EFFECTS OF BOILING ON THE PROXIMATE ANALYSIS AND MINERAL COMPOSITION OF THREE SPECIES OF GARDEN EGG (*Solanum aithiopicum, Solanum aubergine* and *Solanum anguivi*)

BY

AWORINDE, Omowunmi Rebecca

CHE/11/0304

BEING A DISSERTATION SUBMITTED TO THE DEPARTMENT OF INDUSTRIAL CHEMISTRY, FACULTY OF SCIENCE, FEDERAL UNIVERSITY, OYE-EKITI

IN PARTIAL FULFILLMENT OF THE REQUIREMENT FOR THE AWARD OF BACHELOR DEGREE (B.Sc.) HONS IN INDUSTRIAL CHEMISTRY

OCTOBER 2015

CERTIFICATION

This is to certify that AWORINDE OMOWUNMI REBECCA of the Department of Industrial Chemistry, Faculty of Science, Federal University, Oye-Ekiti carried out a Research on EFFECTS OF BOILING ON THE PROXIMATE ANALYSIS AND MINERAL COMPOSITION OF THREE SPECIES OF GARDEN EGG (*solanum aithiopicum, solanum aubergine* and *solanum anguivi*) in partial fulfillment of the award of Bachelor of Science (B.Sc.) in Federal University Oye-Ekiti under my Supervision

.....

DR. (MRS) OGUNDELE J. O.
PROJECT SUPERVISOR

13/11/2015
.....
DATE

.....

DR. (MRS) AKINTAYO C. O.
HEAD OF DEPARTMENT

3/11/2015
.....
DATE

ACKNOWLEDGEMENTS

Glory be to Almighty God who kept me till now and made me who I am. My appreciation goes to my loving and diligent supervisor, Dr (Mrs) Ogundele, J. O. who was always monitoring my work and made sure that I did the correct work. She is like a mother to me, she advices and corrects strictly with explanations which has led to the success of this project. May God be with you ma.

I also wish to extend my sincere appreciation to the Head of Department of Industrial Chemistry Department, Dr (Mrs) Akintayo C.O, for the love and support she gave to make this work a success. My appreciation will be incomplete if I fail to appreciate my lecturers like Prof. Amire, Dr Okolo P.O, Dr Olumayede E.G, Dr Nnamdi Obasi, L, Dr (Mrs) Adubiaro H.O, Dr Malomo D, Dr AyandaO.S, Mr Olusanya S.O, Mrs Babalola B.M, Mr Shodeinde K.O and Mr Abimbade S.F for their support ,encouragement and their constructive critism all through my year of study in FUOYE. God bless you all.

My acknowledgement also goes to all the technologies in this department for their support especially Mr Dayo, my course mates, also Prof (Mrs) Oshidaunsi, Dr (Mrs) Akinyede and Mrs Omoniyi in the Department of Food Science and Technology, Federal University of Technology, Akure, for their support to make this project a success.

My great appreciation goes to my loving and caring parents Mr J.O Aworinde and Mrs T.C Aworinde who were always there for me and have been my source of joy. They laboured under harsh conditions to make me who I am today. You will surely eat the fruit of your labour in Jesus name.

I am also indebted to my pastors and families in Oye and Lagos, Mr and Mrs Oludare and Mr and Mrs Adeniran for their support, morally and spiritually. I appreciate my siblings, Mrs

Adenike Beckley, Mrs Victoria Adesanya, Miss Oluwatosin Aworinde, Daniel Adesanya and Tioluwanimi Beckley.

I would like to appreciate my best friend Oyebode Paul Oluwaseun, who was always around and has being like a sibling. I will not also forget Raji Abimbola, Adeleye Temitope, Adekola Fadekemi, Adekola Adeola, Adenekan Seun, Ikeji Elizabeth., Ayandosu Omoyeni, Akintade Christopher, Imade Great, Ojo Femi, Atolagbe Joy, Alexander Tanimola, Oyeniyi Semilore, Oyinlola Tolulope, and Olowolagba Mary for their support in all ramifications throughout my stay in FUOYE, thank you so much friends.

ABSTRACT

Three species of garden egg namely *Solanum aithiopicum, Solanum aubergine* and *Solanum anguivi* processed into raw and boiled powdered flour, samples were taken for their nutritional and mineral components using standard analytical methods. Proximate composition determined include total ash, moisture content, crude fibre, crude protein, crude fat and carbohydrate by difference, the mineral components determined are P, Fe, Mg, Na, Mn, Zn, Ni and Cu. The proximate analysis (%) shows that *Solanum aithiopicum* has the highest water content of 92.40%, and the raw sample has the values of 12.31 ± 0.01, 10.32 ±0.025, 6.83 ± 0.031, 3.20 ±0.059, 4.27 ± 0.015 and 63.08 ± 0.035 for its protein, moisture, fat, ash, crude fibre and carbohydrate respectively. The values (%) for protein, moisture, fat, ash, crude fibre and carbohydrate of the raw sample of *Solanum aubergine* was also found to be 12.49 ±0.01, 9.47 ±0.01, 6.71 ±0.01, 3.43±0.01, 4.19±0.01, 63.7 ± 0.01 respectively. The values (%) for protein, moisture, fat, ash, crude fibre and carbohydrate of the raw sample of *Solanum anguivi* was also found to be 12.32 ±0.02, 8.87 ±0.01, 6.79 ±0.01, 3.47 ±0.01, 3.11 ±0.01 and 65.4 ±0.02 respectively. The mineral component (ppm) also shows that raw *Solanum anguivi* has the highest potassium composition with the value of 5.113±0.003 while the potassium composition of boiled *Solanum anguivi* is 5.055± 2.857. The value of phosphorus composition (%) of raw *Solanum aithiopicum, Solanum aubergine and Solanum anguivi are* 7.209±0.002, 29.896±0.002 and5.4068±0.002 (ppm) respectively and the values of the boiled (ppm) of *Solanum aithiopicum, Solanum aubergine* and *Solanum anguivi* are 5.7058±0.002, 14.417±0.003 and 2.783±0.002 respectively .Most of the nutrients content were reduced after boiling, these results show that boiling reduces the nutritional contents of *Solanum aithiopicum, Solanum aubergine* and *Solanum anguivi* but the difference is very minimal.

CHAPTER ONE

1.0 INTRODUCTION

Solanum, a widespread plant genus of the family Solanaceae, has over 1000 species worldwide with at least 100 indigenous species in Africa an adjacent island; these included a number of valuable crop plants and some poisonous ones (Jaeger and Hepper, 1986). It is represented in Nigeria by some 25 species including those domesticated with their leaves, fruits or both eaten as vegetables or used in traditional medicine (Gbile, 1987; Gbile and Adesina, 1988). Among them are two African eggplants, *S. aethiopicum L.* (Ethiopian eggplant) and *S. macrocarpon L.* (Gboma eggplant), which are widely cultivated in Nigeria and across the African continents. Garden eggs have different names according to ethnicity, for instance; Hausas calls it dauta, Igbos also call it afufa or añara while Yorubas call it igbagba or igba. Garden eggs are highly valued constituents of the Nigerian foods and indigenous medicines; both rural and urban families (Tindal, 1965) commonly consume them almost on a daily basis. Garden eggs form part of the traditional sub-Saharan African culture. The fruits, said to represent blessings and fruitfulness, are offered as a token of goodwill during visits, marriages and other social events. They are eaten raw and also when boiled or fried as ingredient of stews, soups and vegetable sauces. . Most often they are used in mixed dishes, stews and soups. Their flavours combine well with onions, tomatoes and meats and they can also be fried or grilled (MAFF, 1997).

Wide variations exist within the vegetative and fruit characters both within and between the African species garden eggs including variations in characters like diameter of corolla, petiole length, leaf blade width, plant branching, fruit shape, and fruit colour (Osei, et al, 2010). Their uses in indigenous medicine range from weight reduction to treatment of several ailments (Bello et al , 2015). The desire to eat is primarily driven by the body's need for nutrition, with the intake

of essential nutrients being indispensable for life. This fundamental reason to eat is challenged by the psychological needs of enjoyment and pleasure. Boiling can cause changes in the colour, flavour and texture of foods that allow us to create foods that we derive pleasure from eating. For example, roasting potatoes initiates a series of changes that makes them edible, as well as attractive in colour and taste by generating a golden brown colour, invoking a natural sweetness and producing a crisp shell and a soft internal texture. For many foods, the boiling process gives them the characteristics we associate with edible food, which are generated through an intricate series of physical and chemical changes that occur when foods are heated (EUFIC, 2010).

Nutritional content of food are affected by various factors, particularly, processes that expose foods to high level of heat, light and or oxygen cause the greatest nutrient loss. Nutrients can also be washed out of food by fluids that are introduced during a cooking process e.g. boiling a potato can cause much of the potato's vitamins B and C to migrate to the boiling water. You will still benefit from those nutrients if you consume the liquid i.e. if the potato and water are being turned into potato soup, but not if you throw away the liquid. Similar losses also occur when you boil, roast or fry in oil, and then drain off the drippings (Levenstein, 2003).

The quality of food that we eat can vary depending on the soil and growing conditions of that food. Soil that has been overworked and chemicals added and also drugs and antibiotics that have been given to livestock and crops to aid growth are factors that affect our own body's biochemistry. Nutritional quality of our food can be affected by manufacturing process, storage and preparation of food. The nutrient retention may vary with a combination of conditions, such as the characteristics of food been processed and the concentration of the nutrient of the food (Clarke, 2005).

1.1 AIM OF RESEARCH WORK

The aim of this research work is to determine the effects of boiling on the proximate analysis and mineral contents of three species of eggplant.

- Determine the proximate content (moisture content, crude protein, crude fat, crude fibre, total ash, carbohydrate by diff, water content).
- Determine some mineral content (P, Fe, Mg, Na, Mn, Zn, Ni, Cu) of the fruits.

It is expected that the research will provide information on the effects of boiling on the various types of garden egg and the environment that will enhance the various functional properties of their fruit flour.

1.2 JUSTIFICATION

In this part of the country, garden egg is not only eaten raw, but also boiled and eaten with yam or with stew. This project aims at providing the effects of boiling on the proximate and mineral composition of three tropical garden eggs: *Solanum aithiopicum, Solanum aubergine* and *Solanum anguivi*.

CHAPTER TWO

LITERATURE REVIEW

2.0 INTRODUCTION

The proximate analysis and mineral composition of these three species of garden Egg are: *Solanum aithiopicum, Solanum aubergine* and *Solanum anguivi* Although Oyenuga (1968) reported on feeding stuffs and nutritive value of some Nigerian foods, Edem *et al.* (2008) reported on the proximate composition of *Averrhoa carambolam,* Tanksley (1986) reported on biochemistry of fruits and their product, Edem *et al.* (2009) reported on a Comparative Assessment of the Proximate Composition, Ascorbic Acid and Heavy Metal Content of Two Species of Garden Egg (*Solanum gilo* and *Solanum aubergine*). Sakiko Ando et al (2015) reported on the effect of boiling on the phosphorus and protein content of beef ,nutritive value and phytochemical composition of processed *solanum incanum* (bitter garden egg) (AUTA, 2011) Not much have been reported on the effects of boiling on the proximate analysis and mineral composition **of** these three species of garden Egg namely: *Solanum aithiopicum, Solanum aubergine* and *Solanum anguivi* .Considering the fact that *Solanum aithiopicum, Solanum aubergine* and *Solanum anguivi* are three species of garden egg used as food by many people in the study area in different forms, it can be eaten raw and boiled, the effects of boiling them must be known in order to know the most nutritious form of consumption. The main aim of this study is to assess the effects of boiling on the proximate analysis and mineral composition of these three species of garden eggs with the view of knowing their chemical composition, nutritional values and the effects of boiling on them. The heavy metal content of the three

species will also be determined in order to ascertain the health effect associated with their consumption when eaten raw or boiled.

2.1 VEGETABLES

Vegetables are plants or parts of plants served with the main course of a meal. Apart from nutritive value, vegetables probably do more than other group of foods to add appetizing colour, texture and flavor to our daily food. From food science perspective it may include the following; leaves, stems, roots, flowers, seeds, fruits, bulbs, tuber and fungi. some plants can be used as vegetable such as tomato, egg plants and beans are used as vegetables. (Ajala, 2009). The high biological value of leafy vegetables become depends on the pronounced minerals compound especially, calcium, magnesium, phosphorus and iron (Jaworska and Kmieclk,1999).

In general, these crops also contain significant amounts of beta-carotene, folic acid and dietary fibre. Of this group of vegetable are seasonal crops with a limited value for processing (Takebe et al., 1995).Nutritional importance of vegetables cannot be neglected in our daily meals. Vegetables are the major source of vitamins and minerals, but vegetable, protein is poor in quality. Vitamins and minerals are the chief regulators in metabolism in human (Robinson, 1990).

2.2*Solanum spp*

Garden egg, *Solanum melongena* L., is a popular vegetable crop grown in the subtropics and tropics. It is called brinal in India and aubergine in Europe. The name "garden egg" derives from the shape of the fruit of some varieties, which are white and shaped similarly to chicken eggs. Eggplant (*Solanum melongena*) is a species of nightshade grown for its edible fruit. It is known

in South Asia, Southeast Asia and South Africa as brinjal (OUP, 2014).While "Eggplant" is the common name in American, Canadian, and Australian English, "aubergine" is much more common in British English. Other common names are melongene, (TriniGourmet, 2011) garden egg, (Vanguard, 2013) or guinea squash (John ,2001).

The fruit is widely used in cooking, most notably as an important ingredient in dishes such as moussaka and ratatouille. As a member of the genus *Solanum*, it is related to both the tomato and the potato. It was originally domesticated from the wild nightshade species, the thorn or bitter apple, *S. incanum*, (Yiu, 2006; Doijode, 2001). The plant's relationship with the Solanaceae (nightshade) family, the fruit was at one time believed to be extremely poisonous. The flowers and leaves can be poisonous if consumed in large quantities due to the presence of solanine (Kitchen Daily, 2012).

2.3 CULTIVATED VARIETIES

Different varieties of the plant produce fruit of different size, shape, and colour, though typically purple. The most widely cultivated varieties (cultivars) in Europe and North America today are elongated ovoid, 12–25 cm long (4 ½ to 9 in) and 6–9 cm broad (2 to 4 in) in a dark purple skin. A much wider range of shapes, sizes and colours is grown in India and elsewhere in Asia. Larger varieties weighing up to a kilogram (2.2 pounds) grow in the region between the Ganges and Yamuna rivers, while smaller varieties are found elsewhere. Colours vary from white to yellow or green, as well as reddish-purple and dark purple. Some cultivars have a colour gradient, from white at the stem to bright pink to deep purple or even black. Green or purple cultivars in white striping also exist. Chinese varieties are commonly shaped like a narrower, slightly pendulous cucumber, and are sometimes called Japanese eggplants in North America. The raw fruit can

have a somewhat bitter taste, but becomes tender when cooked and develops a rich, complex flavor. Many recipes advise salting, rinsing and draining of the sliced fruit (known as "degorging"), to soften it and to reduce the amount of fat absorbed during cooking, but mainly to remove the bitterness of the earlier cultivars. Some modern varieties—including large, purple varieties commonly imported into Western Europe—do not need this treatment. The fruit is capable of absorbing large amounts of cooking fats and sauces, making for very rich dishes, but salting reduces the amount of oil absorbed. Eggplant, due to its texture and bulk, can be used as a meat substitute in vegan and vegetarian cuisine. The fruit flesh is smooth, as in the related tomato. The numerous seeds are soft and edible along with the rest of the fruit. The thin skin is also edible. (Westerfield, 2008).

Eggplant is used in the cuisine of many countries. Eggplant is widely used in its native Indian cuisine, for example in *sambhar*, *dalma* (a *dal* preparation with vegetables, native to Odisha), chutney, curry, and *achaar*. Owing to its versatile nature and wide use in both everyday and festive Indian food, it is often described (under the name "baingan" or "Brinjal") as the "king of vegetables". Roasted, skinned, mashed, mixed with onions, tomatoes and spices and then slow cooked make the famous Indian and Pakistani dish *Bainganbharta* or *gojju*, similar to *salată de vinete* in Romania. Another version of the dish, *begun-pora* (eggplant charred or burnt), is very popular in Bangladesh and the east Indian states of Odisha and West Bengal where the pulp of the vegetable is mixed with raw chopped shallot, green chilies, salt, fresh coriander and mustard oil. Sometimes fried tomatoes and deep-fried potatoes are also added, creating a dish called *begun bhorta*. In a dish called *bharlivangi*, brinjal is stuffed with ground coconut, peanuts, and masala, and then cooked in oil (Bharli, 2014).

2.4 CULTIVATION

In tropical and subtropical climates, eggplant can be sown directly into the garden. Eggplant grown in temperate climates fares better when transplanted into the garden after all danger of frost is passed. Seeds are typically started eight to ten weeks prior to the anticipated frost-free date. Many of the pests and diseases that afflict other solanaceous plants, such as tomato, pepper (capsicum), and potato, are also troublesome to eggplants. For this reason, it should not be planted in areas previously occupied by its close relatives. Four years should separate successive crops of eggplants. Common North American pests include the potato beetles, flea beetles, aphids, and spider mites. (Adults can be removed by hand, though flea beetles can be especially difficult to control.) Good sanitation and crop rotation practices are extremely important for controlling fungal disease, the most serious of which is *Verticillium*. A herbicide that is commonly used for eggplant is Dimethyl tetrachloroterephthalate. (Stephen, 2012).

Spacing should be 45 cm (18 in) to 60 cm (24 in) between plants, depending on cultivar, and 60 to 90 cm (24 to 36 in) between rows, depending on the type of cultivation equipment being used. Mulching helps conserve moisture and prevent weeds and fungal diseases. The flowers are relatively unattractive to bees and the first blossoms often do not set fruit. Hand pollination improves the set of the first blossoms. Growers typically cut fruits from the vine just above the calyx owing to the somewhat woody stems. Flowers are complete, containing both female and male structures, and may be self-pollinated or cross-pollinated (Westerfield, 2008).

2.5 USES AND HUMAN HEALTH BENEFITS

This vegetable is quite diverse and more versatile, both in the garden and in the kitchen. Eggplant has chemicals that can cause digestive upset if eaten raw, so is usually cooked. It can be grilled, stuffed, roasted, served in soups and stews and on kebabs, and used in curries and stir-fries. Eggplant is nutritious, being low in calories, fat, sodium and is a non-starchy fruit that is cooked as a vegetable. It contains a large volume of water. It is good for balancing diets that are heavy in protein and starches. It is high in fibre and provides additional nutrients such as potassium, magnesium, folic acid, vitamin B6 and A. Nutritionally, eggplant is low in fat, protein, and carbohydrates. It also contains relatively low amounts of most important vitamins and minerals. A 1998 study at the Institute of Biology of São Paulo State University, Brazil, found eggplant juice to significantly reduce weight, plasma cholesterol levels, and aortic cholesterol content in hypercholesterolemiarabbits (Jorge, 1998)

The results of a 2000 study on humans suggested *S. melongena* in fusion had a modest and transitory effect, no different from diet and exercise (Braz, 2000). A 2004 study at the Heart Institute of the University of São Paulo found that, "Eggplant extract with orange juice is not to be considered an alternative to statins in reducing serum levels of cholesterol (Juliana et al, 2004)

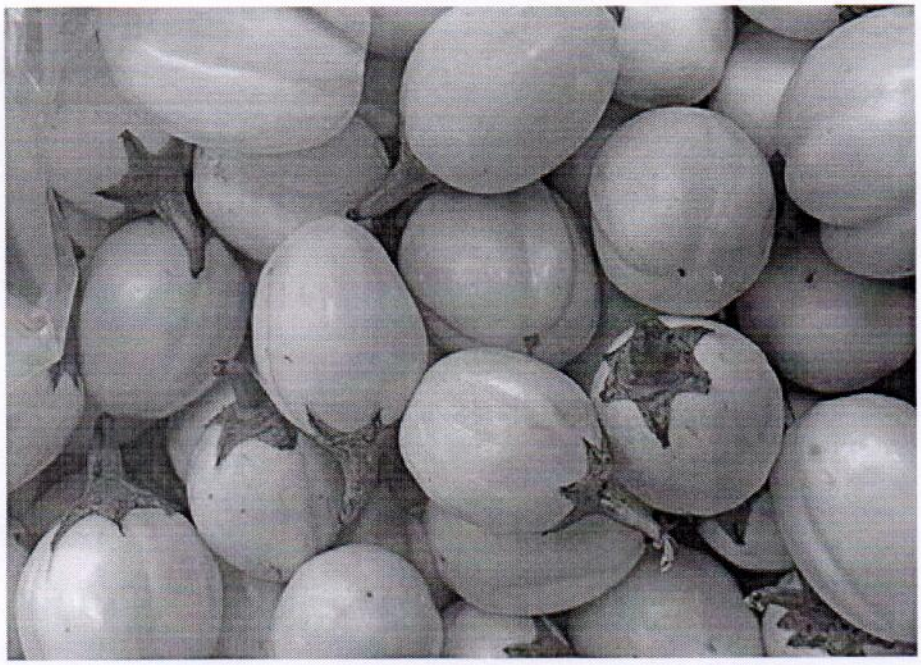

FIGURE 1 :*solanum aithiopicum*

FIGURE 2 S*olanum aubergine*

FIGURE 3 :S*olanum anguivi*

2.6 BOILING

Boiling is a method of cooking foods by just immersing them in water at 100^0C and maintaining the water at that temperature till the food is tender. Rice, egg, meat, root and tubers are cooked boiling. Boiling have some negative effects on the nutritional composition and has encouraged some health conscious consumers to eat more raw foods. In general, this is a positive step. However, boiling is also beneficial because it kills potentially harmful microorganisms that are present in food supply. In particular, poultry and ground meats (e.g. hamburger) should always be thoroughly cooked and the surface of all fruits and vegetables should be carefully washed before eating. Boiling is the rapid vaporization of a liquid, which occurs when a liquid which occurs when a liquid is heated to its boiling point. Food can be boiled using different methods like. Food suitable for boiling includes fruits and vegetables, starchy foods such as rice, eggs, fish, meat, and soups (Wikipedia).

2.7 EFFECTS OF BOILING ON FOOD

Minerals are also affected by high temperature, in some other cases, flavor may be lost by brisk cooking. Excessive cooking may also cause an adverse effect on the digestibility of the vegetables. Nearly every food preparation process reduces the amounts of nutrients in food. In particular processes that expose food to high levels of heat, light, and/or oxygen cause the greatest nutrient loss. Nutrients can also be washed out of foods by fluids that are introduced during a cooking process. For example, boiling a potato can cause much of the potato's vitamins B and C to migrate to the boiling water (Ojiako, 2007) you will still benefit from those nutrients if you consume the liquid (i.e. if the potato soup), but not if you throw away the liquid. Boiling has several advantages. It is appropriate for large- scale cookery, it is simple and safe. Older and

tougher, cheaper cuts of meat and poultry can be made digestible. Nutritious, well flavored stock is produced. Also, maximum colour and nutritive value is retained when cooking green vegetables, provided boiling time to the minimum. On the other hand, there are several disadvantages. There is a loss of soluble vitamins from foods to the water (if the water is discarded). Boiling can be a slow method of cooking and also an act of processing of food. The act of processing can often improve the taste of food significantly (Laudan, 2010).

Minerals are also affected by high temperature, in some other cases; brisk cooking may lose flavour. Excessive cooking may also cause an adverse effect on the digestibility of the vegetables. Methods, temperature and duration of cooking may also affect significantly on the nutritive values of vegetables. This research is to evaluate the effects of boiling on the proximate analysis and the mineral component of three species of garden eggfruit namely: *Solanum aithiopicum, Solanum aubergine* and *Solanum anguivi.*

Human diet is composed of nutrients like carbohydrate, protein, fats, minerals, vitamins and water (Okigbo, 1980).These nutrients are obtained following the intake of food. Different food materials contain varying composition and proportion of these nutrients. Populations, meals planning and calculation of therapeutic diets, food production and nutrition policies (Osagie et al., 1996) use for a variety of purposes; for the assessment of intake of nutrients and non-nutrient constituent of foods this information on nutrients and non-nutrients composition of foods. The increasing interest in and concern for the relationship between diet, food and generative diseases has stimulated for the acquisition of new data and chemical composition of foods.

2.8 DEFINITION OF TERMS

PROXIMATE ANALYSIS ON FOOD

Proximate analysis of a food sample determines the total protein, fat, carbohydrate, ash, and moisture reported as the percentage composition of the product (AOAC, 1998). There are food composition tables that contain proximate analyses for a large number of established foods and as new food items are added to our shopping baskets their proximate composition are added to the database, periodically, in supplements. Data contained in food composition tables and the analytical methods used to produce these data are continually under review17 and reliability. The quality of the assays and the definition of the composition of the composition (I.e. which components are included in the measurement) vary. The diverse range of analytical methods used introduces small differences among the compositional values that require the source to be identified and RSDs be reported with the data (Okigbo, 1980).

Standard proximate analysis include five constituents

- Ash
- Moisture
- Proteins
- Fat
- Carbohydrates (Calculation)

CARBOHYDRATE

Carbohydrate is the principal constituent of almost all normal diets and of all food components. It contributes to the structure and function of all insect tissue and can be found in the nucleus,

cytoplasm and membranes of all cells as well as in the extra cellular hemolymph and supporting tissues (Chippendale, 1978). Carbohydrate is a naturally occurring organic compound containing carbon, hydrogen and oxygen only. The term carbohydrate is derived from the general formula CnH_2nOn or Cn $(H_2O)n$ where n is greater than 3.

When carbohydrates are oxidized in the body, it produces energy. The food substance that is easily oxidized in carbohydrate particularly simple carbohydrate such as glucose (C6H12O6). The oxidation of glucose can be summarized as follows.

$C_6H_{12}O_6 + 6O_2 \longrightarrow 6CO_2 + 6H_2O$ H=+2827 KJ (energy)

The carbon dioxide and water formed are the end products but the energy so formed is used by all living cells in the body for their metabolic activities.

The principal free sugars present in fruits are glucose, fructose, and sucrose. While xylose and arabinose have also been detected in smaller quantities during different stages of ripening (Shakuntal, 1999).

The other carbohydrates or carbohydrate related substances that make up fruits are cellulose, lignin and pentosans.

PROTEIN

The name 'protein' was introduced by (Moulder, 1939) smallest unit is called the amino acid. The source is as follows.

Protein – Peptones – Peptides – Amino acids.

Protein can be obtained from two sources, animals and plant proteins. Animal proteins are food because they comprise virtually all the essential amino acids needed by the human body. Oyenuga (1992) reported that 87% of the total protein consumed in Nigeria comes from plant

sources, but only 13% of the protein consumption comes from animal products. The complete hydrolysis (acids, alkaline or enzymic) or protein yields and amino acids of L- configuration. The components of amino acids are joined together by substituted amide bonds, this is done by elimination of water, when the amino group of one amino acid is linked to the carbonyl group of another amino acid Protein consist of hundreds of such linkages.

Essential amino acids are those that cannot be synthesized in the body but should be present in the diet while non-essential amino acids are those that can be synthesized in the body if there is an available source of nitrogen. The amino acid is presents in fruits and the major ones include: asparagines, aspartic acid, glutamine, glutamic acid, serine, threonine, alanine valine and cysteine. The bulk of nitrogen content of the fruits was contributed by protein nitrogen. Generally, fruits are known to contain essential amino acids but the proportion is not very optimal (Lakshmaraya, 1996).

FAT

Fat is defined as the greasy materials which can be extracted from plants and animal tissue by various non-polar solvent (Suite, 1992). The amount of this varies greatly from one tissue to another. Fats are called oils when they are liquid at room temperature, Fats are used by animals as a source of energy and essentially fatty acids are required for structural lipid membrane tissues such as Brain vasculation. It can also occur in the protoplasm of plants or are specially stored in animal. In cold countries, animals accumulate a layer of fat below the skin to keep their bodies warm. It helps to regulate body temperature. Deficiency of fat in the body can lead to absorption of vitamin from the body and the formation of scaly skin. The vast majorities of lipids present in

fruit are esters of long chain fatty acids they associated with colour and flavour of fruits during ripening (Nagy, 1990).

ASH

The ash content is the measurement of the total inorganic component in food substances. The remaining part obtained when matter is dried in inorganic content. The ash content is usually determined by burning off the organic matter at a controlled temperature in muffle furnace. Ash content is very important because it consist of or mostly the essential and non-essential minerals and in fact it is good in evaluating and grading the nutritive quality of foods. Also, the ash content of fruit is relatively high compared to some other food products. Due to this, they are prescribed for the prevention and cure of anemia (Nagy, 1990). Fruits have been known to aid digestion when consumed due to high fibre content present. For instance, they are now prescribed for correcting intestinal disorders.

MOISTURE CONTENT

Moisture content is also known as the amount of water in food substances. It is of very important factor in storage as a high percentage may activate enzymes that can catalyze the breakdown of such food substances. The drying temperature range varies for different food. For example, proteinous food should be dried at a temperature lower than the temperature at which proteins will be denatured.

Accurate determination of moisture content enables one to know the amount of water to be incorporated during processing. It also predicts the type of preservation technique necessary for a particular food substance. Drying only evaporates water molecules that are physically bonded on

the surface of the food particles, but not those that are chemically bonded. In essence, It is clear that the determination of moisture content involves the amount of water that is physically bonded on the food particles.

The moisture content of the samples was determined using air oven method.

The advantages of this method include:

i) Large number of samples can be analyzed simultaneously

ii) It is very simple and easy to operate.

iii) It is very rapid

iv) It also gives reproducible results.

Principle: The air oven method used is based on drying of the food product at a temperature of 103-105°C at normal atmospheric pressure to practically constant mass.

MINERALS IN FOOD

Dietary minerals (also known as mineral nutrients) are the chemical elements required by living organisms, other than the four elements carbon, oxygen, nitrogen, and oxygen present in the common organic molecules. Examples of mineral elements include calcium, magnesium, potassium, sodium, zinc, and iodine. Most minerals that enter into the dietary physiology of organisms consist of simple chemical elements. Larger aggregates of minerals need to be broken down for absorption. Some sources state that sixteen chemical elements are required to support human biochemical processes by serving structural and functional roles as well as electrolyte (Nelson, 2000). Some of these elements are sodium, calcium, chlorine, ammonia and others.

The dietary focus on chemical elements derives from an interest in supporting the biochemical reactions of metabolism with the required elemental components (Lippard, 1994). Appropriate intake levels of certain chemical elements have been demonstrated to be required to maintain optimal health. Diets can meet all the body's chemical elements requirements, although supplements can be used when some requirements (e.g., calcium, which is found mainly in chemical products) are not adequately met by the diet, or when chronic or acute deficiencies arises pathology, injury, etc. (Corbridge , 1995)

CHAPTER THREE

MATERIALS AND METHOD

3.1 SOURCES OF RAW MATERIALS

Solanum aithiopicum, Solanum aubergine and S*olanum anguivi* were purchased from Akure market in Ondo State. The fruits were washed and cut into smaller pieces and oven dried. The sample were put in polythene bags and then air tight plastic containers and appropriately.

3.2 PROCESSING OF THE FRUITS

Samples of the seeds collected were processed into:

Raw dried form

Boiled form

3.2.1 Processing of the fruits into raw dried samples

Solanum aithiopicum, Solanum aubergine and S*olanum anguivi* were rinsed and dried for several hours in the oven. All seeds were blended and packaged in polyethylene nylon and kept in and kept in a tight plastic container and in a cool dry place out of the reach of pests.

3.2.2 Processing of seeds in the boiled samples

The fresh garden egg fruits were boiled for 30 minutes as described by (Giami and Bakebain, 1992). Boiled fruits were drained and allowed to cool. The samples were evenly spread and dried in the oven at 50^0- 80^0c they were blended by a blender and they were packaged in polyethylene bags and kept in a cool dry place.

3.2.3 Sample coding

The differently processed sample flours were coded as stated below

Code	Description
RI	Raw oven dried white coloured *solanum aithiopicum*
R2	Raw oven dried oval shape green coloured *solanum aubergine*
R3	Raw oven dried round shape green coloured *solanum anguivi*
B1	Boiled oven dried white coloured *solanum aithiopicum*
B2	Boiled oven dried oval shape green coloured *solanum aubergine*
B3	Boiled oven dried round shape green coloured *solanum anguivi*

3.3 DETERMINATION OF THE PROXIMATE COMPOSITION OF THE SAMPLES

Standard procedures recommended by association of official analytical chemistry (AOAC, 1990) were used for sample treatment and analysis. The fat content (FC) was determined using solvent extraction method with n-hexane/Petroleum either (b.p. 40-60^{0}c) in a soxhlet extractor. The moisture content (MC) was determined using air oven as weight difference after oven drying for 4-5 hours at 105^{0}c. Crude Protein (CP) was determined by Kjeldal's method as N x 6.25. Total ash Content (TAC) was determined by weight difference after incinerating a known weight to ash in a muffle furnace. The Crude Fibre (CF) was determined according to Pearson; 1981. Carbohydrate was determined by difference (100-MC, CP, TA and CF). the proximate analysis was carried out in triplicates and the results are in percentage dry weight of flour.

3.4 DETERMINATION OF THE ASH CONTENT OFTHE SAMPLES

The ash content was determined as described by (Pearson,1976). The crucibles for the ashing were washed, dried in the oven and allowed to cool in a dessicator. The cool crucibles were weighed and 3.0g of the flour sample was put in the crucibles and the weight was determined. The crucible and its contents were then transferred into a muffle furnace and its temperature was maintained between 500°C and 600°C to burn off all the organic matters for hours. The ashing was completed when there was no black spec in the ash i.e when the samples turned ash. The crucibles were taken out and immediately covered and were placed in a dessicator to cool and later weighed.

The percentage ash content was calculated as follows

$$\% \text{ ASH} = \frac{\text{Weight of Ash(g)}}{\text{Weight of sample (g)}} \times \frac{100}{1}$$

The experiment was carried out in triplicate and the average result was recorded as the percentage ash content for the sample.

3.5 CRUDE FIBRE ANALYSIS

The crude fibre was determined according to (Pearson, 1981). The samples were defatted with soxhlet extractor using in-hexane as solvent. Samples were continuously defatted for 8 hours. Defatted flours were dried at 50°c to drive off the n-hexane completely from the samples. The samples was latter boiled in 200ml of 1.25% H_2SO_4 for 30 minutes, after boiling, it was filtered with white cloth and rinsed twice with distilled water. The samples was later boiled in 200ml of 1.25% H_2So_4 for 30mins, after boiling, it was filtered with white cloth and rinsed twice with the distilled water. The resulting sample was again boiled in 1.25% NaOH for 30mins and rinsed

with distilled water and 10% HCl, rinsed with ethanol and di- ethylether. The residue was weighed and ashed lightly

$$\% \text{ crude fibre} = \frac{\text{wt of residue} - \text{wt of ash} \times 100}{W1}$$

Where W1 = weight of defatted sample

Wt of residue = weight of sample before ashing

Wt of ash = weight of sample after ashing

3.6 MOISTURE CONTENT ANALYSIS

Procedure: The petri dish was washed and dried in air oven. The hot, clean and dry petri-dish was then transferred to the dessicator and was allowed to cool. The weight of the petri dish was determined. 5.0g of powdered sample was weighed into the petri dish. The petri dish and its content were then transferred into the oven maintained at about 100°C. The content was allowed to dry at this temperature for 3 hours thereafter the petri dish and its content were removed from the oven and cooled in a desiccator, after cooling, the weight was determined. These were later returned to the oven and the process continued. Subsequent weight were recorded after drying for hours until constant weight was obtained. The percentage moisture content was ten calculated as follows

$$\% \text{ Moisture content} = \frac{\text{weight loss(g)} \times 100}{\text{Weight of sample (g)}}$$

OR

$$\% \text{ Moisture} = \frac{(W_1 - W_2)}{W_1} \times \frac{100}{1}$$

Where W1 = Weight of sample

W_2 = Constant weight of dried powdered sample

Two determinations were performed and the average result was recorded as the percentage moisture content for the sample.

3.7 FAT CONTENT ANALYSIS

The fat content was determined using soxhlet apparatus. 3.0g of the flour sample was accurately weighed into a thimble made of filter paper and fixed into the soxhlet extractor. n-Hexane was used as the solvent, the n-hexane was poured into a round bottom flask fitted and placed on the heating mantle. Extraction beings as the solvent refluxed several times. The extraction continued for about 7 hours after which the flask was cooled and disconnected. The thimble with sample was removed and direct to a constant weight in an air oven at 50°C. The difference between the weight of thimble before and after drying was recorded in order to obtain the weight of fat extracted. The percentage fat content was then calculated on dry basis as follows

$$\% \text{ fat content} = \frac{\text{weight of oil/fat extracted (g)}}{\text{Initial weight of sample (g)}} \times 100$$

The experiment was repeated in triplicate and the calculation above

3.8 PROTEIN ANALYSIS

The Kjeldal method of nitrogen analysis is the worldwide standard for determining the protein in a variety of materials ranging from human and animal food, fertilizer, waste water to fossil fuels Digestion is the first step and it is accomplished by weighing 0.5g of all samples placing the

sample in the digestion tube along with 5ml of conc.H_2SO_4 and a kjeldal tablet which is the catalyst. The tubes were heated until they gave light green clear solution. The tubes were carefully removed and allowed to cool. The resulting solution was then made up to 50ml and kept in a plastic container.

The purpose of next step was (steam distillation) to separate ammonia from the digestion mixture. It is affected by raising the pH of the mixture by adding 10ml of 40% NaOH solution and 5ml of the sample into the sample into the steam distillation unit. The NaOH has the effect to changing the ammonium ions to ammonia which is a gas. The nitrogen was separated away from the digestion mixture by distilling the ammonia by raising the temperature and then trapping the distillate in a special trapping solution of 5ml of 2% boric acid with drops of mixed indicator. The distilled solution made up to 50ml and titrated against 0.1M HCl until the blue solution turns pink.

$\%N=0.014\times T\times 10\times 0.1\times 100\div W$

Where T=titre value

$\%P=\%N\times 6.25$

3.9 CARBOHYDRATE

Carbohydrate content was then determined by difference

That is 100- (CP., MC,CP,TA and CF)

3.10 DETERMINATION OF MINERAL COMPOSITION

PREPARATION OF SAMPLE SOLUTION

The mineral were analyzed from solution obtained by ashing as follows. About 1.5g of the sample was placed in the crucible which has been weighed and was heated gently on Bunsen burner in a fume cupboard. When the sample had ceased to emit smoke and was transferred to a muffle furnace at 550^0 C. Heating was continued until all the carbon was burnt away while the crucible and the ash was then transferred to a dessicator to cool after which 0.1m HCl solution was added to the crucible so as to break up the ash. It was then filtered through acid washed with Whatman filter paper into 100ml volumetric flask. The residue and the paper were ashed three times with 0.1M HCl and then diluted to 100ml with the same acid solution (Oshodi, 1992). Minerals analyses were then determined using two different methods. Ca, Fe and Mg were analyzed using Atomic Absorption Spectrophotometer (AAS) while others were analyzed using VanadoMolybdate (yellow method).

3.11 ATOMIC ABSORPTION SPECTROPHOTOMETER (AAS)

AAS was used for analysis of the following metals Na, K, Ca, Fe and Mg. This instrument is used for metal analysis. The techniques require atoms in their ground state to be atomized by absorption, radiation of their characterized wavelengths. The flame used depends on the metal to be analyzed e.g. air, acetylene flame, nitrous oxide flame which is hotter and used for refractive elements such as Ca.

CHAPTER FOUR

RESULTS AND DISCUSSION

4.1 PROXIMATE COMPOSITION AND MINERAL ANALYSIS

Tables 4.1 and 4.2 show the proximate composition of raw and boiled samples of three species seed flour. The corresponding mineral analyses are shown in table 4.3 and 4.4.

Table 4.1: PROXIMATE ANALYSIS OF RAW SAMPLES OF THREE VARIETIES OF GARDEN EGG (%)

	Solanum aethiopicum	*Solanum aubergine*	*Solanum anguivi*
PROTEIN	12.31±0.01	14.49±0.01	12.32±0.02
MOISTURE	10.32±0.03	9.47±0.01	8.87±0.01
FAT	6.83±0.03	6.71±0.01	6.79±0.01
ASH	3.20±0.06	3.43±0.01	3.47±0.01
CRUDE FIBRE	4.27±0.02	4.19±0.01	3.11±0.01
CHO	63.08±0.04	61.71±0.01	65.44±0.02

Table 4.2: PROXIMATE ANALYSIS OF BOILED SAMPLES OF THREE VARIETIES OF GARDEN EGG (%)

	Solanum aethiopicum	*Solanum aubergine*	*Solanum anguivi*
PROTEIN	14.98±0.78	14.79±0.01	14.96±0.50
MOISTURE	11.27±0.49	10.29±0.01	10.20±0.01
FAT	6.39±0.03	3.27±0.01	6.35±0.01
ASH	3.04±0.06	6.29±0.01	3.36±0.15
CRUDE FIBRE	3.95±0.02	2.19±0.01	2.76±0.07
CHO	60.38±0.70	63.17±0.05	62.36±0.4

Table 4.3: MINERALS ANALYSIS OF RAW SAMPLES OF THREE VARIETIES OF EGG PLANTS (ppm)

	Solanum aethiopicum	*Solanum aubergine*	*Solanum aubergine*
Cu	0.263±0.0005	0.168±0.0006	0.196±0.0021
Jn	0.644±0.0085	1.678±0.0073	0.636±0.0057
Ni	0.019±0.0016	0.028±0.0021	0.029±0.0070
Fe	0.605±0.0018	1.106±0.0069	0.591±0.0095
Na	0.838±0.0146	0.800±0.0132	0.704±0.0092
Mn	0.265±0.0072	0.156±0.0036	0.232±0.0005
Mg	1.121±0.0069	1.369±0.0051	1.040±0.0016
P	7.209088±0.002	29.896512±0.002	5.4068±0.002
K	2.068± 0.005	2.491±0.002	5.113±0.003

Table 4.4: MINERALS ANALYSIS OF BOILED SAMPLES OF THREE VARIETIES OF GARDEN EGG (ppm)

	Solanum aethiopicum	*Solanum aubergine*	*Solanum anguivi*
Cu	0.509±0.0024	0.292±0.011	0.234±0.022
Zn	1.035±0.0009	1.051±0.0180	0.890±0.0091
Ni	0.021±0.0105	0.027±0.0056	0.034±0.0033
Fe	0.524±0.0133	0.436±0.0113	0.401±0.0023
Na	1.615±0.0040	0.819±0.0010	0.695±0.0034
Mn	0.328±0.0017	0.200±0.0018	0.247±0.0036
Mg	1.401±0.0076	1.008±0.0060	0.790±0.0052
P	5.7058±0.002	14.4171±0.003	2.78291±0.002
K	2.010±0.007	2.307±0.0074	5.055±2.857

4.2 DISCUSSION

PROXIMATE COMPOSITION

The results of the analysis presented in Table4.1 and table 4.2 shows that the percentage moisture content of raw *Solanum aithiopicum, Solanum aubergine* and S*olanum anguivi were 11.27%, 10.29% and 10.20%* , respectively this value increased after boiling by 0.95%. in *Solanum aithiopicum* , 0.82% in S*olanum aubergine* and 1.33% in S*olanum anguivi* .The increase in moisture content could be as a result of water absorption by the fibres and other natural chemical component of the vegetables. The crude protein content of the raw and boiled *Solanum aithiopicum, Solanum aubergine* and S*olanum anguivi* are 12.31±0.01, 14.49±0.01, 12.32±0.02 and 14.98±0.78, 14.79±0.01, 14.96±0.50 respectively.`

However *Solanum aithiopicum* and S*olanum anguivi* were able to retain more of the fats and lost about 0.44%while S*olanum aubergine* recorded about 0.42% loss. With boiling the fat must have melted into the boiling water thus causing a reduction in the fat content The ash content of raw *Solanum aithiopicum, Solanum aubergine* and S*olanum anguivi* are 3.20%, 3.43%, 3.47% respectively which is significantly higher than that of *Solanum nigrum* and *Solaneciobiafrae which* was 2.99% and 1.05%, respectively this is significantly lower than that of *Cnidosculusaconitifolius*, *Telfairiaoccidentalis and Amaranthuscruentus*which are 11..30, 13.25 and 8.80%, respectively (Kochhar,1981).

Ash content is an indication of the mineral content, these low values shows that the vegetables are low in mineral content. After boiling there was reduction in the ash content up to 3.04% in *Solanum aithiopicum* and 3.36% in *Solanum anguivi* . This reduction in ash content may be due to leaching of the mineral compound into the boiling water. The fibre content of *Solanum*

aithiopicum, Solanum aubergine and S*olanum anguivi* are 4.27±0.02%, 4.19±0.01%, 3.11±0.01% which all reduces to 3.95±0.02%, 2.19±0.01%, and 2.76±0.07% comparable to the results of *Solanum nigrum*and *Solaneciobiafrae which* was 1.13 and1.05%,respectively these valuesare comparable to 0.70 and 0.90% reported for *Laureatetraxidicolie* and *Basellarubra*, respectively (Isa *et al*.,2006). The high ash content of *Solanum aithiopicum, Solanum aubergine* and S*olanum anguivi* which is an index of mineral content shows that the fruit is a good source of mineral element. Potassium was the most abundant element with the concentration of 2.068ppm and 5.113 ppm respectively for the raw which reduced minimally to 2.010ppm and 5.055 ppm respectively in S*olanum aithiopicum* and S*olanum anguivi* which makes it of great benefit to human health because patient suffering from kidney disorder should consume boiled garden eggs rather than raw garden eggs due to the effect of high potassium intake to their health, While most consumers benefit from high levels of potassium in potato tubers, individuals with compromised kidney function must minimize their potassium intake(Food Sci. 2008) . The results showed that heat processing has a minimal effect on the mineral component of *Solanum aithiopicum, Solanum aubergine* and S*olanum anguivi* as can be seen on on Table 4.3 and 4.4. Though minerals are not lost due to boiling, they may be leached into boiling water during per boiling in order to remove the bitter taste.

The fibre content of *Solanum aithiopicum, Solanum aubergine* and S*olanum anguivi* reduces after boiling to 3.95, 2.19 and 2.76%, respectively; this result shows that boiling reduces the fibre content of *Solanum nigrum.* (AUTA et al, 2011) argued that 'proximate composition of *S. incanum* revealed that heat treatment reduces crude protein, lipid and crude fibre, indicating that processing techniques has an influence on the level of these proximate components. The

proximate parameters of the raw garden egg are in agreement with the analysis determined by (Ali, 2010)

CHAPTER FIVE

CONCLUSION AND RECOMMENDATION

5.1 CONCLUSION

The fruits of *Solanum aithiopicum* and S*olanum anguivi* are closely related in proximate analysis, crude protein values ranging from12.31±0.01% to 12.32±0.02% but S*olanum aubergine* has the highest protein content which range from 14.49±0.01%, the three varieties of seeds are all good sources of protein. The nutrient contents of the leafy vegetablesserve as supplements for food and also have potential to improve the health status of its users as a result of the presence of various compounds vital for good health

Decreasing the amount of water you use when boiling vegetables can drastically decrease the loss of nutrients. Most vegetables do not require much water to cook. For example, green beans only need to cook for four minutes in enough water to cover the bottom of the pan. Being aware of the amount of time and water needed to boil a vegetable will help you avoid excessive exposure to water and heat. Since vegetables have different requirements, boil vegetables separately to avoid overcooking one while the other cooks. If needed, you can combine vegetables in your recipe after they have all been cooked. Do not discard water used for boiling vegetables. You can retain the nutrients that seeped into the water by finding a way to consume it, such as making it the base of a soup or stew.

In conclusion, the results from this study showed that Boiling of *Solanum incanum* for 30 minutes showed reduction in some of the parameters that analyzed except for the moisture content. Greater loss in the nutrients was observed as the fruit was boiled for 30 minutes hence

from the analysis carried out, it is not advisable to boil this vegetable for more than 15 minutes as doing so will lead to the loss of nutrients in the fruit.

5.2 RECOMMENDATION

I recommend that more research should be done on the three fruits in order know the nutritional content and the effects of processing on them. However the three seeds were found to contain high level of nutrients which reduces by a little ratio when boiled, it also contain less fat which is good for diet which also reduces when boiled and has high fibre which also reduces when boiled, therefore the helps those people that wants to reduce their weight.

Hence the fruits should be accepted by consumers because they have a great importance on the body when eaten either raw or boiled, the raw ones are very important in the supply of fibre to the body which helps the body to and also important when boiled because according to the result of the analysis the protein increases. The fruits should be eaten by all because it has a lot of nutritional benefits, it can be consumed raw and also if boiled is preferred can be eaten which will still be nutritious to the body which is necessary for the fast growing rate of world population.

References

A. O. A. C, (1990.). *Official Methods of Analysis*, 15th edition. Washington DC pg 124.

Ajala Lola, (2009). The Effect of Boiling on the Nutrients and Anti-Nutrients in Two non-Conventional Vegetable. Pakistan Journal of Nutrition. 8 (9) 1430-1433

Ali, I. (2010). Proximate and Phytochemical Analyses of Bitter Garden Egg (*Solanumincanum*).B.Sc Thesis, Kaduna State University.42 pp.

Auta, R.: James, S. A.: Auta, T. and Sofa, E. M. *(2011):* Nutritive value and phytochemical Composition of processed *solanum incanum* (Bitter garden egg). *Science World Journal Vol 6 (No 3)*

Bello S.O., Muhammed B.Y., Gammaniel K.S. Abdu- Aguye I., Ahmed H., Njoku C.H., Pindiga (2015): Influence of Pre-Treatments on Some Nutritional and Anti-Nutritional Contents of Solanum macrocarpon (Gbagba). American Journal of Food Science and Nutrition Research, Vol. 2, No. 2. Pg 32-39.

Bonsu K. O., Fontem D. A., Nkansah G. O., Iroume R. N., Owusu E. O. and Schippers R. R., (2002): Diversity within the Gboma eggplant (Solanum macrocarpon), an indigenous vegetable from West Africa. Ghana J. Horticulture, 1, 50–58

Chandran, Sheela (2014). "Going green's good for the wallet". The Star Online, Star Publications (Malaysia).

Chippndale, G.M. (1978). The function of carbohydrate in insect life processor in Biochemistry of insects. D Rostem M. Academic Press Inc. N.Y. London Pg 1-53.

Clarke, (2005): Recent development in noninvasive techniques for fresh fruits and vegetables internal quality analysis. American Journal of Food Science and Nutrition Research, Vol. II, No.5. Pg 42-51.

Corbridge, D. E. C. (1995): Phosphorus: An outline of its chemistry, Biochemistry and Tchnology(5th ed.). Amsterdam: Science Journal, Elsevier Science Pub Co. pp.1220.

David L. Nelson, Micheal M Cox (2000) Lehninger principles of Biochemistry, Third Edition (3Har/Com ed.). W.H. Freeman. Pp. 1200

Doiode, S. D. (2001). *Seed storage of horticultural crops* (pp 157). Haworth Press: ISBN 1-56022-901-2

Edem C.A., M.I. Dossunmu, A.C. Ebong and M. Joneas, (2008):Determination of proximate composition Ascorbic acid and heavy metals contents of star fruits (Avesrhoacarambola). Global J. Pure and Appl. Sci., 14: 193-195.

European Food Information Council.The Why, How and consequences of cooking our food, 2010.

Gbile Z. O. (1987): Nigerian Solanum Species, Nigerian Field, 52, 19-26

Gbile Z. O. and Adesina S. K. (1988): Nigerian Solanum Species of economic importance, Annals Missouri Bot. Garden, 75, 862-865

Giami and Bakebain, (1992): Proximate composition and functional properties of raw and processed full fat fluted pumpkin (Telfanaoccidentalis) seed flour.

Grubben G.J.H. and Denton O.A. (2004): Plant Resources of Tropical Africa II: Vegetables (Leiden, Wageningen: Backhuys Publishers) 35- 198.

Isa, F O., S.O. Adesala and F.A. Ojo, (2006): Effect of Maturity on the Nutritional Composition of Selected Green Leafy Vegetables. Proceedings of the 30th Annual conference of Nigerian Institute of Food Science and Technology ASCON Conference Centre, Badagry, Lagos.

Jaeger P.M.L. and Hepper F. N. (1986): A review of the genus Solanum in Africa, In: *Solanaceae:biology and systematics* (eds) W. G. D'Arcy (New York: Columbia University Press) 41–55

Jaworska, G. and W. Kmiecik, (1999): Content of Selected 546-550. Minerals. Electronic Journal of Polish Agriculture University.Vol. 2.2 Series of Food Science and Technology.

John Gerarde (2012): *The Herball, or Generall Historie of Plantes*, Kitchen Daily . "Is Raw Eggplant Poisonous?".*Kitchen Daily*. pg 274.

John Martin Taylor (2001). "Boiled Peanuts".*Gastronomica: The Journal of Critical Food Studies* 1 (4): 25–28.

Jorge, Paulo AfonsoRibeiro (1998). Effect of eggplant on plasma lipid levels, lipidic peroxidation and reversion of endothelial dysfunction in experimental hypercholesterolemia. Arq.Bras.Cardiol., vol. 70, n. 2, pp. 87-91. ISSN 0066-782X.

Juliana MarchioriPraca, Andrea Thomaz, Bruno Caramelli (2004): Eggplant (*solanummelongena*) Extract Does Not Alter Serum Lipid Levels. Arq Bras Cardiol, volume 82 (n°3), 273-6.

Kochhar, S.L., (1981): Tropical Crops, a Textbook of Botany Macmillian Ltd.

Lakshmaraya, B.M., (1996): Vitamins and minerals composition of Africa star apple. The Nigeria trade journal Vol. 23.

Laudan, Rachel (2010). "In praise of Fast Food ".UTNE Reader.Retrieved 2010-09-24." Where modern food became available, people grew taller and stronger and lived longer.

Levenstein.H (2003). "Paradox of Plenty. "pages 106- 107. University of California Press.

Lippard, Stephen J.; Jeremy M. Berg (1994).Principles of Bioinorganic Chemistry. Mill Valley, CA: University Science Books, pp.411

Nagy, O.A.(1990) : The roles of fruits flies in rot disease of cashew apples in the plantation. Annual report cocoa research institute of Nigeria, Ibadan.Pp.101-105.

Nelson M. E., 2000. Dietary intake of selected minerals for the United States population. *The Journal of Critical Food Studies* 1I (5): 35–42.

Ojiako OA, Igwe, C.U. (2007). Nutritional and anti-nutritional compositions of Cleome rutidosperma, Lagenariasiceraria and Cucurbita maxima seeds from Nigeria. J. Med Sci

Okigbo, B.N. (1980). Nutritional implication of proect giving hjigh priority yo the production of taples of low nutritive quality the case of cassava in humid tropical of West Africa. Food and Nutrition Bulletin 2: 1-10.

Oladiran J.A. (1989): The effects of fruit colour, processing technique and seed treatment on the germination of Solanummacrocarpon L. (Igbagba), Nig. J. Technol. Res., 1(1), 17–20

Osagie, A.U., M. Muzquiz, Burbano, C.O.; Cuadrado, C.; Ayet,G., and Castano. A. (1996) .Some antinutritional constituents in ten staple food items grown in Nigeria. Tropical Science (UK) 36: 109-115.

Osei M.K., Banfull B., Osei C K. and Oluoch M. O. (2010): Characterization of African Eggplant for Morphological Characteristics. J. Agric. Sci. Technol. , 4 (3) , 33-37. Oxford University Press..

Oxford University Press (OUP), (2014): Draft genome sequence of eggplant (*solanum melongena*L.) :the representative solanum species indigenous to the old world.

Oyenuga V. A. (1968). Nigeria Food and Feeding Stuffs their Chemistry and Nutrient Values. 3rd Edition Ibadan University Press, Ibadan.

Oyenuga V.A., Symposium on protein foods (proceedings) University of Ile- Ife, Nigeria April 11-13, 1972

Pearson D. (1976) : Chemical Analysis of foods (6th edition) Churchill, London, Pg 6-9.

Robinson D. S. (1990). Food biochemistry and nutritional value. Longman scientific and technical publisher, New York, USA.

Sakiko Ando (2015): The effects of various boiling condition on reduction of phosphorus and protein in meat. The Nigeria trade journal Vol. 22, Pg 23-31.

Shakuntal A.O., (1999): Comparison of chemical composition of Africa star apple. Science Journal. Vol I, 25-34

Stephens, James M. (2012) Eggplant, White-Solanum ovigerum Dun, and Solanum melongena varesculentum (L.) Nees University of Florida IFAS Extension.

Takebe, M., T. Ishihara, K. Matsuno, J. Fujimoto and T. Yoneyama, (1995): Effect of Nitrogen Application on the Content of Sugar, Abscorbic Acid, Nitrate and Oxalic Acid in Spinach (*Spinaciaoleracea*L) and Komatsun (*Brassica campestris*L).Jpn. J. Soil Plant Nutr., 66: 238-246. (English Summary).

Tanksley A. S. (1986): Biochemistry of fruits and their products: New York Academic Press. Pakistan Journal of Nutrition, Vol. 8, Pg 582-584

Tindal H.D. (1965) *Fruits and Vegetables in West Africa* (London: Oxford University Press) 2nd edn., 5(8), 105

TriniGourmet, Trinidad, (2011): *Stuffed Melongene (recipe)* Linked 2015-02-09

Tsao and Lo in "Vegetables: Types and Biology". *Handbook of Food Science, Technology, and Engineering* by Yiu H. Hui (2006).CRC Press.ISBN 1-57444-551-0.

Vanguard Magazine, Nigeria, April 16, 2013: *Garden egg useful for weight reduction says nutritionist* Linked 2015-02-09

Westerfield, Robert (2008). "Pollination of Vegetable Crops" (PDF). Retrieved 2009-07-01.