ANTINUTRITIONAL AND VITAMIN COMPOSITION OF CAKE AS AFFECTED BY VARIED COMPOSITION OF COMPOSITE FLOUR

BY

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CERTIFICATION

This is to certify that this project work titled ‘’antinutritional and vitamin composition of cake as affected by varied composition of composite flour’’ was carried out by **Adulphos Ifekam Prisca** with Matriculation Number **AST/2102070230** in the Department of Food Technology, School of Applied Sciences and Technology, Auchi Polytechnic, Auchi.

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DEDICATION

This work is dedicated to (Jehovah) God for his grace and mercy for a successful project work.

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ABSTRACT

This study evaluated the antinutritional composition (phytates, oxylate, tannin, phenol, phytic acid hydrogen cyanide (HCN) and vitamin. composition (B_1, B_2 and B_3) of cakes as affected by varied composition of composite flour from high quality cassava – sweet potato flour blends were evaluated using standard methods. There were significant ($p<0.05$)

differences in various attribute analysed. The phytates content of the cakes sample increased as the levels of addition of sweet potato flour increased (4.65mg/100g, 4.37mg/100g, 4.33mg100g and 4.69mg/100g) respectively. The oxylate values (9.41mg/100g, 9.09mg/100g, 10.17mg/100g and 8.19mg/100g) of sweet decreased as the rate of addition of sweet potato increased. The tannin content values (0.17mg/100g, 0.17mg100g, 0.24mg100g and 0.12mg/100g) of the composite cake samples decreased as the rate of addition of sweet potato increased. The phenol content values (4.30mg/100g, 4.27mg/100g, 5.89mg/100g and 3.05mg/100g) increased and decreased as the rate of addition of sweet potato flour increased. The phytic acid increased as the addition of sweet potato decreased (1.32mg/100g, 1.2mg/100g, 1.22mg/100g and 1.32mg/100g). The antinutrients determined had low values and high values and poses no risk to human health. The result of vitamin shows that the flour blends increased in values as the rate of addition sweet potato increased in the vitamin B_1, B_2, and B_3 content of the cake vitB_1 (2.27mg/100g, 2.26mg/100g, 2.27mg/100g and 2 and 28mg/100g), vitB_2 (1.15mg/100g, 0.72mg/100g, 1.22mg/100g and 1.38mg/100g) vitB_3 (0.75mg/100g, 0.15mg/100g, 0.87mg/100g 0.90mg/100g) In all the sample, sample AIPG is more preferable, due to reduction in the antinutritional properties and increase in the vitamin composition. This study paves way for enhanced utilization of composite flour blends of high quality cassava and sweet potato flours are therefore encouraged for use in the production of butter cakes as this will minimize the cost of wheat importation in Nigeria.

CHAPTER ONE

1.0 INTRODUCTION

Cake is one of the semi-dry form foods that have air pockets enclosed in a protein and starch network. Cakes are convenient food products. They are usually sweet and often baked, prepared from flour, sugar, shortening, baking powder, egg and essence as principle ingredients (Okorie, and Onyenke, 2012). The consumption of baked foods such as cake has become a wide variety in Nigeria, especially among children. Cakes are ready to eat, convenient and inexpensive food products, containing digestive and dietary principle of vital importance. They are nutritive food which is produced from unpalatable dough that is transformed into appetizing product through the application of heat in the oven (Olaoye *et al*., 2007).

The baking industry in Nigeria is flourishing day by day. A wide variety of based goods is available in the market to fulfill consumer demand for nutritional requirements. Cakes are known to be of the most popular bakery products widely consumed by youth and elderly people to do its ready to eat nature, good nutritional quality, low cost and longer shelf life that has also been enriched with dietary fiber and ability to serve as a vehicle for important nutrient (Adeleke and Odedeji, 2010, Hooda and Jood, 2005).

Utilization of composite flour is considered beneficial in emerging nations as it decreases importation of wheat flour and boasts the use of indigenous crops as flour (Hugo, *et al*, 2000; Mamat *et al.*, 2014). Roots and tuber crops such sweet potatoes, yam and cassava are second only in importance to cereal as a global source of carbohydrate and are among the world's major food crops which produce the highest amount of edible energy per hectare per day (Oladipo *et al*., 2017; Adegunwa *et al*., 2010). However, cassava is the second most important tropical root crop in West Africa (Adisa *et al*, 2015, Falola *et al*., 2017). Cassava (*Manihot esculenta)* is a root crop that is consumed in many parts of the world. It is drought tolerant and can withstand harsh climate conditions and can thrive well on poor soil and marginal lands (Ezui *et al*., 2018).

Cassava root is a starchy crop that has been processed into various forms for utilization for example it may be processed into high quality cassava flour (HQCF) is an unfermented, smooth, odourless, white or creamy, blend with no gluten cassava flour product that has been successfully used as partial and complete replacement for wheat flour in processing of cakes, bread, cookies and other confectioneries (Maziya-Dixon *et al*., 2017).

In Nigeria and some parts of the tropics, cassava roots are processed into traditionally fermented food products such as garri, fufu, elubo and tapioca. Cassava is considered a good source of dietary fibre which may be used to increase bulkiness and facilitate digestion. More importantly, cassava is also an important source of starch for various industrial application (Oyenyinke *et al*., 2019).

Sweet potatoes *(Ipomoea batatas*) is a vital tuber crop, whose important role in improving household and national food security, health and livelihoods of poor families in sub-saharan Africa is becoming recognized gradually (Shasha, 2009; CIP, 2013). Several varieties exist with a wide range of skin and flesh colour, from white to yellow – orange and deep purple (CIP, 2013). Sweet potato roots are bulky and perishable unless they are cured. The bulkiness and perishable nature of the root are major constraint on the marketing and availability of the crops. This limits the distance over which sweet potato can be transported economically. Sweet potato as a crop has many good attributes such as high yield, wide ecological adaptability, low input requirements and shorter growing period than other root crops. Sweet potato roots are rich in carbohydrates and are among the world's major food crops which produce the highest amount of edible energy per hectare per day (Adegunwa *et al*., 2010).

Despite its high carbohydrates content, sweet potato has low glycemic index, indicating low digestibility of starch (ILSI, 2008). It is the only starchy staple crop, which contains appreciable amounts of β- carotene, ascorbic acid and the amino acid, lysine that is deficient in cereal based diets like rice. It also contain appreciable amount of soluble fibre which helps in reducing cholesterol level and anti-oxidant nutrients which can inhibit the development of coronary heart disease (Misra and Kulsretha, 2003).

Sweet potato is a crop that provides food to a large segment of the world population's especially in the tropies where the bulks of the crop are cultivated and consumed. Raw sweet potato roots can be processed into forms with a longer shelf life and characteristics, more in keeping with latent demand and emerging utilization pattern. However, based on diagnostic assessment carried out in developing countries processing of sweet potato into forms such as dried chips, starch and flour were identified among the most promising options (Vanhall, 2019). Oyeyinka *et al*. (2019) Processing methods, growing conditions and genotypic differences may influence the antinutritional, vitamin composition of varied composite flour.

1.1 STATEMENT OF PROBLEM

The production of any food product depends on its raw material availability. The major problem facing baker industry in Nigeria is the total dependence on importation of wheat to sustain its production. Currently, it is known that micronutrient deficiencies threaten about 2 billion people globally, and have become a chronic health problems especially in developing countries of the world.

The research in cassava and sweet potato processing has established the fact that there is a lot more in cassava and sweet potato than starch. Natural colorant and antioxidant present in purple and red – flesh potatoes can be use for developing functional foods. Cassava as a staple food in most parts of the world or countries has to be supplemented with protein rich foods such as sweet potatoes for it to be nutritious due to its low levels of protein (FAOSTAT, 2011). Considering the large quantities in which sweet potatoes could be a very good vehicle for addressing some health related problems and serve as food security (FAOSTAT, 2011) Cassava has also been found to contain Calcium, Vitamin B, and other essential minerals (Montagnae *et al*., 2009). United Nation's Food and Agricultural Organization reported that sweet potato (*Ipomoea batatas L)* is very important crop in the developing world and a traditional, but less important crop in some parts of the developed world (FAO, 2011).

The increasing importance of cassava (*Manihot esculenta*) among crops grown in Nigeria is not only connected to its increasing demand as food but also as food security (FAO, 2018).

1.2 JUSTIFICATION

Nigeria has unfavourable climate condition for wheat cultivation but suitable for tropical crops such as roots, tubers and cereals. Therefore, consumption of cereal based foods like biscuits, bread, cracker, cake, muffins e.t.c; requirement development of an adequate substitute for wheat. Also, because of the high cost of wheat flour which is usually imported into Nigeria, flour will be source locally from tropical crops to make butter pond cake using composite flour from cassava and sweet potato (Adeleke *et al*., 2010).

Composite flour has become emphasis of various studies since there has been arisen the need to use affordable indigenous crops that still provide optimum nutritive value, the use of affordable roots and tubers which also have nutritive value and good processing attributes to substitute for wheat flour in food industry (Noor *et al*., 2009). Have the need to anti-nutritional and vitamin content of cake as affected by varied composition of composite flour.

1.3 AIM AND OBJECTIVES

The aims of this work are;

- to produce composite flour from cassava and sweet potato.
- to bake cake from the composite flour
- to determine anti-nutritional and vitamin properties of the cake.

CHAPTER TWO

2.0 LITERATURE REVIEW

Cake is a form of sweet dessert that is typically baked and can also be produced from sweet potato and wheat. In its oldest forms cakes were modifications of breads, but cakes now cover a wide range of preparation that can be simple or elaborate and that share features with other desserts such as pastries, meringues, custards and pies (Castella, 2010). Typical cake ingredients are flour, sugar, eggs, butter or oil or margarine, a liquid, leavening agent and cassava and also sweet potato flour. Common additional ingredients and flavorings include dried, candled, or fresh fruit, nuts cocoa, and extra such as vanilla, with numerous substitutions for the primary ingredients. Cakes can also be filled with fruit preserves, nut or dessert sauces (like pastry cream), iced with butter cream or other kings and decorated with marzipan, piped borders or candled fruit (Ayto, 2002).

2.1 CAKE AND ITS HISTORY

The term ‘’Cake’’ has a long history. The word itself is of viking origin from the old norse world ‘’kaka’’. The ancient Greeks called cake (Plakous), which was derived from the word for ‘’flat’’ (plakoers). it was baked using flour mixed with egg, milk, nut, and honey. They also had a cake called ‘’Satura’’ which as flat heavy cake. During the Roman, period, the name for cake become ‘’plocenta’’ which is derived from the Greek term Aplacenta was baked on a pastry base or inside a pastry case.

The Greeks invented beer as a leavener, fry filters in olive oil and cheese cakes using goat’s milk (Castella and Krystine 2010). In ancient dough was sometime enriched with butter, egg and honey, which produced a sweet and cake like baked good (Ayto and John, 2002).

Early cakes is England were also essentially bread, the most obvious different between a ‘’cake and a ‘bread’ is the cooking method which turned cakes over once while cooking, while bread was left upright throughout the baking process (Ayto and John 2002).

Sponge cake levered with beat eggs originated during the renaissance possibly in Spain (Castella and Krystina, 2010). During the great depression, there where surplus of molasses and the need to provided easily make food to millions of economically depressed people in the United States (Park and Micheal, 2013), one company patented a cake bread mix in order to deal with the economic situation, and thereby establishing the first cake in the box. In so doing, as it is known today become a mass produced goods rather than home or bakery made special.

2.1.1 NUTRITIONAL BENEFITS OF CAKE

1. Provide energy: carbohydrates are one of the major source of energy in plenty of foods. And cakes and cupcakes are generally made by mixing flour and sugar together, which are excellent sources of carbohydrates. They can provide the entire body, including muscles, brain and nervous system, with a sufficient amount of energy. In addition to that, the fats present in cake are good sources of energy (Deborah and Feltham, 2016).

2. Are body building and give strength: apart from providing energy to your body, these sweet confection can also supply your body with a quality amount of protein. Cakes contain milk and eggs which are known to some of the major sources of protein. And milk contains calcium which improves the functionality of bones and teeth. Also, cakes that are baked with dry fruit such as almond, cashew nuts, etc can serve the body with a good quantity of Vitamins and thereby strengthen the immune system (Deborah and Feltham 2016).

3. Improves digestion: Cakes containing fruit such as berries, pineapples and apples are a good sources of fibre too. Fibre rich foods can help our body to have a better digestive system. Some cakes and cupcakes are even made with carrot, and carrot contain a lot of fibres as well Consuming cupcakes and cakes containing all the aforementioned fruit can help to increase and fibre levels in body; improve digestion and minimize the risk of heart disease. Eating cakes can provide you with numerous health benefits and help your body stay fit. However, it is always important to maintain a balanced diet in order to live a healthy life, and having too much of something can be bad, even if it has health benefits. Therefore, cakes should be eaten in limited quantities as a part of a balanced diet (Deborah and Feltham, 2016).

4. Rich in Fats and oils: Cakes are the source of fat and oils too. Fats and oil give you the energy and warmth.

5. Rich in Vitamins: The body need vitamins inadequate intake to work properly. Some vitamins found in cake are; Vitamin B_1, Vitamin B_2, Vitamin B_3, Vitamin B-9, Vitamin A and Vitamin K.

Vitamin B_1 is one of the eight water –soluble B Vitamins. It plays an essential role in the production of energy from food, the conduction of nerve impulses and synthesis of nucleic acids. 100g of cake contains 0.4 mg of vitamin B1, that's the 27% of the daily recommended value for an adult.

Vitamin B_2 is one of the most widely distributed water – soluble vitamins, meaning the body does not store it. Riboflavin plays an important role in the protection of cell constituents from oxidative damage and reduction of tiredness and fatigue 0.27mg of vitamin B_2 can be found on every 100g of cake, the 16% of the total daily recommended vitamin B_2 intake.

Vitamin B_3 also known as niacin, vitamin B_3 is a water – soluble nutrient that is part of the B vitamin family. It is essential for the metabolism of carbohydrates and fats. It also helps to lower harmful cholesterol while raising good cholesterol 0.19my of vitamin B_3 can be found on every 100g of cake, the 1% of the total daily recommended Vitamin B_3 intake.

2.1.2 VARIETIES OF CAKES

Cakes are broadly divided into several categories based primarily on ingredients and mixing techniques. Although clear examples of the difference between cake and bread are easy to find, the precise classification has always been elusive.

- Butter cakes are made from creamed butter, sugar, eggs and flour. They rely on the combination of butter and sugar beaten for an extended time to incorporate air into the batter. A classic pound cake is made with a pound each of butter, sugar eggs and flour. Baking powder is in many butter cakes, such as Victoria sponge cake, The ingredient are sometimes mixed without creaming the butter, using recipes for simple and quick cakes (Castella and Krystina, 2010).
- Sponge cakes (or foam cakes) are from whipped eggs, sugar and flour. They rely primarily on trapped air in a protein matrix (generally of beaten eggs) to provide leaving, sometimes with a bit of baking powder or other chemical leaven added as insurance. Sponge cakes are thought to be the oldest cakes made without yeast. An angel food cake is a while sponge cake that uses only the whites of the eggs and is traditionally baked in a tube pan. The French Genoese is a sponge cake that includes clarified butter. Highly decorated sponge cake with lavish toppings are sometimes called gateail, the French word for cake
- Chiffon cakes sponge cakes with vegetable oil which adds moistness.
- Chocolate cakes are butter cakes, sponge cakes, or other cakes flavoured with melted chocolate or cocoa powder. German chocolate cake is a variety of chocolate cake. Fudge cakes are chocolate cakes that contains fudge.

- Coffeecake is generally thought of as a cake to serve with coffee or tea at breakfast or at a coffee break. Some types use yeast as a leavening agent while others use baking soda or baking powder. These cakes often have a crumb topping called streusel or a light glaze drizzle.

2.1.3 CAKES BASED ON WAY OF COOKING

- **Baking**

  Baking is a way of preparing food by the process of conduction, generally in a closed oven. The term baking means the use of heat in a oven to convert the batter into baked food. In the process of baking, starch content in the food in processed usually decreased that provides the food a brown colour which gives it an attractive and appetizing look (Gabon, 2014). The key to proper baking really comes down to the proper ratio between the oven temperature and the baking time which can be determined by the size or weight of the dish (Adams, 2015).

- **Steaming**

  Daniel (2015), stated that steaming is a moist-heat cooking technique that employs hot steam to conduct the heat to the item. Once water is heated at 212^0f, it stops being water and turns into steam. Steaming allows to reach the higher temperature with liquids by steaming them. Steaming is common method due to its fast cooking times, high heat and moist heat cooking nature.

2.2 CASSAVA AND SWEET POTATO ORIGIN

Cassava (*Manihot esculenta*) is a shrubby perennial plant that grows to a height of 6 – 8 feet. It is a member of the *euphorbiaceac* family and the genus and species *Manihot spp*. Cassava was introduced into sub-Saharan Africa from Brazil in the 16th century, becoming the main staple food in a number of countries because it could grow and produce dependable yield in places where cereals and other crops would net grow or produced well in the tropics. World production of cassava was about 256 million tons (FAO, 2011). Cassava is cultivated in around 40 Africa countries, stretching through a wide belt from Madagascar in the South East to Senegal and to Cape Verde in the Northwest. Around 70percent of Africa's cassava output is harvested in Nigeria, the Congo and Tanzania (IFAD and FAO, 2005).

Cassava roots are high in starch making than a good source of energy but low in vitamin A and protein (Scott *et al*., 2000). This means that other food should be in jested to make a nutritionally balanced diet, However, innovative projects such as Biocassava plus are a actively being researched, with the aim of enhancing cassava with carotene, iron and protein (Cassava News 2010).

Cassava is classified based on the cyanoglucosidic content of the tubers which delineates the tubers as ''sweet'' or ''bitter'' Cassava, the sweet form have low (< 140 ppm) cyanoglucosides while the bitter cassava contain greater then 140ppm (>140ppm) cyanoglucosides on dry weight basis (Falade and Akingbala, 2019). Cassava is the source of raw material for a number of industrial products such as starch, flour and ethanol. The production of cassava is relatively easy as it is tolerant to the biotic and edaptic encombrances that hamper the production of other crops. Cassava utilization pattern vary considerable in different parts of the world (Andrew, 2002).

The utilization of cassava flour in bakery products, confectionery and other food products is relatively new and insignificant compared to its potential and wide opportunities (Sanni *et al*., 2006). Simple and appropriate technology now exists for the application of cassava flour as partial replacement for wheat flour in bread making, cakes, biscuit, pastries and snacks foods (FIRO, 2003; Akobundu, 2006; Sanni *et al*., 2006; Ukpabi, 2006).

Sweet potatoes (*Ipomoea botatas*) are starch, sweet tuber roots crop of the convolvulaccae tuberous family often thought to be related to white potatoes from the *solonaccous* family, sweet potatoes are much more nutritious and come in variety of colours with purple. The nutritional benefits, cultivation conditions and easy preparation make sweet potatoes a highly sought after commodity with grown demand.

Among the approximately 50 genera and more than 1000 species of this family, only *Ipomoea batatas* of major importance as a food (Adeyeye and Akingbala, 2014).Sweet potato rank fourth in the word after rice and wheat. It is not known in the wild state but it is but it is known to have come from central or South America and was introduced into West Africa by the Portuguese and Asia by the Europeans. It was concluded that the sweet potatoes were introduced in Africa by the Portuguese from Atlantics Coast regions of mild latitude America (Bourke, and Vlassak, 2004; Igbabul *et al*., 2014).

Sweet potato roots serves as staple food, animal feed, and to a limited extent as a raw material for industrial purposes as a starch sources and for alcohol production. In Japan dehydrated sweet potato is ground into flour which is cooked for human consumption. Sweet potato starch is used for the manufacture of adhesive, textile and paper sizing and in the confectionery and baking industries, in most part of the tropics, sweet potato is consumed boiled, baked, roasted or fried, preparation practices vary according to the location (Singh *et al*., 2008).

Sweet potatoes are an excellent source of carbohydrates for those with blood sugar problems, it helps regulate blood sugar levels and prevent conditions like insulin resistance, it is healthy for the digestive tract being rich in digestive fibre, especially when the skin is also consumed, it helps to relieve constipation and may prevents colon cancer (Van Jaarsveld *et al*., 2005).

Sweet potatoes can help prevent the onset of heart disease like heart attack and stroke. Potassium also helps to maintain fluid and electrolyte balance in the body which is important for stabilizing blood pressure and regulating heart function. Sweet potatoes are good for aveviating muscle crams. Sweet potatoes are good for treating stress related symptoms (Kano *et al.*, 2015).

2.3 NUTRITIONAL VALUE OF CASSAVA ROOTS

The composition of cassava depends on the specific tissue (root or leaf) and on several factors, such as geographic location, variety, age of the plant and environmental conditions. The roots and leaves, which constitute 50% and 6% of the mature cassava plant respectively, are the nutritionally valuable parts of cassava (Tewe and Lutaladio, 2004). The nutritional value of cassava roots is important because they are main part of the plant consumed in developing countries.

2.3.1 Minerals and Vitamins

Cassava roots have calcium, iron, potassium, magnessium, copper, zinc and manganase contents comparable to those of many legumes, with the exception of soybeans. The calcium content is relatively high compared to that of other staple crops and ranges between 15 and 35mg/100g edible portion. The vitamin C (ascorbie acid) content is also high and between 15 and 45mg/100g edible portions (Okigbo, 1980; Charles *et al*., 2004).

Cassava roots contain low amount of the B vitamins that is thiamine, riboflavin, and niacin, and part of these nutrients is lost during processing. Usually the mineral and vitamin contents are lower in cassava root than in sorghum and maize (Gil and Butrago, 2002). The protein, fat, fibre and minerals are found in large quantities in the root peeled root .However the carbohydrates, determined by the nitrogen-free extract are more concentrated in the peeled roots (central cylinder or pulp) (Gil and Buitrago, 2002).

Cassava root are rich in calories but low in protein fact and some minerals and vitamins. Their nutritional value is consequently, lower than those of cereals, legumes and some other root and tuber crops.

2.3.2 Macronutrient

Cassava root is an energy-dense food. Macronutrient present in staple crops that are being targeted for biofortification include vitamin A, iron, and zine. Cassava has been targeted for biofortification because of its unique geographical distribution and its importance as a staple food (Gil and Bultrago, 2002).

Roots contain small quantities of sucrose, glucose, fructose and maltose (Tewe and Lataladio, 2004). In sweet cassava varieties, up to 170% of the roots is sucrose with small amounts of dextrose and fructose (Charles *et al*., 2004).

Raw Cassava root has more carbohydrate than potatoes and less carbohydrate than wheat, rice, yellow corn and sorghum on a 100g basis. The fibre content in cassava roots depends on the variety and the age of the root usually its content does exceed 1.5% in fresh root and 40% in root flour (Gil and Buitrago, 2002).

2.3.3 Nutritional benefit of sweet potato

Benefits are shown in table 1. The nutritional composition of sweet potato are important in meeting human nutritional needs including carbohydrates, fibres, carotenes, thiamine, riboflavin niacin, potassium, zinc, calcium, iron vitamin A and C and high quality protein. Sweet potato provides energy in human diet in the form of carbohydrates, they are also rich in dietary fibre and have high water content and also provide 359KJ energy with low total lipid content, which is only about 0.05g per 100g and low in cholesterol. The carbohydrate content of the storage roots varies from 25% to 30%, while the rest is composed of water (58% - 72%). In addition, sweet potatoes also are high in minerals such as potassium, calcium, magnesium, sodium, phosphates and iron (USDA, 2009).

Sweet potato is comparatively a nutritional heavy weight rich in complex carbohydrates vitamin C and E, and also contain good quantities of vitamins A and B, calcium and iron. The tuber can be steamed, roasted, boiled, baked and fried (Nungo *et al*., 2001).

Table 1: Nutritional value of raw sweet potato per 100g

Value per 100g	Unit	Nutrient
77.28	G	water
359.00	kj	Energy
1.57	G	protein
0.05	G	Total lipid (Fat)
0.00	G	Ash
20.12	G	Carbohydrate
3.00	G	fibre, total energy
3.00	G	Calcium, Ca
0.60	mg	Iron, fe
25.00	mg	Magnesium,Mg
17.00	mg	Phosphorus, p
337.00	mg	Potassium, k
55.00	mg	Sodium, Na
240	mg	Vitamin C
0.80	mg	pantothenic acid
0.21	mg	Vitamin B-6
14.187	Iu	Vitamin A

Source: USD National nutrient database (2009).

Literature abound on the use of composite flours in production of cake. Fasano (2011) reported the use of fauve beans and cowpea flour in the production of cake. The use of wheat- based composite flour in the production of cookies have also been reported. Sanful (2010) reported that cakes made from wheat rice flour were more acceptable that whole wheat flour cake and nutritional contents increased as the amount of rice increased. The production of cake from wheat, soybeans and rice flour have also been reported (Ugwuona, 2012). These authors reported that cakes produced from composite flour blends were higher in protein, carbohydrates and fat contents than those made of 100% wheat flour (Ubbor and Akobundu, 2009). Successfully produced cookies from composite flours of watermelon seed, cassava and wheat and concluded that a nutritious and acceptable biscuit can be produced by replacing wheat with up to 20% watermelon seeds flour and 15% cassava flour.

Different flour such as cereals (maize, rice, sorghum, millet) and tubers rich in starch (Cassava, cocoyam, sweet potato, yam) and protein – rich flours (cowpea, soybean) have been used in bread (Siddiq *et al*., 2009; Oladumoye *et al*., 2010; Mongi *et al*., 2011; Nindjin *et al*., 2011; Rai *et al*., 2014; Trejo-Gonzalez *et al*., 2014). In those studies, feature such as loaf weight and volume, specific volume, specific weight, texture and colour parameter have been evaluated to characterize the quality of the composite baked products. All of them have indicate that the optimum amount of wheat to be substituted is about 10% without an impairment of the quality characteristic of wheat bread. However, the percentage limit seems to be dependent on the source of the non-wheat flour.

In Nigeria the consumption of cake is high, as celebrations takes place weekly across the country and thus, the consumption of wheat flours attempts to remove the gluten ingredients in foods may result in the loss of nutrient balance (Olaoye, 2006). Wheat flour has also been known to be expensive in Nigeria compared to their cereal mainly because it is not produced locally, However, there are so many other crops grown in Nigeria and attempts have been made by many researchers to complement wheat flour with non-wheat flours. Particularly legumes flour for pastry products. Onwuka *et al*., (2005) reported that acceptable cakes could be produced from wheat flour substituted with up to 50% of rice flours.

The active ingredients of cake such as wheat flour, sugar and fat have been known to be linked to health related problems like the celiac disease, diabetes and obesity respectively. One way to solve this problem is to seek alternative sources of composite flour like high quality cassava and sweet potato flour and sweetners in cake production. This crops has the potential to impact on the nutritional profile of confectionery if incorporate into cereals flour due to their high nutritive value.

2.4 ANTINUTRITIONAL FACTORS CASSAVA AND SWEET POTATO

Cassava contains anti-nutrient, such as phytate, nitrate, polyphenols, oxylate and saponins that can reduce nutrient bioavailability. However, some of these compounds can also act as an anticarcinogens and antioxidants depending on the amount ingested. Phytate interferes with the absorption of divalent material, such iron and zinc which are essential nutrients, The aqueous and ethanolic extracts of raw cassava tuber contain alkaloids, flavonoids, tannins and anthocyanosides, anthraquinone, phlobaglucosides. The cassava leaves contain cardiac anti-nutrients, such as tannic, oxalate, phycate and trypsin inhibitors (Achidi *et al*., 2008).

2.4.1 Tannins

Tannins bind tightly to proteins and therefore have defense function. Tannins are a collective term for a variety of plant polyphenols used in the tanning of rawhides. Tannin protein complex in similar ways. These complexs are very stable structures and are very difficult for the gut to breakdown, it is possible for protein to interact with tannins when the amount of protein is in excess of that tannins (Hurell *et al*, 2000). Insoluble complex will only form when the amount of tannins that of protein and a hydrophobic outer layer is formed (Jaramilo *et al*., 2015).

2.4.2 Trypsin

Trypsin is an enzyme that helps us digest protein. In the small intestine, trypsin breaks down proteins, continuity the process of digestion that began in the stomach. Trypsin is essential for your body to digest a critical component for building and repairing tissue including bones, muscles, cartilage, skin and blood. When combined with chymotraypsin, trypsin can help in injury recovery (Holmes *et al*., 1995).

2.4.3 Oxalate

Oxalate can bind to minerals to form compounds, including calcium oxalate and iron oxalate. These anti-nutritional agent bind calcium, leading to formation of crystals excretion through urine. The crystal that form (calcium oxalate) major contribute to kidney stones. It is highly advisable to reduce oxalate intake and promote the intake of calcium among individuals who are risk of kidney stones (Massey *et al*., 2007). The regular consumption of foods containing high concentrations of soluble oxalates is of concern because of the harmful effects they cause when absorbed into the body. High soluble oxalate diets are widely known to cause an excessive urinary excretion of oxalate (hyperoxaluria), which causes an increased risk of developing calcium oxalate-containing kidney stones. About 75% of all kidney stones are composed mainly of calcium oxalate (Massey *et al*., 2007). Therefore, people predisposed to forming kidney stones are recommended to minimise their intake of foods high in oxalates (Massey *et al*., 2007).

2.4.4 Phytates

Phytates (phytic acid) in whole grain, seeds legumes, some nuts can decreased the absorption of iron, zinc, magnesium and calcium it has a strong binding affinity to the dietary minerals, calcium, iron and zinc inhibiting their absorption (Schlemer *et al*., 2009). Phytate from dietary sources reduces the digestion for starch and the absorption of sugars from food which helps modulate blood sugar levels. Heart disease prevention of cholesterol and has a beneficial effect on risk factors for cardiovascular disease (Macfarlane *et al*., 2006).

CHAPTER THREE

3.0 MATERIALS AND METHOD

3.1 MATERIAL

Fresh cassava root, sweet potatoes tuber, sugar, egg baking powder, margarine, preservatives.

3.1.1 SOURCE OF MATERIAL

Fresh mature cassava roots were harvested from a farm in Ewu, Etsako west, Edo state. While sweet potato tuber and other ingredient used in the preparation of cakes were obtained from a local market (Uchi) in Auchi Edo state, and taken to the food processing laboratory in the Department of Food Technology, Auchi polytechnic, Auchi Edo state for processing.

3.1.2 SOURCE OF EQUIPMENT

Equipment were gotten from food technology department, Auchi Polytechnic, Auchi, Edo state.

3.2 SAMPLE PREPARATIONS

3.2.1 Preparation of High Quality Cassava Flour

Cassava was processed into HQCF using Adekunle *et al*., (2012) method within 24h from the time harvest to drying in order to produce good quality flour that conforms to the set standard. The cassava roots were peeled, thoroughly washed and grated into a mash with a grater (modelSD.500, Henan, China). The mash was then dewatered by manual pressing in clean woven sacks, the lumps were pulverized and the mash was solar dried on a raised platform in a solar house (direct natural convention solar). The dried mash was then milled into using the disc attrition milling machine. The flour was sieved with a 0.25-mm sieve to obtain very fine HQCF. The flour was packaged in a polyethene bag stored at 4^0c for production.

Fresh cassava roots
↓
Peeling
↓
Washing (with portable water)
↓
Grating (model SD-500, Henan China)
↓
Pressing (Manual pressing)
↓
Drying (direct natural convening solar dried)
↓
Milling (disc attrition milling machine)
↓
Sieving (0 – 25mm sieve)
↓
Packaging
↓
Cassava Flour

Figure 3.1 Flow chart for the processing of high quality cassava flour (HQCF)

3.2.2 Preparation of sweet potato flour

Sweet potato flour used was produced using the methods as described by (Eke and Kabari, 2010) Shown in fig 3.2, sweet potato tuber were sorted and washed to remove sand, dirt and other adhering materials. The tuber were peeled using a sharp stainless knife and sliced using a kitchen slicer to obtained a sliced thinckness. The slices was washed in water and placed in a sieve to remove excess water. The sliced drained sweet potato is then dried in the kiln dryer for 5hrs at 65^0c to ensure proper drying. The dried slices were milled in a hammer mill machine to obtain flour. The flour was sieve after cooling to give fine coarse flour and then stored at ambient temperature (Eke and Kabari, 2010).

Sweet potato tuber

↓

Washing and cleaning

↓

Peeling

↓

Slicing

↓

Draining

↓

Kiln drier (65^{0}c for 5hour)

↓

Milling

↓

Sieving (0.25mm sieve)

↓

Packaging

↓

Sweet potato flour

Figure 3.2: flow chart for the processing of sweet potato flour

3.2.3 Butter Cake Production

Cake was prepared using the method as describe by (Okorie *et al*., 2012). The flour used for cake production was from blends of cassava and sweet potato. The composite flour formulations are shown in Table 3 with the ingredients used. The ingredient used for the cake production include flour (250g), sugar (125g), margarine/fat (250g), egg (5pcs), baking powder (5g), flavour (milk)

(2.5ml) powdered milk (1tb), preservative (ethanol) (5ml). The qualities used were determined from preliminary studies. The method of Alozie and Chinma (2015) adopted for the preparation of cake. The margarine and sugar were creamed in a bowl using turning stick for 15min until light and fluffy. The eggs were beating for 3min and added to the creamed mixture gradually and beating continued. Flour samples from various composite blends were separately sieved with powdered milk and baking powder and gradually folded into the mixture until soft consistency batter is formed, adding preservative to the batter and are thoroughly mixed. The batter was transferred to a greased baking pan and baked in a preheated oven at 160^0c for 25minutes, after which it was turned out and allowed to cool on a rack after which they were packaged in a low density polyethylene bags for analysis.

Weight margarine and sugar

↓

Creaming for 15mins

↓

Mixing eggs, flour, baking powder, preservative, flavor

↓

Panning pouring batter into greased pan

↓

Baking at 16^0c for 25min

↓

Cooling

↓

Cake

Fig 3.3: Flow diagram for the cake production.

Table 3: Recipe/formulation of composite flour and butter cake production

Total flour used was 250g				
Ingredient	**AIPC**	**AIPE**	**AIPF**	**AIPG**
Cassava (g)	125	250	188	167
Sweet potato (g)	125	0	62	83.333
Fat (g)	250	250	250	250
Sugar (g)	125	125	125	125
Eggs (pcs)	5	5	5	5
Flavour (powdered milk) (tb)	1	1	1	1
Milk flavour (liquid) (ml)	2.5	2.5	2.5	2.5
Preservative (alcohol) (ml)	5	5	5	5
Baking powder (g)	5	5	5	5

ANALYSIS CARRIED OUT

3.3 Anti-Nutritional Factors Determination

The anti-nutritional composition of (Oxalate, phytates, tannin, phenol, phytic acid, hydrogen cyanide (HCN)) of the prepared samples were determined using standard method of association of official chemist (AOAC, 2010).

DETERMINATION OF PHYTATES: The phytates content was determined by the method of Young and Greaves (1940). 4.0g of the finely ground sample was soaked in 100ml of 2.5% HCL for 3 hours and then filtered.25.0ml of the filtrate was placed in a 100ml conical flask and 5.0lm of 0.03% NH4CN solution was then added as indicators. 50.0ml of distilled water was then added to give the proper acidity. This was titrated with feC13 solution which contain about 0.005mg of fe/ml ferric chloride solution used. The equivalent was obtained and from this, the phytates content in mg/100 was calculated.

Phytic acid = titre x 1.95 x 1.19 x 3.55mg/g.

DETERMINATION OF OXALATE CONTENT: 1.00g of the sample was weighed into 100.0ml conical flask 75.0ml of 1.5N sulphuric acid was added and the solution was carefully stirred intermittently with a magnetic stirrer for about 1hour and then filtered using whatman no. 1filter paper. 250ml of the sample filtrate was collected and the filtrate was placed on a heating mantle to raise the temperature of the solution to about 80^0c. The hot solution was then titrated against 0.1NKMnO4 solution to a faint pink colour was obtained which persists for about 30 seconds (Day and Underwood, 2012).

DETERMINATION OF TOTAL PHENOL: The total phenol method content of the sample was determined by the method of (Singleton *et al.*, 2000). 0.20ml of the plant extract was mixed with 2.5ml of 10% folin ciocaltceau’s reagent and 2.0ml of 7.50% sodium carbonate solution. The reaction of the mixture was subsequently incubated as 45^0c for 40mins and the absorbance of the colour mixture was read at 700nm using UV visible spectrophotometer. Garlic acid was used as standard phenol.

DETERMINATION OF TANNIN CONTENT: This was carried at using the van – Burden and Robinson method (2001). 50mg of the sample was weighed into a paste bottle. 50ml of distilled water was added and shaken for 1hour in a mechanical shaker. This was filtered into a 50ml volumetric flask and the volume made up to the mark. 5ml of the filtrate was prettied out into a test tube and mixed with 2ml of 0.10m FecL3 in 0.10N HCL and 0.008M potassium Ferrocyanide. The absorbance was then measured at 120nm.

CYANIDE CONTENTS DETERMINATION: 4.0g of the sample was weighed into a 250ml conical flask. 50.0ml of distilled water was then added followed by the addition of 2.0ml of orthophosphoric acid. The sample was then stirred using a magnetic stirrer for 30minutes and was covered with aluminum foil and left overnight at room temperatures in order to liberate all bound hydrocyanide acid. The resulting mixture was then transferred into a 250ml distillation flask with a drop of paraffin oil and some anti-bumping chips. The distillation set up then fitted and about 45ml of the distillate was collected in a receiving flask containing 40ml of distilled water and 1g of NaOH pellet. The distilled was then transferred into a distilled water 20ml of this solution was measured into an Tri flask with 1.60ml of 5% KL solution. The solution was then titrated against 0.10M solution of AgNO. Black was also titrated until the end point was indicated by a faint ,but permanent turbidity.

DETERMINATION OF VITAMIN B1:5g of the sample was homogenized with 50ml ethanoic sodium hydroxide. It was filtered into a 100ml conical flask,10ml of the fiterate was pipette and the colour was develop by addition of 100ml of potassium dichromate and read the absorbance at 360mm.A blank solution is also prepared (Okwu and Josiah, 2016).

DETERMINATION OF VITAMIN B2:5g of the sample was extracted with 100ml of 50% ethanol and shaken for one hour. This was filtered into 100ml flask,100ml of the extract was pipette into 100ml of 5% potassium permanganate and 100ml of 30% H202 was added and allowed to stand over a hot water bath 30min.2ml of 400% sodium sulphate was added. This was made up to 50ml mark and the absorbance measured at 510nm using spectrophotometer (Okwu and Josiah, 2016).

DETERMINATION OF VITAMIN B3:5g of the sample was treated with 50ml in H2SO4 and shaken for 30min. 3 drops of ammonia solution were added to the sample and filtered. The filterate was pipette into a 50ml volumetric flask and 5ml of potassium cyanide was added. This was acidified with 5ml of 0.02N H_2SO_4 and absorbance was measure using spectrophotometer at 470nm (Okwu and Josiah, 2016).

CHAPTER FOUR

4.0 RESULT AND DISCUSSION

4.1 RESULT

Table 4.1.1 Antinutritional Composition of Cake

Sample	Phytates (mg100g)	Oxylate (mg/100g)	Tannin (mg/100g)	phenol (mg/100g)	Phytic (mg/100g)	HCN (mg/100g)
AIPC	4.65 ± 0.06^{b}	9.41 ± 0.12^{b}	0.17 ± 0.01^{b}	4.30 ± 0.17^{b}	$1.32. \pm0.01^{b}$	2.35 ± 0.04^{a}
AIPE	4.37 ± 0.03^{a}	9.02 ± 0.01^{b}	0.17 ± 0.00^{b}	4.27 ± 0.28^{b}	1.2 ± 0.01^{a}	4.64 ± 0.23^{b}
AIPF	4.33 ± 0.00^{a}	10.17 ± 047^{c}	0.24 ± 0.01^{c}	5.89 ± 0.07^{c}	1.22 ± 0.01^{a}	3.63 ± 0.16^{c}
AIPG	4.69 ± 0.05^{b}	8.19 ± 0.16^{a}	0.12 ± 0.00^{a}	3.05 ± 0.08^{a}	1.32 ± 0.02^{b}	3.32 ± 0.04^{b}

Values with the symbol (±) are mean standard errors

Values with different superscript on the same column are significantly different (<0.05).

Key

Sample AIPC: 125g cassava + 125g sweet potato

Sample AIPE: 250g cassava + 0g sweet potato

Sample AIPF: 188g cassava + 63g sweet potato

Sample AIPG: 167g cassava + 83.333 sweet potato

Table 4

Sample	**VITB1** (mg/100g)	**VITB2** (mg/100g)	**VITB3** (mg/100g)
AIPC	2.27 ± 0.00^{c}	1.15 ± 0.00^{6}	0.75 ± 0.01^{b}
AIPE	2.26 ± 0.00^{a}	0.72 ± 0.00^{a}	0.15 ± 0.01^{a}
AIPF	2.27 ± 0.00^{c}	1.22 ± 0.00^{c}	0.87 ± 0.01^{c}
AIPG	2.28 ± 0.00^{d}	1.38 ± 0.01^{d}	0.90 ± 0.01^{d}

Values with the symbol (±) are mean standard errors.

Values with different subscript on the same column are significantly different ($p< 0.05$).

Table 4.1.1 show the result of the anti-nutritional composition of the high quality cassava + sweet potato composite butter cake sample. Table 4.1.2 shows that vitamin B composition of the butter cake sample.

4.2 DISCUSSION

Antinutrients Analysis

The antinutritional composition of cake produced from high quality cassava + sweet potato composite flour were analysed as shown on table 4.1.1

The value of sample AIPG (167 cassava and 83.333 sweet potato flour) was found to be the highest 4.69mg/100g in terms of phytate while sample AIPF (188g cassava and 63g sweet potato flour) was found to be least 4.33mg/100g. There were significant difference between sample AIPC, sample, sample AIPE, sample AIPF and sample AIPG. Sample AIPG was found to have the maximum amount of phytate with values of 4.69mg/100g and sample AIPF was found to be the least amount of phytate with values of 4.33mg/100g. This indicates that sample AIPF is safer for consumption and sample AIPE having a considerable amount of phytate with value of 4.37mg/100g can still be considered for consumption.

The oxylate antinutrient was found to be highest 10.17mg/100g in sample AIPF (188g high quality cassava and 63g sweet potato flour) while sample AIPG (167g high quality cassava and 83.333g sweet potato flour) was found to be the least 8.19mg/100g. There was a significant difference ($p<0.05$) between sample, AIPC, AIPE, AIPF and AIPG. The WHO set maximum permissible limit of oxalate content in cassava as 60mg/100g, hence the result obtained in this study is less than this value. On the other hand, the result obtained is less than the result obtained in Ethiopia by Jiru and that is 59.0mg/100g (La dino *et al*., 2009).

The Tannin antinutrient was found to be the highest 0.24mg/100g in sample AIPF (188g high quality cassava and 63g sweet potato flour) while sample AIPG (167g high quality cassava and 83.333 g sweet potato flour) was found to be the least 0.12mg/100g. There was a significant difference ($p<0.05$) between sample AIPC, sample AIPE, sample AIPF and sample AIPG.

The phenol was found to be highest 5.89mg/100g in sample AIPF (188g high quality cassava flour and 63g sweet potato) while sample AIPG (167 high quality cassava and 83.333g potato flour) was found to be the least 3.05mg/100g. There was a significant difference ($p<0.05$) between sample AIPC, sample AIPE, sample AIPF and AIPG.

The phytic acid content sample AIPC (1.32mg/100g), sample AIPE (1.23mg/100g), sample AIPF (1.22mg/100g) and sample AIPG (1.32/100g) there was significant difference among all samples. Phytic acid was high in AIPC and AIPG sample having a value of 1.32mg/100g and 1.32mg/100g while the lowest value 1.22mg/100g was recorded for sample AIPF. Similar trend was recorded in the phytates, tannins polyphenol compounds lectins and trypsin inhibitor of the cake samples. Antinutrient are undesirable in foods as they tend to form complex with certain components and render them available for assimilation in the body for example, phytates and oxalate usually form insoluble salts with mineral elements such as zinc, calcium and iron to prevent their utilization in the body (Sarkiyayi and Agar, 2010).

The hydrogen cyanide of high quality cassava – sweet potato flour cake were sample AIPC, AIPE, AIPF and AIPG for 2.35mg/100g, 4.64mg/100g, 3.63mg/100g and 3.32mg/100g respectively. Significant differences were observed in all four sample. Sample AIPE (250g high quality cassava flour) had the highest HCN (4.64mg/100g) while sample AIPC (125 high quality cassava and 125g sweet potato flour) had the least (2.35mg/100g) value. The value of HCN of all high quality cassava – sweet potato flour cake sample were below the Nigerian industrial standard (10mg/kg) for cassava and cassava products (NIS344, 2004) maximum specification for HQCF (Sanni *et al*., 2006).

The reduction in these antinutrients can be explained by the partial degradation of the molecules of phytate. Although many findings have considered phytic acid as an antinutrient, recent finding have pointed out that phytic acid is an important antinutrient and addictive, with a applications in the manufacture of many novel food products such as pasta, bread, fish, paste, meat, fruits and vegetables (Oatway *et al*., 2001, Batista *et al*., 2010).

Vitamin

The vitamin composition of the sample is shown on table 4.1.2: Vitamin B_1 value was the highest in the sample and the value ranged were 2.27mg/100g, 2.26mg/100g, 2.27mg/100g and 2.28mg/100g for sample C, E, F, and G respectively for cake sample.

Vitamin B_2 contents of the sample were sample C (1.15mg/100g), E (0.72mg/100g), F (1.22mg/100g) and G (1.38mg/100g) respectively for the cake sample. The vitamin B_3 content of the sample were C, E, F, and G were 0.75mg/100g, 0.15mg/100g, 0.87mg/100g, and 0.90mg/100g for the cake sample.

There were significant differences ($p \leq 0.05$) in all the vitamin component analyzed. Cake samples were found to have high vitamin content of the samples increased from 0.15mg/100g – 2.28mg/100g with sample AIPG (167g high quality cassava: 83.333g sweet potato flour) having the highest value of (2.28mg/100g) in vitamin B_1 followed closely by sample AIPE (250g high quality cassava flour) with having the lowest mean value of 2.26mg/100g.The values are higher than the formulation than the value (0.25mg/100g) reported by Suresh *et al*. (2015) for cassava-wheat composite bread and below the recommended daily nutrient intakes of vitamin B_1 for infants, children, and adults(0.2-0.9, 1.1-1.2, 1.1-1.5mg/day) (FAO/WHO,2005).

The vitaminB_2 content is higher in sample AIPG (1.38mg/100g) had least value in while sample AIPE (0.72mg/100g), there was a significant difference ($p<0.05$). The cassava flour had more influence on vitamin B_2 content than the sweet potato flour, the composite cakes containing higher proportion of cassava flour had higher vitamin B_2 content. However the values obtained in this study are generally high and are below the FAO/WHO. (2005), recommended daily intake (RDI) for adolescents and adults (1.00 to 1.30mg/day), pregnant women (1.40mg/day) and lactating women (1.60mg/day) but within the RDI for infants and children (0.30 to 0.90mg/day).

The result of vitamin B_3 content of the cakes range from 0.75 to 0.90 mg/100g with sample AIPG (167g high quality cassava and 83.333g sweet potato flour) having the highest vitamin B_3 while sample AIPE (250g high quality cassava flour) had the least value respectively, there was a significant difference ($p<0.05$) among the four samples. The results were below the FAO/WHO. (2005), recommended daily intake for infants and children (2.00 to 12.00 mg/day), adults (14.00 to 16.00 mg/day), pregnant women (18.00 mg/day), and lactating women (17.00 mg/day).

CHAPTER FIVE

5.0 CONCLUSION AND RECOMMENDATION

5.1 CONCLUSION

This study investigated the antinutritional and vitamin composition of cake, as affected by varied composition of composite (High quality cassava and sweet potato) flour. Result of the study revealed that inclusion of sweet potato flour enhanced the nutritional qualities of cassava cakes substitution of cassava with 83.333g sweet potato flour (sample AIPG) result in notable increase in the spread mg/100g phytates and was moderate in oxylate, phenol, tannin and phytic acid content. The result also revealed that sample AIPG has the highest value for vitamin B_1, vitamin B_2 and vitamin B_3. Hence, it can be concluded that sample AIPG (167g cassava and 83.333g sweet potato flour) gave the best result for cake with good nutritional quality.

5.2 RECOMMENDATION

It is recommended that high quality cassava and sweet potato cake production should be encouraged which would greatly enhanced the utilization of those crops. Particularly sweet potato in countries where the crops have not been optimally utilized.

It could also be recommended that further researches be done on storage of any product from cassava and sweet potato.

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