *et al*. 2022; Zhang *et al*. 2022).

### 1.5.7 Antihypertension Activity

Purple *I. batatas* tuber extract has been found to decrease systolic blood pressure and have antihypertensive properties. It also has a hypolipidemic effect through the elevation of serum HDL-C concentration and regulation of LPL activity. The leaves show hypolipidemic and anti-atherosclerotic properties, while flavonoid compounds like Luteolin and luteoloside have positive effects on blood lipids and hepatic steatosis (Sun *et al.*, 2021; Ntchapda *et al*., 2021; Wu and Lin 2017).

### 1.5.8 Antidiabetic/Hypoglycemic Activity

The Simon No. 1 cultivar of *I. batatas* leaves extract has been found to have anti-diabetic properties, protecting pancreatic beta-cells and suppressing insulitis in rats induced with STZ-induced diabetes. It also contains ethyl caffeate, primary anthocyanin, and white skinned *I. batatas* roots/peeloff, with antihyperglycemic activity (Akhtar *et al*. 2018; Jang *et al*. 2019; Luo *et al*. 2020; Novrial *et al*. 2020; Yustiantara *et al*. 2021).

### 1.5.9 Inhibition of Xanthine Oxidation and Hypouricemic Activities

Purple *I. batatas* extract (APSPE) inhibits xanthine oxidase activity in hyperuricemic mice, reducing serum uric acid levels. Studies suggest cyanidin-3-O-glucoside and peonidin-3-O-glucoside major anthocyanins in purple *I. batatas* tubers as potential antidepressant candidates (Zhang *et al.*, 2015; Zhang *et al.*, 2017).

### 1.5.10 Wound Healing Activity

*I. batatas* root peels' ethanolic extracts show significant wound-healing effects in mice due to their potent anti-inflammatory properties. Secondary metabolites like gallic acid, kaempferol, rutin, catechin, and quercetin also aid in healing. White *I. batatas* tubers and anthocyanin-rich extracts also promote healing (Xu *et al*. 2013; Majid *et al.*, 2018; Hermes *et al*., 2013; Silva-Correa *et al.*, 2021; Hong *et al.*, 2022).

### 1.5.11 Prebiotic Activity

Root of *I. batatas* flours show positive prebiotic activity, stimulating beneficial bacteria like Lactobacillus acidophilus, Lactobacillus casei, and Bifidobacterium animalis. Peonidin and purple anthocyanin extracts induce Bifidobacterium and Lactobacillus species proliferation. *I. batatas* fiber extract promotes beneficial bacteria growth (Lestari *et al.*, 2013; Sun *et al*., 2018; De Albuquerque *et al*., 2020).

### 1.6 Toxicity

In vivo studies found that *I. batatas* extracts, even at doses up to 2000 mg/kg, were safe for rats. The LD50 values of purple *I. batatas* extract were over 5,000 mg/kg, and aqueous extracts showed no mortality up to 10 mg/kg. In vitro cytotoxicity showed no cell toxicity, indicating high cell viability and safety for therapeutic applications (Adeyemi *et al.*, 2015; Majid *et al*., 2019; Vishnu *et al.*, 2019; Ameamsri *et al.*, 2021).

## 2.0 CONCLUSION

Inconclusion, I *batatas* has long history of nutritional and medicinal applications. This cut across all parts of the plant ranging from leaves, branches and tubers. The plants parts are widely used in the treatment of ailments such as cancer, diabetes, aneamia due to the antioxidant, aphrodisiac, genoprotective, anticancer, antibacterial, anti-inflammatory, antihypertensive, hypolipidemic, antidiabetic, and hepatoprotective effects of its extracts. Similarly, the tubers are of high nutritional benefits owing to their high available carbohydrate and mineral content.

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