THE UTILIZATION OF RICE IN THE PRODUCTION OF BREAD AND SNACKS

BY

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CERTIFICATION

This is to certify that this project work has been written by OLAWALE IBIRONKE ADUNNI wit h Matric No: **ND/23/HMT/PT/0109**has been examined and approved as meeting part of th e requirement for the Award of National Diploma (ND) in Department of Hospitality Manag ement, Institute of Applied Science, Kwara State Polytechnic, Ilorin, Kwara State.

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DEDICATION

This project is dedicated to Almighty Allah whose supremacy in the knowledge of everythin g is absolute

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ABSTRACT

Freshly harvested tubers of irish and sweet potato variety were processed into flour using standard methods. Whole irish and sweet potato flour were also included wher e 100% than wheat flour was used as control or standard. The aim of this research is to study the utilization of irish and sweet potato in produciion of swallow and cake w hile the objective of this work is to utilize of irish and sweet potato in production of s wallow and cake and To improve nutritional contests of irish and sweet potato in Nig eria. This project is restricted to the utilization of irish and sweet potato in production of swallow and cake and its health benefits which included of starch or flour to whea t gave acceptable desired colours. A cost evaluation for the irish and sweet potato b ased complementary food should be conducted in comparison to the cow and gate p roducts.

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CHAPTER ONE

INTRODUCTION

1.1 BACKGROUND TO THE STUDY

Sweet potato is an important food security crop that feeds millions of people in the developing world. The crop is popular among farmers with limited resources and pr oduces more biomass and nutrient per hectare than any other food crop in the world (Parkash, 1994).

Sweet potato as food product is a source of energy, proteins, pro-vitamin A (B- carot ene), vitamin C and iron (Dufour et al., 1996). In Nigeria, the roots are cooked and pre pared in limited number of ways; most commonly boiled.

They are also cooked with beans and other foods, and sometimes fried as chips (W oolfe, 1992). Sweet potato roots possess a variety of chemical compound relevant t o human health. About 80-90% of sweet potato dry matter is made up of carbohydra te consisting mainly of starch and sugar with lesser amount of pectin and hemi-cellu lose and cellulose. Sweet potato also contains protein (0.46-2.93%), dietary fiber (0. 49-471%), lipids (0.06-0.48%) and ash (0.31 - 1.06%). It also contains essential miner als such as zinc, phosphorus, magnesium, potassium and iron. Sweet potato is also an important source of provitamin A, thiamine, riboflavin, niacin, ascorbic acid and m any other functional compounds (Woolfe, 1992). Sweet potato tuber and leaves also contain anti-nutrients such as phytate, oxalate and tannins (Fleming, 1981; Udoessie n and Ifon, 1990; Osagie, 1990). Sweet potato is now consumed mainly for its nutrie nts rather than for its energy (Jack et al., 1992). The crop has high Beta-carotene tha n any other root and tuber crops (Suda et al., 1999). Orange fleshed sweet potato is very rich in pro-vitamin A (Jack et al., 1992).

Sweet potato starch is isolated same way like other starchy roots except that the so lution is kept alkaline (pH 8) using lime which help to dissolve the pigment (Akoroda and Egeonu, 2009). Unlike cassava and maize starches, sweet potato starch does no t have high viscosity values on pasting and gelatinization temperature (Garcia, 199

3). Sweet potato flour can serve as a source of energy and nutrients: carbohydrate, b eta-carotene (pro-vitamin A), minerals and can add natural sweetness, colour flavour and dietary fiber to processed food products (Woolfe, 1992; Ulm, 1988).

Bread may be described as a fermented confectionary product produced mainly fro m wheat flour, water, yeast and salt by a series of process involving mixing, kneadin g, proofing, Shaping and baking (Dewettinck et al., 2008). Bread has been a major co mponent of human diet dating back to pre-historic man. This has made the baking o f yeast leavened and sour dough bread one of the oldest biotechnological processes (Christine et al., 2012). Bread is an important staple food, the consumption of which is steady and increasing in Nigeria. It is however relatively expensive, being made fro m imported wheat that is not cultivated in the tropics for climate reasons (Edema et al., 2005).

Cake isa baked batter made from sugar, egg, shortenings, milk and leavening mixed together in such a way as to produce a fluffy fined grained baked product (Victor et al.,

1995). It is described as a desirable delicate tender, highly sweetened, non-yeast ba ked product (Okaka, 2005). Cake has become a constant food in our diet for a long t ime and their continual popularity has encouraged the development of newer and m ore attract- tive product that is available in the market today (Eke et al., 2009). They can be served alone, packed with lunch, taken on a picnic or traditional favourite as r efreshment for guests (Signori, 2004).

Chinchin is a fried snack popular in West Africa. It is sweet, hard, donut-like baked or fried dough of wheat flour, and other customary baking items. Chinchin may also con tain cowpeas (Akubor, 2004). Many people also bake it with ground nutmeg for flavo r. It is usually kneaded and cut into small squares of 1 square inch or so, about a qua rter of an inch thick, before frying (Mepha, 2007).

Wheat as the chief raw material in the production of wheat flour cannot thrive well in Nigerian soils; therefore, wheat flour has to be imported. This leads to relatively high

price of bakery goods. The availability of adequate supply of flour has been a major economic and political issue in Nigeria. The objective of this work is to utilize sweet potato flour and starch as substitutes to wheat in bread making and confectionery a s this may help to improve nutrition of consumers of root crops in Nigeria and also e nsure national food security.

1.2 STATEMENT OF THE PROBLEM

The utilization of Irish and sweet potato in production of swallow and cake. In Nigeri a, complementary foods are normally prepared from either cereals only or blended with legumes. These complementary foods are not fortified with vitamins and miner als and normally of low nutritive value which affects the developmental growth.

Sweet potato (örange fleshed variety) is grown and promoted in Nigeria by the Minis try of Agriculture but is currently being underutilized. It has high carotene content but easily perishable, therefore it cannot be stored for a long period of time. It should be processed to prolong its shelf life and diversify its uses. Increasing the utilization an d the consumption of orange fleshed sweet potato (OFSP) in human diet may be an excellent approach to reducing vitamin A deficiency in Nigeria as an estimated preval ence rate of 35.6% was reported in Nigeria in 2012 (Egbi, 2012).

It is in view of this, that the researcher developed complementary food like swallow and cake from orange fleshed sweet potatoes that would be accepted by the popula ce so as to help reduce the problem of vitamin A deficiency especially among infant s and adults in Cape Coast and its environs.

1.3 OBJECTIVE OF THE STUDY

The main aim of the study was utilization of Irish and sweet potato in production of swallow and cake.

The specific objectives of this work are;

1. To utilize of Irish and sweet potato in production of swallow and cake.
2. To improve nutritional contests of Irish and sweet potato in Nigeria.
3. To investigate and understand the factors that utilization of Irish and sweet po

tato in swallow and cake.

4. To relate Irish and sweet potato quality to specific end uses such as cake and other bakery products.

1.4 RESEARCH QUESTIONS

1. What are the utilization of Irish and sweet potato in production of swallow and cake?

2. What are the nutritional contests of Irish and sweet potato in Nigeria?

3. What are the factors that utilization of Irish and sweet potato in swallow and c ake?

4. What are the relation of Irish and sweet potato quality to specific end uses su ch as cake and other bakery products?

1.5 SIGNIFICANCE OF THE STUDY

With the persistent vitamin A deficiency in Nigeria, coupled with rising cost of vaccin es, it will be pertinent to identify alternative sources of vitamin A which are more cos t effective and available to all. Orange fleshed sweet potato (OFSP) is locally grown but underutilized. Developing complementary food from orange fleshed sweet potat o (OFSP) would result in numerous benefits to the society and country as a whole. T his would lead to inside and are rolled in cinnamon on the outside. resulting in an app earance reminiscent of small potatoes.

Sweet Potatoes: The sweet potato or sweet potato is a dicotyledonous plant that be longs to the bindweed or morning glory family, Convolvulacee. Its large, starchy, swe et-tasting, tuberous tubers are used as a tuber vegetable. The young shoots and leav es are sometimes eaten as greens.

Production: The action of making or manufacturing from components of raw materi als, or the process of being so manufactured. Production is the process of combinin g various material inputs and immaterial inputs (plans, know-how) in order to make s omething for consumption (output).

Cake: Cake is a flour confection made from flour, sugar, and other ingredients, and is usually baked. In their oldest forms, cakes were modifications of bread, but cakes now cover a wide range of preparations.

Hospitality: Hospitality is the relationship between a guest and a host, wherein the host receives the guest with some amount of goodwill, including the reception and entertainment of guests, visitors, or strangers.... Hospitality ethics is a discipline that studies this usage of hospitality.

Industry: In macroeconomics, an industry is a branch of an economy that produces a closely-related set of raw materials, goods, or services. For example, one might refer to the wood industry or to the insurance industry. An industry is a group of companies that are related based on their primary business activities.

CHAPTER TWO

2.1 INTRODUCTION

This chapter presents literature relevant to the Study. It begins with a review of the o rigin and distribution of sweet potato, agronomic characteristics and cultivation of s weet potatoes, post-harvest storage of sweet potatoes, economic importance, and utilization of sweet potatoes, nutritional value of sweet potatoes and proximate com position of sweet potatoes. It also reviews origin and distribution of tomato, nutritio nal and health benefits of tomatoes, origin and distribution of onion, nutritional and h ealth benefits of onion, origin and distribution of anchovies, nutritional and health be nefits of anchovies, effects of dehydration, functional characteristics of sweet potat o flour, and complementary foods from sweet potato and sensory evaluation of foo d products.

2.2 ORIGIN AND GEOGRAPHICAL DISTRIBUTION OF SWEET POTATO

Sweet potato (Ipomoea Batatas) is believed to have originated from Central Americ a (Geleta, 2009). According to Austin and Gregory (1988), the plant had most likely b een spread by local people to the Caribbean and South America by 2500 BC. Sweet potatoes were introduced to Africa by Spain and Portugal explorers during the 16th century (Zhang, Guo & Peng, 2004). Low, Lynam, Lemaga, Crissman, Barker, Thiele, N amanda, Wheatley and Andrade (2009) also believed that sweet potatoes may have extended from the Americas via slave traders into tropical Africa. Sweet potatoes ar e now cultivated in tropical and warm temperate regions, wherever there is sufficient water to support their growth (FAO, 2000).

Today, sweet potato is cultivated in most parts of tropical regions including Nigeria (Walker, Thiele, Suarez & Crissman, 2011). Sweet potato plant is a branching, creepin g vine with spirally arranged lobed, heart shaped leaves and white or lavender flower s. According to PAOSTAT (2012), between the year 2006 and 2010, China produced the largest amount (80%) of sweet potato in the world supply followed by Indonesia, Vietnam, India, Japan and Philippines. In Africa, 11.6million tones of sweet potatoes are produced annually. Uganda is the largest grower of sweet potatoes followed, by

Nigeria and Tanzania.

2.2.1 AGRONOMIC CHARACTERISTICS AND CULTIVATION OF SWEET POTATO

Sweet potato is known scientifically as Ipomoea batatas [L.] Lam. It is a perennial tu ber crop and a member of the Convolulacee family. There are about 400 species of I pomoea, but only Ipomoea batatas has roots that are fit for human consumption (To rres,

1989). Sweet potatoes are grown between 40°N to 32° S of the equator and on the e quator it is grown from the sea level to 3000 meters. Sweet potato is a perennial pla nt, but is normally grown as an annual crop and is propagated asexually from vine cu ttings, or sexually from seed (Woolfe, 1992). The quantity of nutrients contained in s weet potato variety varies from place to place depending on the climate, soil type, th e crop variety and other factors (Ingabire & Hilda, 2011). Sweet potato is most com monly grown on mounds or ridges, and occasionally on raised beds, or on the flat (L ow et al., 2009). The leaves are simple and spirally arranged alternately on the stem i n a pattern known as 2/5 phyllotaxis.

Each sweet potato plant produces about 60 - 300 leaves (Somda, Mohammed & Kay s, 1991), it also produces flowers of different colours such as white, cream, yellow, o range and purple (Wolfe, 1992; Bovell-Benjamin, 2007). According to Nair and Nair (1 995) certain conditions and practices increase the number of leaves each plant prod uces. Some of these conditions and practices are; increase in irrigation, decreases in plant density, and nitrogen application. According to Ishiguro, Toyama, Islam, Yoshim oto, Kumagai, Kai and Yamakawa (2004), sweet potato is more tolerant to diseases, pests and high moisture than many other leafy vegetables grown in the tropics. Swe et potato has the ability to stand low soil fertility and climatic conditions and yet giv e reasonable yield (van den Berg & Laurie,

2004).

When compared with other roots and tubers it has a short production cycle, which is 3-8 months from planting (Woolfe, 1992). The edible root tuber is long and tapered, with a smooth skin whose colour ranges from red, purple, brown and beige. Its flesh colour ranges from white through yellow, orange and purple (Villareal, 1982;Dapaah, Asafu-Agyei, Baafi, Adofo, Evelyn & Obeng, 2005).

2.2.2 SWEET POTATO VARIETIES

Sweet potato tubers are classified by the colour of their flesh. The flesh of the tubar can be white, cream, yellow, orange, or purple but white and cream are the most com monly grown and eaten in Nigeria. According to Hagenimana, Oyunga, Low, Njoroge, Gichuki, and Kabira, 2001; Ofori, Oduro, Ellis, and Dapaah, 2009; Ssebuliba, Nsubuga and Muyonga (2001), sweet potato variety may contain high level of B-carotene. The colour of the flesh can be used to classify the varieties. Simone, Kays. Koehler and Ei tenmiller. (1993) also report that on dry weight basis the varieties of sweet potato c an be grouped based on their B-carotene content. The groupings are: non-detectable (<1 g/g), low B-carotene (1-39ug/g)-pale orange, moderate B-carotene (40-129 g8) - orange and high B-carotene (>130 ng/g) - dark orange. Between 1998 and 2005, the Crops Research Institute (Council for Scientific and Industrial Research (CSIR), in Nig eria, released eight varieties of sweet potatoes (Akoroda, 2009). Subsequently, four varieties namely Faara, Sauti Okumkom and SantomPona were also released (CSIR, 2006; Otoo, Missah and Carson, 2001). In 2005, CSIR-CRI released High -Starch, Apo muden, Ogyefo and Otoo varieties of sweet potatoes (CSIR-CRI, 2005).

The Apomuden variety has orange flesh tuber therefore named orange fleshed swee t potato (OFSP). It contains more -carotene than the other varieties. OFSP is known t o have an excellent amount of ß -carotene which is highly bio available and converted into vitamin A (retinol) in the human body (Haskell, Jamil, Hassan, Peerson, Hossain,

Fuchs & Brown,

2004; Van Jaarsveld, Faber, Tanumihardjo, Nestel, Lombard & Benade, (2005). Sweet potato roots are rich in starch, sugar, vitamin C, B-carotene, iron, and several other mi nerals (Laurie et al., 2012; Oloo et al., 2014).

The Apomuden variety is an orange-fleshed variety of sweet potato which has more ß-carotene compared with the other varieties, therefore incorporating it into a compl ementary food for infants between the ages of 6 months and 2 years will be a good alternative which will help reduce vitamin A deficiency.

2.3 SWEET POTATO PRODUCTION IN NIGERIA

Nigeria is located on West Africa's Gulf of Guinea; it is a few degrees north of the Eq uator. The country covers a total area of 238,538 square kilometres (World Atlas, 20 17).

Root and tuber crops such as sweet potatoes contribute greatly to Nigeria's agricult ural growth. Nigeria is one of the West African countries whose Gross Domestic Pro duct (GDP) is driven principally by agriculture (Dittoh, Bhattarai & Atosiba, 2013; Way o, 2002).

According to CSIR - CRI, approximately 40% of GDP is contributed by roots and tube rs whilst cereals account for 7% (CORAF/IFPRI, 2006). Sweet potato ranks fourth in Nigeria after cassava, yam and cocoyam (Ennin, Dapaah & Asafu-Agyei, 2007). Sweet potato is grown in all the regions except Western region. Upper East region is the m ain producer which contributes 34.9% of what is produced in Nigeria, followed by Ea ster region with 26.4% and Upper West with 14.8%. Greater Accra and Ashanti region s are the least producing regions (MoFA & SRID, 2012).

About ninety thousand (90,000) tonnes of sweet potatoes are produced annually in t he tropical regions of Nigeria (FAOSTAT, 2006). Although, sweet potato is grown in al most all the regions, it is still not very well inculcated into the diet of the average Nig eriaian (Adu-Kwarteng, Otoo and Oduro, 2001). This is because sweet potato is ofte n considered a low-grade crop that is consumed by the poor, thus, not being given th

e essential thought it deserves as a staple food crop (Walker, Thiele, Suarez & Criss man, 2011).

In Nigeria, sweet potato is principally significant in the Northern and Coastal belts w here it is both food and cash crop (Otoo, Missah, Osei, Manu-Aduening, Carson, Odur o et al., 2000; Otoo, Missah & Carson 2001; MOFA-SRID, 2012). It is produced mostl y by subsistence farmers on small scale without inputs such as fertilizer. In the Cape Coast Metropolis, communities that cultivate sweet potato are Moree, Jukwa, Efutu, Ankaful and Koforidua (Teye, 2010).

2.3.1 POST-HARVEST STORAGE OF SWEET POTAOES

Post-harvest storage of sweet potato is a major problem because the tuber is bulky and after harvesting it has a short shelf life. Most crops suffer the improper post -ha rvest treatment such as chilling injury, poor handling and extreme temperatures. On h arvest, sweet Pomato tools are stored mainly rooms(in sacks) and in pits(Engoru, Mugisha & bushasha Nagujja & Yanggen, 2005). Research works conducted in Niger ia by Osei-Gyamera (2000), Duku (2005) and (Golokumah (2007) on different traditi onal storage techniques gave average shelf-life of 2 weeks. Birago (2005) and Golok umah (2007), also conducted studies and found that, sweet potato farmers in the Ca pe Coast Metropolis do not store up their harvested sweet potato due to the high de terioration in storage and improper storage technology. Farmers therefore, practice i n-situ storage or piece meal harvesting (leye, 2010).

By tradition, harvested tubers are stored in baskets covered with banana leaves. Tub ers can also be stored in dug pits lined with a layer of dried grass followed by anoth er layer and at least 5 cm of top soil. According to Engoru, Mugisha and Bashasha (2 005) the pit is reported to be effective for at least 4 months but its use is constraine d by rodents and rotting According to Amoah, Teye, Abano and Tetteh (2011), traditi onal barns and other forms of storage structures used widely in tropical countries to protect the integrity of the tuber have not yielded the desired results. Department of Agriculture, Forestry and Fisheries (DAFF), (2011) revealed that storage temperature is between 12 and 15 °C. Relative humidity should be maintained between 75 to 80%

to avert extreme water loss from the roots. Some aeration should be provided to av oid carbon dioxide build up.

2.3.2 ECONOMIC IMPORTANCE OF SWEET POTATO

Economically, sweet potato plays a vital role in improving the standard of living of pe ople across the globe. Sweet potato is ranked as the seventh most important food c rop in the world after rice, wheat, Irish potatoes, maize, yam and cassava (Loebenste in, 2009).

Sweet potato is an important versatile crop in many parts of the world. In the develo ping world, sweet potato plays a significant role in the global food structure, where t hey are ranked among the top 10 food crops (Phillips, Taylor, Sanni & Akoroda, 200 4). In terms of global production, sweet potato is ranked as the seventh most impor tant food crop (Loebenstein, 2009). About 133 million tonnes of sweet potatoes is p roduced annually worldwide (Warammboi, Dennien, Gidley & Sopade, 2011). Out of t his amount, China produces about 85.2 million tonnes of it.

In Sub-Saharan Africa, sweet potato is one of the most widely grown root crops (Lo w et a., 2009). In Nigeria, 73,400 hectar of sweet potato are planted per annum, and in order of importance it comes after cassava and yam (FAOSTAT, 2010). Sweet pot ato is a root crop that provides food to a great section of the world population, espe cially in the tropics where the bulk of the crop is grown and eaten as food (Opeke, 2 006).

According to Consultative Group on International Agricultural Research [CGIARJ (20 00), in Asia over 50% of sweet potato produced is used to feed farm animals wherea s in Africa it is for human consumption. Sweet potato has numerous industrial applic ations (Lin, Lai, Chang, Chen & Hwang, 2007). In Nigeria, orange fleshed sweet potat o is processed into flour and sold at higher prices than flour from other varieties (Ak oroda, Edebiri, Egeonu, Bello & Yahaya, 2007; Odebode, 2010). Amante 1995) report s that in the ice cream manufacturing industries sweet potato flour is used as a stab ilizer. Local drinks like Kunu-zaki and burukutu are sweetened with sweet potato flou

r and for fortifying baby foods (Tewe, Ojeniyi & Abu, 2003).

In Uganda, sweet potato roots are processed into dried chips which are eaten during periods of food shortage (Kapinga & Carey, 2003). Sweet potato can also be proces sed into flour and used for food items such as bread, starch for noodles and as raw material for industrial starch and alcohol. According to Rahman, Wheatley, and Raksh it (2003), the starch produced is of a higher rank which is appropriate to be eaten as food and pharmaceutical uses. The starch can also be used as a thickener, water bin der, emulsion stabilizer, and gelling agent (Iheagwara (2013); Eleazu and Ironua (201 5). It is also used in textile, paper, cosmetics, insulating and adhesive industries. Swe et potato flour is also used for making a variety of food products such as pastries (c akes, cookies, biscuits); doughnuts, breakfast foods (instant porridge, crisp, flake-ty pe products); farinaceous goods; cold sauces (soy sauce, ketchup); and brewing adj uncts (van Hal, 2000; Mais & Brennan, 2008).

Sweet potato is processed into chips in the same way as french fries from Irish pota to (Brigato, Oliveira & Collares-Quieroz, 2010; Hagenimana & Omo, 2010). Sweet pot ato has prospective carbohydrate base in baby food manufacturing (Nandutu & How ell, 2009). It also has great potential for bio fuel production (Mays, Buchanan, Bradfo rd & Giordano,

1990).

2.4 UTILIZATION OF SWEET POTATO

Sweet potato is grown for human consumption in more than 100 countries, but mos tly

considered as a substitute food and not a staple food because it is underutilized.

According to Chittaranjan (2007) in the United States of America, orange fleshed pot atoes are used as a source of natural dye or valued as a healthy food due to their hig h ß-carotene content. The starch produced from sweet potatoes is graded as high -g rade one which is suitable for food and in the pharmaceutical industries. In Indonesi a, food items such as tomato sauce, tomato ketchup, dried-cake, spongy cake, and b iscuit are produced from sweet potato which is used as a major ingredient (Suismon

o, Indrasari & Damardjati, 1994).

In Asia and some parts of Africa, the leaves are served as vegetables (Ofori et al., 2009). According to Consultative Group on International Agricultural Research (CGIAR) (2000), about 50% of sweet potatoes grown in Asia is used to feed farm animals. Lopez, Iguaz, Esnoz and Virsed (2000) established that sweet potato can be used in manufacturing of sweet potato flakes which is also called sweet potato buds.

According to Truong and Fermentira (1990), sweet potato can also be used in the preparation of beverage. Ellong, Billard and Adenet (2014) also report that sweet potato can be used in the production of beverages such as wine, liquor as well as vinegar, sugar, biscuits, flour and pasta. In Uganda, sweet potato produced into flour, is used for the preparation of buns, chapattis and mandazi (Hagenimana & Owori, 1997). Also, in Nigeria sweet potato is consumed boiled, roasted or sliced and fried as chips. At times, the tubers are used in the preparation of flour, which is used in the sweetening of porridge. It is also used in the preparation of pounded foofoo (Agbo and Ene, 1994).

In Nigeria sweet potatoes have many cookery uses. The tubers are mostly deep fried and eaten as snack or boiled and consumed as "ampesi" with stew. According to Missah, Kissiedu and Okoli (1993) sweet potato is also used in the preparation of "oto" (a traditional Nigerian dish for Akans made from boiled and mashed tubers with pepper, onions, and tomatoes). It is also used as a sweetener in a local snack called "bodoo" (oral conservation).

A research by Ellis, Oduro, Fianko and Otoo (2001), found that sweet potato varieties like "Santom Pona" and Hi-Starch grown in Nigeria can be used in the preparation of gari (grated and fried). Sweet potato variety "okumkom" has been found to posses' relatively high water binding capacity which is an essential condition for the manufacturing of all types of bakery products (Oduro, Ellis, Nyarko, Koomson & Otoo, 2003).

2.4.1 NUTRIENT AND HEALTH BENEFITS OF SWEET POTATO

Sweet potato is ranked highest in nutritive value, outranking most carbohydrate food

s in vitamins, minerals, protein and energy content (Onuh, Akpapunam & Iwe, 2004).

According to U.S. Department of Agriculture (USDA) (2009), 100 grams of uncooked sweet potato contain the following amount of nutrients. Table 2 presents the nutrien ts that can be obtained from 100g of raw sweet potatoes.

Sweet potato roots and tops hold a range of chemical compounds appropriate for h uman health (Woolfe, 1992). According to Ofori et al. (2005) sweet potato is about 5 0% more nutritious than Irish potato. The major nutrients in sweet potato are carboh ydrates in the form of starch and simple sugars, protein, fat and fat soluble vitamins. Moreover, varieties with yellow and the orange fleshed contain considerable amount s of B carotenes (Allen, Corbitt, Maloney, Butt & Truong, 2012). B carotene is essenti al for growth, good eye sight and for boosting the immune system. Table 3 summari zes the nutrients obtained from 100g of orange-fleshed and white-fleshed sweet pot atoes.

From the table, the amount of vitamin A obtained from OFSP is 588 mcg which is hig her than that obtained from WFSP which was 0.05 mcg. Sweet potatoes also contai n a good amount of minerals such as calcium and potassium (Luis, Rubio, Gutiérrez, González-Weller, Revert & Hardisson, 2013), carbohydrates, fiber, antioxidants, starch and vitamins such as vitamin A & C (Anderson & Gugerty, 2013; Odongo, Mwanga, O wori, Niringiye, Opio, Ewell, Berga, Agwaro, Sunjogi, Abidin, Kikafunda & Mayanja, 200 2).

Fibre provides a feeling of satiety which helps in controlling the ingestion of food an d promotes a healthy digestive tract; it also keeps the bowels healthy and lowers ch olesterol.

Vitamin C helps fight infections, heal wounds and aids in the absorption of iron. Alth ough sweet potatoes are rich in carbohydrate, its glycemic index is low. This slows t he rate of digestion of complex carbohydrate, lowers the rate of assimilation of suga rs into the blood stream. This makes it excellent for diabetics and obsessed people (Ellong et al., 2014; Fetuga, Tomlins, Henshaw & Idowu 2014; International Life Scien

ces Institute 2008; Ooi & Loke, 2013), According to Willcox et al. (2009) the danger of constipation, diverticulosis, colon and rectal cancer and obesity can be lowered b y the eating of sweet potato. According to Oloo, Shitandi, Mahungu, Malinga and Oga ta (2014), the protein found in sweet potatoes is higher than that found in roots and tubers such as cassava and yam. It is ranked to be high biological value due to its hi gh lysine content; the protein content ranges from 1% to 2%, however the lipids cont ent is low ranging from 0.1 to 0.4 % (Mazzei, Puchulu and Rochaix, 1995; Food and A griculture Organization [FAO1, 2002). The leaves of sweet potatoes are rich in essent ial amino acids, such as lysine and tryptophan which is always inadequate in cereals (Mwanri, Kogi-Makau & Laswai, 2011; Oloo, Shitandi, Mahungu, Malinga & Ogata, 201 4). A study has shown that sweet potato leaves contain as much vitamins, minerals and other nutrients as contained in spinach (Ishiguro, Toyama, Islam, Yoshimoto, Ku magai, Kai & Yamakawa, 2004). Orange fleshed sweet potato is a good source of die tary fibre, minerals, vitamins and antioxidants such as phenolic acids, anthocyanins, a nd tocopherol. They also provide vitamin C, B vitamins (B2, B3, & B6), potassium and copper (FAO, 2007, Kosambo, 2004; Welch, 2005 & WHO, 2002).

Two research work conducted by Van Jaarsveld, Faber, Tanumihardjo, Nestel, Lomba rd, Spinner and Benade (2005) & Low, Arimond, Osman, Cunguara, Zano and Tschirel y (2007) in South Africa and Mozambique respectively revealed and proved that con suming orange fleshed sweet potato on regular basis potentially increase the vitami n A status in children. Hagenimana, Low, Anyango, Kurz, Gichuki and Kabira (2001), al so reported that in Kenya women and children had their vitamin A intake boosted thr ough the consumption of orange fleshed sweet potatoes (OFSP).

Having enumerated these health benefits of sweet potato, promoting its utilization w ill help improve the health status of infants who are fed with it. The ß-carotene of sw eet potatoes may help reduce VAD in Nigeria and Africa. Therefore incorporating ora nge fleshed sweet potato into a complementary food will enhance the nutritional val ue of complementary foods.

Proximate Composition of Sweet Potato

According to Maleki (2003), sweet potato can be considered as an alternative food i tem because it may have benefits as infant food above other cereal based baby foo ds, particularly wheat and wheat related cereals, owing to its hypoallergenic effect.

Laryea (2016), reports of lower carbohydrate content 83.29% as compared to what was reported by Dansby and Bovell-Benjamin (2003) which was 90.6%. Again Laryea (2016) reports of a higher protein content of 5.17% whiles Dansby and Bovell -Benja min 2003) report protein content of 1% for another orange-fleshed variety. Senanaya ke, Ranaweera, Gunaratne and Bamunuarachchi (2013) studied five varieties of swee t potatoes and found the protein content to range between 1.2 and 3.3% on dry weig ht basis. Truong, McFeeters, Thompson, Dean and Shofran (2007); Steed and Truon g, 2008; Yencho, Pecota, Schultheis, VanEsbroeck, Holmes, Little, Thornton and Truo ng (2008) researched on the B-carotene content of Beauregard and Covington which are varieties of orange fleshed sweet potato; Beauregard contained 9.4 per mg/100 g while Covington had 9.1 mg/100g. According to Ogunlakin et al. (2012), protein lev els in sweet potato flour ranged between 4.93-5.17%, fat was between 0.50-0.57% a nd ash between 2.47-2.87%, oven dried flour had the highest values in each case. Ro drigues et al. (2016) report moisture content of 6.9 to 10.97% in flours however OFS P flours showed higher protein content 4.8% while the flour showed 0.39% fat and 9 0.13% of carbohydrate. Looking at the proximate composition of sweet potato it can be seen that it is nutritious. Literature proves that sweet potato has short maturity c ycle and is grown in communities around Cape Coast Metropolis such as Moree, Juk wa, Efutu, Ankaful and Koforidua therefore most people can easily acquire and use it.

Effects of Drying on Foods

Drying is one of the oldest methods of processing and preserving food. Drying can b e defined as a process of moisture removal due to simultaneous heat and mass tran sfer (Ertekin & Yaldiz, 2004). Drying is carried out to minimise the water level to one at which microbial spoilage and deterioration reactions are greatly reduced (Akpinar & Bicer, 2004). Sun, oven, and solar drying are the most frequently used methods; su n drying is the most common method practiced (Matazu & Haroun, 2004) but, the dri

ed product can be affected by contamination from insects, dust, or spoilage resultin g from rain during drying (Lahsasni, Kouhila, Mahrouz, Mohamed & Agorram, 2004). Presently hot air oven drying is the most commonly used method of drying agricultu ral products. Doymaz (2004) reported that products that are dried using oven drying produce a more uniform, hygienic and attractively coloured dried product. According to Ogunlakin et al. (2012), oven drying methods have better effect on nutritional and functional properties of cocoyam flour than direct sun drying method. During the per iod of drying, there is the addition of heat and the elimination of moisture from the f ood. Several changes take place which affect the nutrient contents of food in various ways; it can either increase the concentration of some nutrients by making them mo re available or decrease the concentration of some nutrients (Hassan, Umar, Maisha nu, Matazu, Faruk & Sanni, 2007; Morris, Barnett & Burrows, 2004; Ladan, Abubakar & Lawal, 1997). For instance vitamin C is lost (Perera, 2005) and changes of colour an d appearance which may not be desirable (Kendall, DiPersio & Sofos, 2004). Modera te losses of B vitamins also occur during drying.

According to Baysal, Icier, Ersus and Yildiz (2003), the structural and physico-chemic al changes that take place affect the final product quality. According to Krokida and Maroulis (2001) drying method and processing conditions affect significantly the co lour, texture, nutritional content, density and porosity and sorption characteristics of the material so the raw material may end up as a completely different product depen ding on the type of drying method and conditions applied. According to Sablani (200 6) losses of nutrients can be reduced by applying pretreatments such as blanching, selection of appropriate dying methods and optimization of drying conditions.

Complementary Foods

After the first 6 months of an infant's life, breast milk alone cannot provide the full nu tritional requirements thereby creating a gap which keeps expanding with the increa sing age of the infants (WHO/UNICEF, 2003). Complementary feeding plays a vital ro le in bridging these gaps. According to USDA (2009), in order to fill those nutritional gaps, infants should be introduced to complementary foods (foods other than breas