# Harnessing the Potentials of Sweetpotato (Ipomoea batatas L.) for Enhanced Livelihood and Development


## Abstract

This review gives an overview of the potentials of sweetpotato as a versatile and multi-functional crop. It brings together careful reviews of some of the outstanding characteristics and revealing potentials of the crop which have been established and reported by several researches and authors. The contents of this review contains reviews on components such as the various types of sweetpotato based on the flesh color and their various constituent compounds, nutritive features, phenolic acids contained in sweetpotato, the phytochemical and pharmacological properties such as diseases' prevention and promotion of good health through its antioxidant, anticancer, antiulcer, anti-inflammation, cardiovascular properties and the enhancement of the immune system, processing of sweetpotato in to various food products such as vinegar, chips, flakes, cubes, yoghurt, cheese and some industrial utilization in the processing of alcohol and starch, the utilization potentials in animal feed; use as silage, processed to hay, as green-chop, the use of the tuber in poultry feeds and the contributions of the crop towards food security and development through the ability to fight hunger, poverty reduction, income generation, climate resilient and adaptability to vast range of climates. Various authors and researches have investigated and voted sweetpotato as one of the crops with the best production, consumption and utilization attributes which can help the smallholder farmers in the forest, tropical and subtropical zones to achieved food security and households' income stability. Sweetpotato is gaining attention and registering growing demands with appreciating growth in exports and imports in some countries across the globe due to its quality and potentials. The developing countries in particular which have the comparable advantages in the cultivation of sweetpotato should develop schemes and policies that will enable them to tap in to its potentials for livelihood improvement and development.



**Keywords**: Anthocynin, Carotene, Phytochemical, Pharmacological, Sweetpotato




## 1 Introduction

Sweet potato is a root-tuber crop which is rated as the 5th and 7th most principal food crop in the less developed countries and globally respectively [1]. Sweetpotato comes next after cassava among the root and tuber crops, making it the second most valuable tuber crop in the world [2]. Sweetpotato is the most prominent among the members of the *Ipomoea* genus, and it is by far the only member in the genus with the characteristics of bearing root tubers of great nutrition and economic values [3]. Sweetpotato is regarded as one of the important crops grown for man's consumption across the globe. Sweetpotato, among other crops is of economic advantage and has been rated as the 15th and the 29th cultivated crop on the account of the amount of yield and the area under cultivation respectively, with the average annual yield of 92, 000000 tons [4-6].

Sweetpotato is arguably an important tuber crop in most areas, cultivated in over 100 countries across the globe and has been regarded as a staple food for the people in the tropical and subtropical regions, which provides nutritional security for both the urban and rural dwellers through enhanced cultivation and utilization [7, 8]. Sweetpotato is grown around the world in about 114 nations, with the global average yield of 14 tons/hectare [9]. Sweetpotato among other staple crops is well adaptable to wide range of climates, rapid and short maturity and promising yield capacity [9].

## 2 Sweetpotato types, nutritional and chemical constituents

### *2.1 Types of sweetpotato according to flesh color*

There are different types of sweetpotato varieties growing across the globe, with variation in skin and flesh color such as white, cream, orange, purple, pale yellow, etc. these types of sweetpotato do not only vary in the fleshed or skin color, but also possess different levels and kinds of important chemical constituents of enviable relevance in nutrition, medicine and other industrial usage.

**Table 1: Types of sweetpotato according the fleshed color and their major compounds**

| Sweetpotato type | Major bioactive compound contained | Reference |
|---|---|---|
| Purple fleshed | Anthocyanins, phenolic acids | [10, 11] |
| Orange fleshed | β-5 cryptoxanthin, β-carotene, α-carotene, flavonoids | [8,12] |

| | | |
|---|---|---|
| White fleshed | Starch, phenolic acids | [13, 11] |
| Cream fleshed | Starch, phenolic acids | [13, 11] |

*2.2 Nutritional components of sweetpotato*

Sweetpotato is a rich source of various important nutrient ingredients such as protein, energy, carbohydrates, Lipids, minerals and vitamins [14].

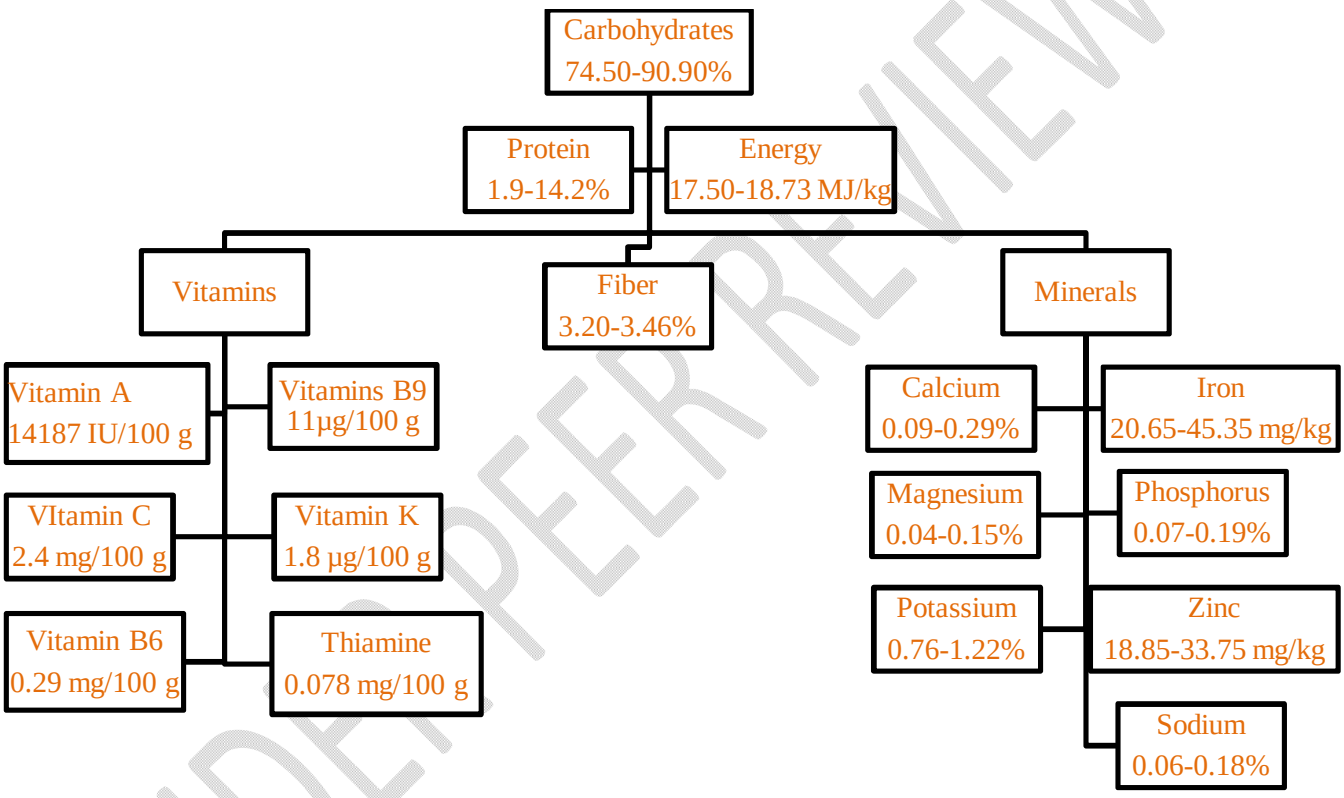
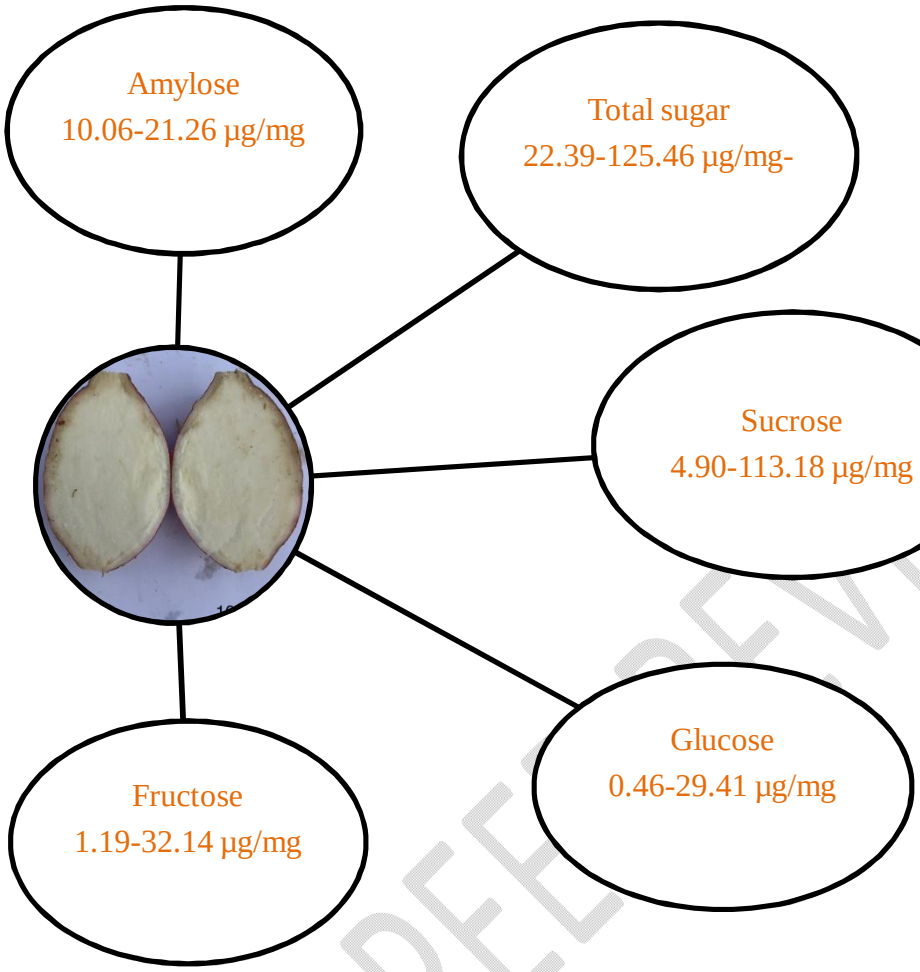



**Figure 1: Nutritional composition of sweetpotato** [14, 15].

The flour produce from the tubers of sweetpotato also contains some sugars, which contribute greatly to the dough fermentation in the process of making bread.




[16]

**Figure 2: Sugars identified in sweetpotato flour**

*2.3 Phenolic acids present in sweetpotato*

The various varieties of sweetpotato generally contain a number of phenolic acids which are importantly linked to the unique sensory traits possess by the varieties.

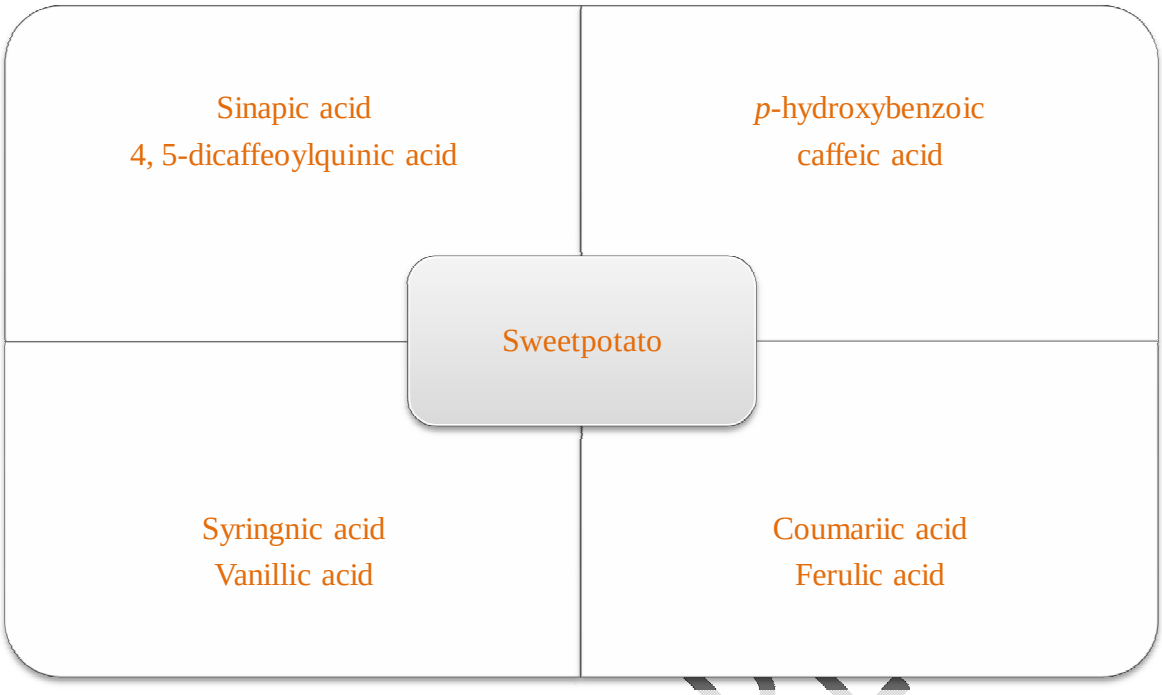



**Figure 3: Phenolic acids present in sweetpotato** [17, 18].

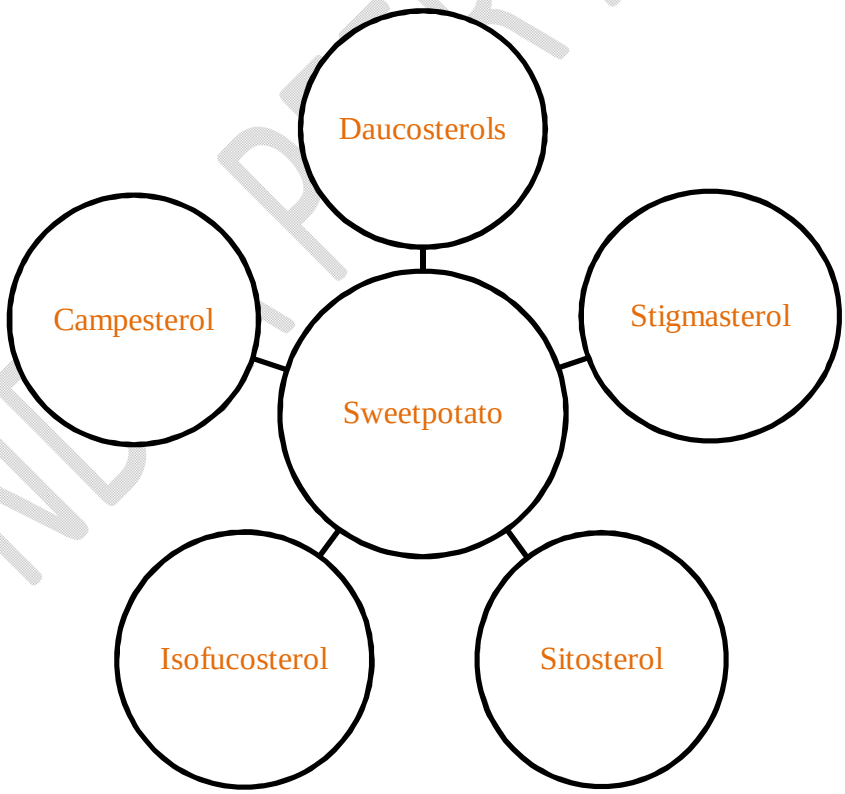



**Figure 4: Main phytochemical constituents of sweetpotato** [19, 20].

## 3 Benefits and potentials of sweetpotato

*3.1industrial utilization*

The tubers of sweetpotato can be used to produce starch, which is indigenously used to produce noodles, sugar, vermicelli, syrups, contributing significantly to food products. Additionally the starch and the sugar obtained from it can also be used to make products such as monosodium, citric acid, microbial enzymes, glutamate, lactic acid and alcohol [9, 20]. Sweetpotato are also used in the manufacturing of snacks and bakery foods like chips [21].The purple and orange fleshed varieties of sweetpotato are reported to have been extensively applied in the making of inartificial anthocyanin colorants and β-carotene in some beverage products on a large scale in Japan [9]. The purple and orange fleshed sweetpotato are used in making beer and wine, due to their characteristics of being rich sources of starch which is convertible to sugar [9]. Sweetpotato provides good industrial raw materials for the producing of alcohol and starch [22].

Maintaining and scaling up the growth and expansion of the sweetpotato sub-sector through processing and formulation of food products is directly proportional to the commercialization and value addition of sweetpotato, due to its richness in polyphenols and dietary fiber, which have the potentials of reducing the digestibility of starch [23, 24].

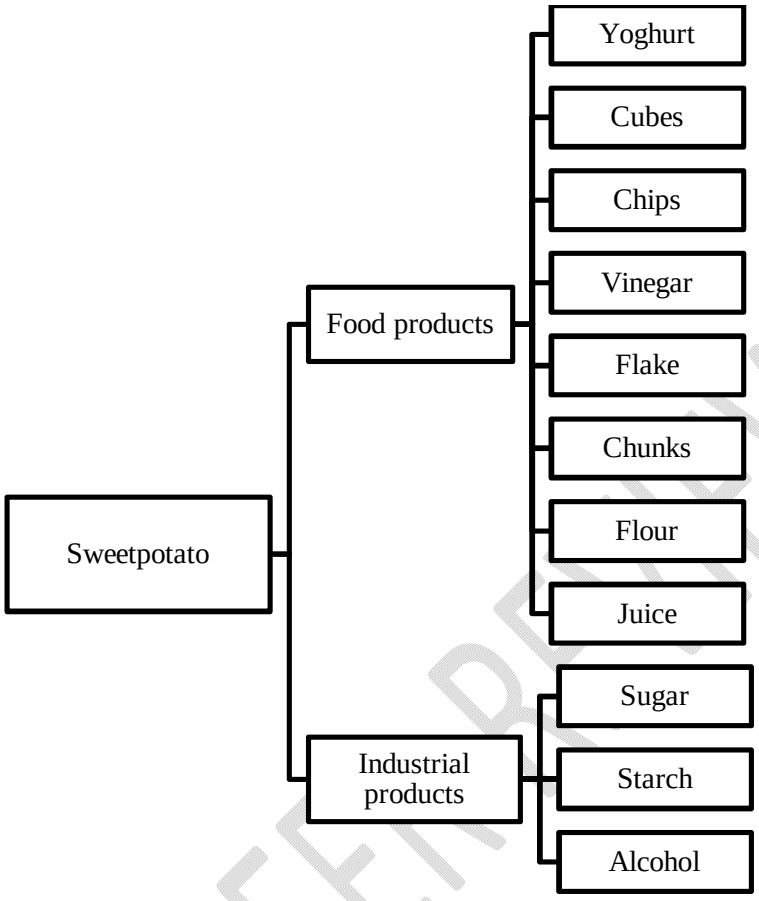



**Figure 5: Food and Industrial products from sweetpotato** [9].

Alpha-amylase: the beta-amylase enzyme, oxidase causes the breaking down of the starch component of sweetpotato during processing [25], and the enzymatic reaction of the amylase results to maltose formation during processing leading to the high level of sweetness and sugar content of the end product formed [26].

The Mitsui and Toyota motor companies are collaboratively exploring the potential of sweetpotato in the manufacturing of plastics materials which are bio-degradable, and has also projected sweetpotato as a potential efficient energy source like hydrogen and alcohol in the day ahead of us [27].

*3.2 The pharmacological and health potentials of Sweetpotato*

There are several therapeutic, pharmacological, phytochemicals and other health related attributes associated with Sweetpotato, which have been studied and their relevance being investigated. Sweetpotato is an excellent source of several phytochemical compounds of

therapeutic importance. Nutritionally, the various parts of sweet potato have great dietary fiber, the stem and leaves have high carotene, vitamin E, vitamin C, vitamin B2 and iron [28]. The sweet potato roots are good sources of vitamin C, starch, β-carotene and sugar [29]. It is reported that the tubers of sweetpotato have high protein level than that of yam and cassava [30].

**Table 2: Pharmacological properties of sweetpotato**

| **Property** | **Mechanism of reaction** | **References** |
|---|---|---|
| Anti-oxidant action | Flavonoids and n-hexane, ethanol and ethyl-acetate extracts from leaves help to remove oxygen-based reactive radicals in the cell. | [31, 32] |
| | Reduces the chances of getting degenerative disorders like senile, dementia, cancer, diabetes, asthma, which are highly caused by the actions of free harmful radicals. | [33] |
| Boost of immune system | The leaves of purple Sweetpotato regulate the activities of lytic, T-lymphocyte deleterious cell. Generation of antibody production in healthy humans | [34] |
| | The derivatives of ethyl-acetate from Sweetpotato have immune-modulatory actions | [35] |
| Anti-cancer property | The polyphenol constituent of sweetpotato extract hinders the proliferation and also leads to apoptosis in prostate cancer cells | [36, 37] |
| | The anthocyanin in the sweetpotato with purple flesh is potent against the development of cancers of the breast and stomach. | |
| Anti-diabetic property | The white-fleshed sweetpotato increases the adiponectin level in the blood, a hormone that modifies the metabolism of insulin. | [38] |
| | | [39] |

| | | |
|---|---|---|
| | Extracts of white-fleshed sweetpotato potentially reduces blood sugar level | |
| Antimicrobial property | Extracts of ethanol and acetone obtained from the leaves of sweetpotato respectively have antimicrobial inhibitory actions on *Pseudomonas aeruginosa* and *Salmonella typhimurium* | [40] [41] |
| | Liquid extracted from the leaf of sweetpotato highly inhibits the growth of *E. coli, Bacillus cereus* and *Staphylococcus aureus* | |
| Cardiovascular enhancing property | Extract rich in phytochemicals, obtained from the leaves of sweetpotato inhibits the oxidation of less dense lipoprotein in humans. | [42] [43] |
| | Anthocyanin in purple skinned sweetpotato decreases the chances of getting coronary infections. | |
| Anti-ulcer property | Extract rich in methanol, obtained from the roots of sweetpotato protects the stomach of rat against ulcer, induced by aspirin. | [44] [45] |
| | The flour obtained from the roots of sweetpotato inhibits gastric ulcer induced by ethanol. | |
| Anti-inflammatory property | Inhibition of inflammatory infection of the brain by preventing the inflammatory reactions caused by lipopolysacharide. | [46] |
| Haematological property | The leaf of sweetpotato has haematinic action, and it is used in indigenous treatment of anaemia. | [47] [48] |
| | Powder from the leaf of sweetpotato increases the levels of red blood cells and | |

| haemoglobin of mice. |
|---|

*3.3 The uses of sweetpotato in feed and feed ingredients of animals*

The vegetative parts and the tuber of sweetpotato are use as silage and fodder for livestock [49]. There was improvement in the growth of young female cattle when fed with roughage diet, supplemented with silage prepared from the vines of sweetpotato [50]. According to Mibach *et al.* [51] substituting of ground-corn for any amount of sweetpotato flour for sheep put on diets of multiple constituents does not interferes with the intake and digestibility of dry matter, nitrogen retention and microbial synthesis of protein. According to Murugan *et al*. [52] averagely 43% of the sweetpotato produced per annum globally is utilized as feed for animals; the vines and other foliar parts of sweetpotato are commonly use as protein supplementary feed and feed materials for farm animals like pigs in several countries across the globe such as Uganda, Korea, Taiwan, Vietnam, Indonesia, Papua New Guinea, China, Philippines and India.

The tubers of sweetpotato has been studied and identified as one of the nutritious and less expensive alternative feed material for broiler chickens [52, 53]. The addition of about 25% and 20% of the orange fleshed sweetpotato tuber-meal to layer and broiler chickens feeds respectively do not has any negative impact on the quality of eggs and growth [54]. Sweetpotato-meal inclusive diet has proven to have an enhancer influence on the growth and performance of quails in Japan [55]. The most desirable feed conversion efficiency and growth can be achieved in chicken, when fed with diet containing about 10% of dried sweetpotato-leaves, and can result to more weight gain in broilers in particular compare with other diets containing no sweetpotato leaves [56]. A diet of dried leaves of sweetpotato can increase the level of the yellow color of the egg yolk and the skin of chickens [57]. The meal prepared from the tubers of the orange fleshed sweetpotato has been suggested with proven results, to be the best substitute for corn at the rate of 12% -16% and 15% and 20% during the starter and grower stages of chicken respectively, with positive influence on chicken characteristics such as ingestion, weight increase and meat attributes [58]. Meal prepared from sweetpotato tubers can be included at the levels of 25% and 50% in the diets of layer and broiler chickens respectively to achieved optimal production [59].

*3.4 The potentials of sweetpotato in fostering food security*

According to Scott and Maldonado [60] Sweetpotato is largely cultivated in low and middle income earning countries, and because of that, scaling up of sweetpotato cultivation is noted as a greater tool to foster food security and improve the livelihoods and living standards of the economically disadvantaged class of the rural and urban settings.

Sweetpotato plays several fundamental functions, contributing significantly to the “food basket” of the globe, which has a viable potential of reducing the food need of the growing world’s population, decreases poverty, promotes food security and improves livelihoods [2]. Sweetpotato tubers are great hunger-combating food materials which significantly saved millions of people during some daring moments in the history of the world such as the period critical food insecurity at china (in the 1960s), Uganda (during the 1990s) and Japan, that is the time during which there was a development of phytosanitary problems in fields of cassava in Uganda and the destructions of rice farms by typhoons in Japan [61, 2].

In addition to food, Sweetpotato has got multi-industrial uses because of its wonderful attributes such as cheap and simple cultivation, ability to tolerate infections and pests, high output and rich in carbohydrate, minerals and vitamins in both its roots and leaves [62]. The vitamin A precursor (Beta- carotene) rich orange fleshed sweetpotato can importantly contributes to the global fight against the deficiency of vitamin A among people, which has started yielding positive results in improving status quo of vitamin A among lactating and expectant mothers and children in Africa [9, 63].

In the populous semi-arid plains of Eastern Africa, sweetpotato is a cherishable food material used to combat food insecurity by thousands of rural communities [64]. The development and demands of snack-foods developed from sweetpotato have seen a surge in recent years, covering a significant portion of the food commodity market, meeting the taste and preference of consumers [65]. Sweetpotato cultivation is very profitable, with high sale-value and has the potentials of earning its growers more incomes [66].

Okoye [67] has noted that sweetpotato has a good comparative advantage in Nigeria, in terms of its production and small holder farmers earn significant amount of income from the vines, tubers and the leaves. In terms of nutrients and biomass per hectare, sweetpotato is very excellent and tops all other crops worldwide, and as such it is considered as one of the best crops with the

capacity to fight hunger and poverty [63]. Various primary and secondary processed food products such as puree, flour, chips, noodles, pasta and biscuits can be made from the tubers of sweetpotato [68], and therefore, it can be investigated in advance level as a key crop for the formulation of sustainable nutritionally resourced food items.

The tubers of the purple fleshed type of sweetpotato contribute to the keeping of the body stable; they can best substitute rice in our food menu due to their richness in carbohydrate, and also contain more nutrients than the white rice [69]. Ice cream is made from sweetpotato [70] and the purple type sweetpotato can best be used in place of corn in terms of starch for bread making [71].


**Figure 6: The roles of sweetpotato in promoting food security**

## 4 Future Research focus and prospects

Sweetpotato (*Ipomoea batatas* L.) is noted globally as one of the great cultivated crops among the roots and tubers, being a cheap and sustainable source of nutrition. It has several underutilized health advantages, market and export potentials and above all, the crop and its products possess greater prospects in the areas of sustainable food, nutrition and income security

for every player along its value chain in Africa, most particularly in the Sub-Saharan African sub region where majority of the rural peasant farming populations are bedeviled with acute hunger, income instability and poverty. The starch of sweetpotato is of promising industrial importance, and can be explored vastly by research to develop more starch production efficient varieties for expansion of the processing industry. The molecular, chemical and mineral richness as well as the medicinal potentials of the edible portions of sweetpotato could be exploited in to detail and well incorporated in to infant foods, other dietary packages for children to improve health and reduce the incidence of infantile minerals and nutritional deficiencies related diseases. The crop is naturally endowed with anthocyanin, anticancer, anti-inflammatory, antibacterial and numerous other disease fighting properties, which can be further explore in medical and pharmaceutical products such as capsules, mixtures, ointment for enhance administering and use. Currently, less priority is given to research focus on the development of more industrially efficient varieties, especially for starch, medicinal and pharmaceutical purposes. Some national and regional agricultural institutions in Africa have demonstrated little interests and weak commitment towards investment in the sweetpotato sub-sector by helping rural and urban growers to expand production and helping to create the enabling local and international market spaces to fully exploit the market and export opportunities of the crop and its related products. Sweetpotato is a kind of crop which is climate smart, cheap to cultivate and serves as a good source of sustainable income and food security, and as such, developing nations that have the comparable advantages in sweetpotato cultivation can invest adequately in the sector to help improve livelihoods, and income for rural development and growth of national economy.



**5 Conclusions**

This comprehensive review has revealed some of the promising potentials of sweetpotato. These characteristics show how multipurpose and versatile the crop is. It has the capacity to fight hunger, employment and income generations, reduction in poverty and raising the standard of living in the. Sweetpotato has the capacity to improve lives and promote development if the potentials along its value chains from production to processing and utilizations are well harnessed. It is nutritionally rich and can be processed industrially and locally in to several food products and feed forms. Major attention from the research community should be given to the development of sweetpotato varieties that are viable for industry and value addition. The numerous potentials of the crop should be adequately harnessed for development..

**Authors' contributions**

This review was collaboratively carryout by all authors. It has been accepted and certified by all authors.

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