IOSR Journal of Environmental Science, Toxicology and Food Technology (IOSR-JESTFT)
e-ISSN: 2319-2402,p- ISSN: 2319-2399.Volume 18, Issue 4 Ser. 2 (April 2024), PP 08-21
www.iosrjournals.org

Quality Evaluation Of Pasta From Durum Wheat(Triticum Aestivum) And Heat Treated African Yam Bean (Sphenostylis Stenocarpa) Flour Blends

Agada Mabel Ene
B.Sc (Food Science & Technology)16/9610/Msc
Department Of Food Science And Technology,University Of Agriculture, Makurdi.

Abstract
The aim of this study was to quality evaluation of pasta from durum wheat(triticum aestivum) and heat treated african yam bean (sphenostylis stenocarpa) flour blends. The seeds of brown coloured African yam bean (AYB) and lime were purchased from Oju market in Benue State, Nigeria.
Composite pasta were made by supplementing wheat flour (WF) with African yam bean flour (AYBF) after the seeds have been sorted, sun dried, roasted, milled, and sieved into fine flour using a sieve size of 0.4mm and used at various ratios. (WF/AYBF 100:0, 95:5, 90:10, 85:15, 80:20, 75:25, 70:30). The 100% wheat flour pasta served as the control. Sensory evaluation of the pasta were determined using a nine point hedonic scale to collect data on sensory and acceptability tests of the pasts. Means and standard deviations were calculated and least significance difference test was used to separate means and subjected to Statistical Analysis of Variance (ANOVA) and means were separated using the Generalized Linear Model (GLM) of SAS system. The means were separated using Fischer LSD and judged significantly different at 95% confidence level ($P<0.05$).
The flour samples were chemically analyzed for proximate composition using standard laboratory methods. The pasta samples had proximate compoition values for moisture content differed significantly ($p<0.05$) between all blends, values ranging from 8.31 to 7.92%. Protein content of the blend increased significantly ($p<0.05$) from 7.82 to 14.03%. Values ranged between 1.18 to 2.37%, 0.94 to 1.72% and 0.92 to 1.22% for crude fibre, ash and crude fat respectively. Substitution with African yam bean flour significantly ($p<0.05$) reduced carbohydrate content from 80.83% in sample AAA (100% wheat flour) to 73.64% .
The functional properties of the pasta samples ranges from bulk density (0.72 to 0.84 g/ml), welling index decrease (6.34 to 5.88),values ranging from 1.83 to 2.08 g/g and 1.43 to 1.64 g/g for water and oil absorption capacities respectively.
The physical properties of the pasta Sample recorded, AAA was not significantly different from sample ABA. Increase in African yam bean into wheat flour reduced the hardness of pasta from 1.26 to 0.95 %. Samples ADA, AEA, AFA, and AGA did not differ significantly
The textural properties of flour samples recorded highest and least values were obtained for samples AAA (100% wheat) and AGA (70% percent wheat flour + 30% African yam bean flour) respectively. Highest value (0.02g) for cohesion was observed for the control sample, whereas, with increasing levels of African yam bean flour into wheat, the samples became less cohesive.
Sensory evaluation results showed that In terms of general acceptability, pasta with 30% African yam bean was ranked lowest (5.15), whereas, the control sample was the most accepted (8.75). There was no significant ($p<0.05$) between samples AFA and AGA.
Pasta from other substitution levels were generally acceptable as they were neither liked nor disliked by the panelists.

Date of Submission: 14-04-2024 Date of Acceptance: 24-04-2024

I. Introduction

Composite Flour

Wheat is the ideal flour suitable for pasta. The high level of its utilization has resulted in an overdependence on wheat flour for pasta goods especially in developing countries like Nigeria. Unfortunately, wheat is a temperate crop that will not do well under tropical conditions due to unfavourable soil and climatic conditions (Abdelghafor, Mustafa, Ibrahim, & Krishnan, 2010; Edema, Sanni, & Sanni, 2005). Hence, wheat-consuming countries located in the tropical regions, which are mostly developing nations, rely on countries located in the temperate regions, mostly developed nations, for wheat importation. Many developing nations

spend huge amount of their foreign exchange for the importation of wheat (Ohimain, 2014). It is therefore of economic importance if wheat importation is reduced by substitution with other locally available raw materials (Oyeku et al., 2008) such as African yam bean, plantain etc. Seibel (2006) reported that it is well known that no other crop can achieve the pastry properties of wheat, hence composite flour has become the subject of numerous studies. Therefore, there has arisen the need to develop a strategy of using less expensive local resources that could still combine optimum nutritive value with good processing attributes to replace wheat flour for use in food industries. Over the years, there have emerged two definitions of composite flour. Composite flour is a blend or mixture of wheat with other materials to form suitable flour for baking purposes (Dendy, 1992, 1993; Oyeku et al., 2008). Sanni, Christiana, and Silifat (2004) defined composite flour as the name given to wheat that has been diluted with non-wheat materials like African yam bean and plantain. Of recent, composite flour is now defined as a blend of wholly non-wheat flours for the purpose of making pasta (Dendy, 1993). Putting both definitions together, Seibel (2006) defined composite flour as a mixture of flours from tubers rich in starch (e.g. cassava, yam) and/or protein-rich flours (african yam beans,cowpea, soybean) and vegetable (plantain) with or without wheat flour. Some of the documented advantages of composite flour include saving of foreign exchange, promotion of high-yielding native species, a better supply of proteins for human nutrition, enhancement of domestic agriculture, generates rural income and supports rural development (Andrae & Beckman, 1985; Bugusu, Campanella, & Hamaker, 2001; Seibel, 2006). Because of these and other advantages, Nigeria and many developing nations have implemented composite flour policies. Hence, the aim of this study is to achieve protein complementation by blending wheat with African yam bean (AYB) and plantain flours in order to improve the utilization of underutilized legume.

Objectives

Broad Objective

The broad Objective of this study was:

To evaluate the quality characteristics of pasta from blends of wheat and heat-treated African yam bean.

Specific Objectives

The specific objectives of the study were to:

Evaluate pasta from blends of Wheat and toasted African yam bean

Determine the physico-chemical properties of flours and pasta from Wheat and African yam bean.

Determine the functional properties of pasta from blends of Wheat and African yam bean.

Determine the sensory quality of pasta from Wheat and African yam bean.

The above results if favourable will help to; reduce the high demand for wheat in making pasta, provide an alternative and cheap source of increasing the protein intake of pasta consumers and encourage mass production of high quality African yam bean flour in Nigeria.

Statement Problem

The study provides the information about a commercially viable application of increasing protein and fibre content in pasta and also these can solve the problem of malnutrition and other essential macro and micro nutrients deficiency among the population.

II. Literature Review

Wheat

Wheat is a cereal grain which is a worldwide staple food. In 2016, world production of wheat was 749 million tonnes, making it the second most-produced cereal after maize. Globally, wheat is the leading source of vegetal protein in human food, having a protein content of about 13%, which is relatively high compared to other major cereals and staple foods. When eaten as the whole grain, wheat is a source of multiple nutrients and dietary fiber, and is associated with lower risk of several diseases, including coronary heart disease, stroke, cancer and type 2 diabetes. In a small part of the general population, gluten - the major part of wheat protein - can trigger coeliac disease, non-coeliac gluten sensitivity, gluten ataxia and dermatitis herpetiformis.

Coronary artery disease (CAD), also known as ischemic heart disease (IHD), is a group of diseases that includes: stable angina, unstable angina, myocardial infarction, and sudden cardiac death. It is within the group of cardiovascular diseases of which it is the most common type. A common symptom is chest pain or discomfort which may travel into the shoulder, arm, back, neck, or jaw. Occasionally it may feel like heartburn. Usually symptoms occur with exercise or emotional stress, last less than a few minutes, and get better with rest. Shortness of breath may also occur and sometimes no symptoms are present. The first sign is occasionally a heart attack. Other complications include heart failure or an irregular heartbeat.

Risk factors include: high blood pressure, smoking, diabetes, lack of exercise, obesity, high blood cholesterol, poor diet, and excessive alcohol, among others. Other risks include depression.

Prevention is by eating a healthy diet, regular exercise, maintaining a healthy weight and not smoking. Sometimes medication for diabetes, high cholesterol, or high blood pressure are also used.

Signs And Symptoms

Chest pain that occurs regularly with activity, after eating, or at other predictable times is termed stable angina and is associated with narrowings of the arteries of the heart. Angina that changes in intensity, character or frequency is termed unstable. Unstable angina may precede myocardial infarction. In adults who go to the emergency department with an unclear cause of pain, about 30% have pain due to coronary artery disease.

Risk Factors

Coronary artery disease has a number of well determined risk factors. The most common risk factors include smoking, family history, hypertension, obesity, diabetes, lack of exercise, stress, and high blood lipids.

A stroke is when poor blood flow to the brain results in cell death. There are two main types of stroke: ischemic, due to lack of blood flow, and hemorrhagic, due to bleeding.

Cancer is a group of diseases involving abnormal cell growth with the potential to invade or spread to other parts of the body. Not all tumors are cancerous; benign tumors do not spread to other parts of the body. Possible signs and symptoms include a lump, abnormal bleeding, prolonged cough, unexplained weight loss and a change in bowel movements.

Diabetes mellitus type 2 (also known as type 2 diabetes) is a long term metabolic disorder that is characterized by high blood sugar, insulin resistance, and relative lack of insulin. Common symptoms include increased thirst, frequent urination, and unexplained weight loss. Symptoms may also include increased hunger, feeling tired, and sores that do not heal.

Wheat is probably the most common cereal available all over the world and is in even higher demand in recent years due to its abundant health benefits. Over the years, it has shown itself to be one of the most successful and sustainable cereals crops in the world. It originated in southwestern Asia, but today it is grown in countless countries. Commonly, wheat cultivation is done at higher latitudes and is primarily used for foods like bread, pasta, crackers, bagels, cakes, and muffins are just a few common examples of wheat sources. Wheat is believed to be one of the most wholesome food items, and it ensures a diet rich in nutrients. Research has already proven that wheat is extremely beneficial for healthy living. It considerably lowers the hazards of heart diseases, owning to its comparatively low fat content. It also regulates blood glucose levels in diabetic patients. Wheat is able to provide you with an immense energy source due in all parts of the grain kernel, including the bran, germ, and endosperm. The nutrient value of wheat is retained even after processing it into flour. However, if you wish to get the maximum benefit out of wheat products, it's advisable to choose those products that are made from whole-wheat flour rather than the refined varieties.

Wheat Varieties

The health benefits of wheat greatly depends on the form in which you consume it. While whole wheat is extremely nutritious, the benefits of wheat are reduced if you eat bleached white flour which is obtained by processing after only 60% extraction from the grain. In the United States, most wheat products undergo 60% extraction; you see this in noodles, breads, and pasta, as well as in baked goods like rolls, biscuits, and cookies. In these foods 40% of the original wheat grain was removed, and you get only the remaining 60%. Usually the 40% that is removed - the outer brown layer - contains the highly nutritious bran and the germ of the wheat grain. In the process of making 60% abstraction flour, more than half of the vitamin B1,vitamin B2,vitamin B3,vitamin E, calcium, phosphorus, folic acid, copper, zinc, iron, and fiber are lost. If you buy 100% whole wheat products, you are assured of all the nutrients of the bran and the germ, as well as the endosperm. In recent years, the nutritional value of whole wheat is being recognized by consumers. Low-carb diets and an increase in the whole wheat cereal market are prevalent around the world, especially in the Mediterranean. Just like in whole wheat, wheat germ is a rich source of nutrients. Wheat germ has an abundance of vitamins and minerals, but it is particularly rich in vitamin E. Wheat germ is known to be a main source of the vitamin B complex in dietary structures throughout the world, and includes vitamins like thiamin, folic acid, vitamin B6 and minerals like manganese, magnesium, and zinc. The wheat germ oil improves strength and increases life span.

Nutritional Value Of Wheat

Wheat is rich in catalytic elements, mineral salts, calcium, magnesium, potassium, sulfur, chlorine, arsenic, silicon, manganese, zinc, iodide, copper, vitamin B, and vitamin E. This wealth of nutrients is why it is often used as a cultural base or foundation of nourishment. Issues like anemia, mineral deficiencies, gallstones, breast cancer, chronic inflammation, obesity, asthenia, tuberculosis, pregnancy problems and breastfeeding problems are quickly improved by consuming whole wheat. It is also recommended to treat sterility. Since germinated wheat comprises 2 or 3 times more vitamin B than the common kind; the seeds are used for useful for

treating gastrointestinal conditions, skin diseases, respiratory illnesses, and cardiovascular ailments. It is also known to help balance cholesterol levels and protect the heart.

Nutrition

In 100 grams, wheat provides 327 calories and is a rich source (20% or more of the Daily Value, DV) of multiple essential nutrients, such as protein, dietary fiber, manganese, phosphorus and niacin (table). Several B vitamins and other dietary minerals are in significant content. Wheat is 13% water, 71% carbohydrates, and 1.5% fat. Its 13% protein content is comprised mostly of gluten as 75-80% of total wheat protein, which upon digestion, contributes amino acids for human nutrition.

Health Effects

Consumed worldwide by billions of people, wheat is a significant food for human nutrition, particularly in the least developed countries where wheat products are primary foods. When eaten as the whole grain, wheat is a healthy food source of multiple nutrients and dietary fiber recommended for children and adults in several daily servings amounting to about one third of total food intake. As a common component of breakfast cereals, whole wheat is associated with improved micronutrient intake and lower risk of several diseases. Its effects on gastrointestinal health, risk of obesity and cognition need further evaluation. By supplying high dietary fiber content, whole wheat in the diet contributes toward lowering the risk of multiple diseases, including coronary heart disease, stroke, cancer and type 2 diabetes, with lower all-cause mortality. Manufacturers of foods containing wheat as a whole grain in specified amounts are allowed a health claim for marketing purposes in the United States, stating: "low fat diets rich in fiber-containing grain products, fruits, and vegetables may reduce the risk of some types of cancer, a disease associated with many factors" and "diets low in saturated fat and cholesterol and rich in fruits, vegetables, and grain products that contain some types of dietary fiber, particularly soluble fiber, may reduce the risk of heart disease, a disease associated with many factors". Dietary fiber may also help people feel full and therefore help with a healthy weight. Further, wheat is a major source for natural and biofortified nutrient supplementation, including dietary fiber, protein and dietary minerals.

The Problem With Wheat and Inflammation

What is wrong with wheat? What if you stick to the whole-grain products? It doesn't matter. The wheat grain itself, whether organic, whole grain, whole meal, or white, pretty much all has the same effect on the body. The bottom line: wheat is highly inflammatory. And since the average person is also consuming dairy and sugar on top of wheat, our diets on the whole are highly inflammatory, which is why so many people suffer unnecessarily from disorders such as irritable bowel syndrome, eczema, asthma, arthritis, and allergies to name a few.

The Problem With Wheat

Einkorn is an ancient grain that is healthier, but harder to harvest. In addition to all this, the modern milling methods used to commercially produce white flour eliminate the portions of the wheat kernel (bran, germ, and shorts) that are richest in proteins, vitamins, fats, and minerals. This results in the grain itself being nutritionally deficient and so far removed from its original form that our bodies basically view it as a foreign substance. It is seen by our bodies as an irritant with little nutritional value. Example, It seems so normal to eat eggs on toast for breakfast or a sandwich for lunch. A muffin or some pretzels dipped in salsa for a snack and pasta for dinner to refuel after a heavy workout. Of course, the muffin is low fat and the toast is whole grain. It only makes sense to eat healthy when you are working out and trying to maintain a good lifestyle, right? What most people don't realize is that this diet, which is typical for most Westerners, is slowly killing them, and that is no exaggeration. These foods I mentioned all have one thing in common - they are derived from wheat.

The Problem With Wheat and Inflammation

What is wrong with wheat? What if you stick to the whole-grain products? It doesn't matter. The wheat grain itself, whether organic, whole grain, whole meal, or white, pretty much all has the same effect on the body. The bottom line: wheat is highly inflammatory. And since the average person is also consuming dairy and sugar on top of wheat, our diets on the whole are highly inflammatory, which is why so many people suffer unnecessarily from disorders such as irritable bowel syndrome, eczema, asthma, arthritis, and allergies to name a few.

Why Wheat Is So Bad for Us

The modern wheat grain we consume today is the product of thousands of years of breeding and modification to create a grain more resistant to disease, heat, and drought. In fact, the difference between the ancient wheat grain and the modern grain can be clearly seen - the original wheat plant is much shorter and the kernels are much harder to pick off. These changes came about because the longer grain with kernels that were able to be separated through threshing was much easier to harvest. Breeding wheat so it became easier to harvest,

more resistant, and lasted longer in storage was great for our survival, especially when resources were scarce, but these "improvements" were not necessarily better for our health. In fact, modern wheat actually contains more gluten than its older form, and research in the Scandinavian Journal of Gastroenterology demonstrated that the ancient grain einkorn, known as the oldest variety of wheat, does not have the same negative effects on intestinal cells that modern wheat does.

Wheat and Our Immune System

Our immune system protects our bodies from potentially harmful substances by recognizing and responding to foreign bodies such as viruses, fungi, or bacteria. Our immune system is also ready to invade or kill non-living substances such as toxins, chemicals, drugs, and foreign particles. It does this by moving into an area and flooding it with little immune system soldiers ready to do battle - to us on the outside this shows up as inflammation. Unfortunately, the modern wheat grain triggers the same inflammatory response in our bodies. What most people experience, without necessarily realizing it, is a mild chronic form of inflammation that typically manifests as gluten intolerance, leaky gut, bloating, gas, lethargy, chronic infection, and allergies. This state of chronic low inflammation is often compounded if the wheat product we have ingested is packed with other inflammation-provoking nasties such as preservatives, partially hydrogenated vegetable oils, and artificial colors.

- Heart attack
- Cancer
- Obesity
- Insulin Resistance
- Asthma
- Gout
- Arthritis
- Celiac Disease
- Lupus
- Depression
- ADHD
- Alzheimer's Disease
- Depression and Postpartum Depression
- Eczema
- Inflammatory Bowel Syndrome
- Diabetes

If you suffer from any of these illnesses, try eliminating wheat from your diet and see how you feel.

Gluten, one of the most heavily consumed proteins on earth, is created when two molecules, glutenin and gliadin, come into contact and form a bond. When bakers knead dough, that bond creates an elastic membrane, which is what gives bread its chewy texture and permits pizza chefs to toss and twirl the dough into the air. Gluten also traps carbon dioxide, which, as it ferments, adds volume to the loaf.

Health Benefits Of Wheat

- Controls Obesity (especially in women): Wheat has a natural ability to control weight in everyone, but this ability is more pronounced among women. The American Journal of Clinical Nutrition has shown through research that whole wheat, rather than refined form, is a good choice for obese patients. Women who consumed whole wheat products over long periods showed considerably more weight loss than the others subjects.
- Improves body metabolism: Saturated and trans fats increase the chances of cardiovascular diseases, while omega-3 fats decrease cardiovascular disease risk. Whole grains like wheat are immensely effective on patients with metabolic disorders. Common types of metabolic syndromes include visceral obesity, also known as the "pear shaped" body, high triglycerides, low levels of protective HDL cholesterol, and high blood pressure. It protects against all of these conditions. Research has shown that foods made from refined grains not only tend to increase weight but they also increase the hazards of insulin resistance. Doctors recommend eating whole wheat bread and other fiber-rich foods. The majority of fiber works to help the digestive process in the body and improve the overall metabolism. Having a whole wheat diet is probably the most effective, quick, and enjoyable way to reduce metabolic syndrome, but also to stay slim and healthy throughout your life.
- Prevents Type 2 Diabetes: Wheat is rich in magnesium, which is a mineral that acts as a co-factor for more than 300 enzymes. These enzymes are involved in the body's functional use of insulin and glucose secretion. The FDA permits foods that contain whole grain by at least 51% weight and are also low in saturated fat and cholesterol, which means a lower risk of coronary ailments and certain types of cancer. Moreover, regular consumption of whole grain wheat promotes healthy blood sugar control. People who suffer from diabetes are able to keep their sugar levels under control by replacing rice with wheat in their diet.

- Reduces Chronic Inflammation: The betaine content of wheat is what aids in the prevention of chronic inflammation. Betaine is usually found in whole wheat, beets and spinach. Inflammation is a key constituent in most types of rheumatic pains and also some rheumatic diseases. Thus, it is a good idea to eat a healthy amount of whole wheat food products that will actively reduce inflammation. Consumption of betaine affects a number of aspects in our body chemistry that assures a lower risk of chronic inflammation and other ailments like osteoporosis, heart disease, Alzheimer's disease, cognitive decline, and type-2 diabetes.
- Prevents Gallstones: In various surveys by the American Journal of Gastroenterology, it has been proven that breads and cereals made from whole wheat help women to avoid gallstones. Since whole wheat is rich in insoluble fiber, it assures a quick and smooth intestinal transit time and lowers the secretion of bile acids. Excessive bile acids are a major cause of gallstone formation. Moreover, a high intake of wheat increases insulin sensitivity and thereby lowers triglycerides or fat in the blood. Besides wheat, you also get insoluble fiber from the edible skins of fruits and certain vegetables like cucumbers, tomatoes and squash, berries, apples, and pears. Beans also provide both insoluble and soluble fiber.
- Whole Grain Wheat Assures a Healthy Lifestyle: Wheat is the most popular and easily available bulk laxative. Three cups of wheat consumption per day is enough for an individual to live a long, healthy and disease-free life. When you maintain a fiber-rich diet comprised of wheat breads and cereals that are high in bran, you can be confident that problems such as pain, flatulence, nausea, constipation, and distension will be alleviated in no time. Diverticulitis often occurs due to inflammation and lower intestinal pains. This can also lead to chronic constipation and unnecessary straining, which can result in a sac or a pouch in the wall of the colon. Such cases can be easily dealt with naturally by keeping up with a fiber-rich diet and including whole grain wheat on a regular basis.
- Promotes Women's Gastrointestinal Health: Benefits of wheat bran are bountiful, and promoting overall women's health is yet another important role of this cereal variety. Wheat acts as an anti-carcinogenic agent, particularly in women. Wheat bran enhances the metabolic rate of estrogen, which often leads to breast cancer if left at an excessive level. In one survey of pre-menopausal women in the age group of twenty to fifty, they ate three to four high-fiber muffins per day made from wheat, and they showed reduced blood estrogen levels by 17% in only 2 months. The other group of women eating corn bran did not show this result. Wheat contains contain lignans, which are phytonutrients acting as hormone-like substances. The lignans often occupy the hormone receptors of our body, thereby alleviating certain risk factors for breast cancer. This effectively checks the high circulating levels of estrogen. Wheat increases the metabolic rate of estrogen production and protects women against this key factor of cancer. Wheat bran considerably reduces bile acid secretion and bacterial enzymes in the stool, thereby cutting down chances of colon cancer. If you include bread, pasta, and bran cereals in your daily diet, these ailments will be avoided.
- Protective Against Breast Cancer: Research at the UK Women's Cohort Study found that a fiber-rich diet is extremely important for women to keep breast cancer at bay. Foods from whole grains like wheat and fruits provide significant safeguards for pre-menopausal women against breast cancer. Studies say that around 30 grams of wheat consumed daily is enough for women to reduce the risks of breast cancer. Reports say that pre-menopausal women who have consumed wheat had a 41% reduced risk of breast cancer in comparison to others who ate other forms of fiber.
- Prevents Childhood Asthma: The American Lung Association says that around 20 million Americans experience some form of asthma. Studies have stated that whole grains and fish in the diet can lower the chances of childhood asthma to a great extent. The International Study on Allergy and Asthma in Childhood proved through numerous studies that a wheat-based diet has the capacity to lower chances of developing asthma by almost 50%. During the survey, the wheat diet was increased considerably and the mothers were given special diets high in fish and whole grains; this showed an almost 66% reduction in the possibility of becoming asthmatic. Bronchial hyper-responsiveness is the key factor that encourages asthma. This condition is characterized by the narrowing of the airways and increased sensitivity. In many surveys, it has been seen that children who eat wheat and fish in high amounts do not suffer from such ailments. The magnesium and vitamin E provided by wheat also contributes in reducing the problem of asthma. However, in some cases, wheat consumption may be harmful for asthma patients, since wheat also happens to be a food allergen closely linked with asthma. Consult a doctor who can give you a complete examination and diagnosis of possible allergies you may have.
- Protects Against Coronary Diseases: Plant lignans, a type of phytonutrient, is abundant in whole wheat. These lignans are converted by responsive flora in the human intestines into mammalian lignans. One of these lignans is called enterolactone, which protects against breast and other hormone-dependent cancers, as well as heart disease. Wheat is not the only source of lignans; nuts, seeds and berries are also rich sources of plant lignans, as well as various other vegetables, fruits, and beverages like coffee, tea and wine. A Danish journal published in a recent article that women eating the most whole grains were found to have considerably higher blood levels of this defensive lignan.

- Improves Cardiovascular System in Postmenopausal Women: Whole wheat is supposed to be a primary element in the diet of a post-menopausal woman so as to avoid any kind of cardiovascular problems. Daily intake of this whole grain cereal is the best way to avoid such ailments. Doctors prescribe a high wheat intake diet for women who are dealing with conditions like high blood pressure, high cholesterol, or other signs of cardiovascular syndromes. A survey has concluded that this kind of diet slows down the progression of atherosclerosis, which is the building of plaque in the arteries and blood vessels, as well as reducing the frequency of heart attacks and strokes.
- Prevents Heart Attack: In the United States, heart failure is the prime cause of hospitalization and death of elderly people. The medicinal drugs have been successful in certain cases, but natural remedies work much faster and with less of an impact on the rest of the body's systems. Hospitals use ACE inhibitors and beta-blockers, but the long-term effects are not yet clear. Whole grain products and dietary fiber have been shown to considerably reduce blood pressure levels, thereby checking the possibility of a heart attack. Of course, confounding factors like age, alcohol consumption, smoking, exercise and proper nutrition are equally important. Ample vitamins, vegetables and fruits are extremely important in such cases as well. The start of your day can be both healthy and tasty with a daily bowl of whole grain cereal. There are various other forms in which you can serve wheat like bread, puddings and a variety of baked goods.

The health benefits of wheat are no longer unknown, and people all over the world have experienced them by including wheat in their daily diet. This "health food" reputation is due to the important B vitamins, such as thiamin, folate, and vitamin B6, and the minerals magnesium, zinc, and manganese content. Wheat can be easily integrated into cakes, burritos, brownies, waffles, bread, muffins, patties and pancakes or simply sprinkled over your favorite cereal or yogurt.

Caution

There are some limitations to wheat consumption as well. If you are susceptible to allergic reactions, whole wheat consumption can enhance your allergies, such as hives, itching, skin rash, and eczema. Thus, it is advised to check with your physician to be sure that you are not allergic. Whole wheat contains oxalates, which are the naturally-occurring substances in animals, plants, and human beings. However, too much oxalate in bodily fluids can lead to crystallization, thereby causing health problems like gallstones, kidney stones, and gout.

Wheat Whole Grain

The seeds of whole grains have three distinctive components called the endosperm, germ and bran. When these are intact, whole grains offer you higher nutrient value. Foods that derive from whole grains, such as pasta, have this same effect, while refined grains do not. The refining process takes away part of the bran, germ or endosperm, which devalues the nutrient content. If you are on the fence whether to switch to whole-grain pasta or not, let its multiple benefits make your decision for you.

Lasting Energy

Carbohydrates are known as macronutrients, which the body needs in high amounts. They function to give you energy and support the brain and nervous system. Simple carbs occur naturally in milk, milk derivatives and fruits, but they are also prominent in cakes, cookies, candy, sweet drinks and sugary cereals. When consumed, simple carbs give you a fast spike of energy, but it wears off quickly. White pasta is technically a complex carb, but it is refined and starchy. This makes it act like a simple carb in the body. Consistent intake of simple carbs can promote weight gain and hinder weight loss efforts. Complex carbs, on the other hand, are digested at a slow pace and give you lasting energy levels. Whole-grain pasta is a good source of complex carbs. The recommended daily intake of carbs is 130 grams. A 2-ounce serving of whole-grain angel hair pasta has 41 grams of carbs.

Improved Digestive Health

Fiber is a nondigestible form of carbohydrate that brings numerous benefits to the body. It comes in the form of soluble or insoluble. Insoluble fiber is the type found in whole grains and derivatives like pasta. This type creates softer stool that is easier to pass through the digestive system, which, in turn, prevents constipation and reduces the risk of developing intestinal conditions like diverticulosis. Diverticulosis is a painful condition where small pouches on the intestinal wall become inflamed. Whole-grain pasta generally has at least 5 grams of fiber per serving. In contrast, regular pasta generally has 2 grams or less. The recommended amount of fiber per day is 30 to 38 grams for men and 21 to 25 grams for women. Oat bran is a form of soluble fiber, which helps reduce cholesterol and stabilizes blood sugar levels. Look for oat bran pasta in your local grocery store to reap these benefits as well.

Muscle Recovery and Tissue Repair

Protein is another macronutrient that has different responsibilities in the body than carbs. It helps repair cells and tissue, rebuilds muscle and strengthens hair, nails and skin. The recommended amount of protein per day is 46 grams for women and 56 grams for men. Whole-grain pasta has a moderate amount of protein, and a higher amount than regular pasta. Two ounces of penne for example, contains 6 grams. Regular pasta generally has half this amount or less.

Improved Functional Capacity

Iron is important for oxygen transportation to the muscles and rest of the body. This, in turn, gives you the ability to do daily functions optimally. Iron also helps with immune function and neurotransmitter production in the brain. Meats and fish tend to have a high amount of this mineral, but whole grains have moderate amounts as well. Whole-grain spaghetti has 8 percent of the recommended daily value in 2 ounces. Have your pasta with turkey or lean beef meatballs to add more iron to your meal. Spinach also has a moderate amount of iron, and would pair well as a side salad with your meal.

Stronger Bones and Immunity

Whole-grain pasta contains generous amounts of phosphorus, manganese, magnesium and selenium, while refined pasta has only negligible amounts. Each one of these minerals has a specific function in the system. Phosphorus, which is stored in the bones, helps with energy production, reduces muscle soreness from intense workouts and aids cell and tissue repair. Manganese helps with sex hormone production, blood clotting and it also contributes to strong connective tissue. Magnesium is essential for heart rhythm, strong bones, nerve function and blood sugar regulation. Selenium is an antioxidant that boosts immunity and promotes thyroid function.

Whole Grain / Refined Grain

Regular pasta is made from refined flours, such as wheat flour. The milling process involves stripping the grain of its bran and germ, which gives the flour a finer texture, but also alters the nutritional content of the grain, according to MayoClinic.com. Whole-grain pasta is made from flour as well, but the grain is not as highly processed. Most of the bran and germ are retained in whole-grain pasta, giving it a hearty flavor and texture. The best way to identify a whole-grain pasta is to read the nutrition label. The first item in the ingredient list of a whole-grain pasta will say "whole-wheat flour." You can also get whole-grain pasta made from grains such as brown rice and quinoa. If you have thought about trying whole-grain pasta instead of regular pasta, it's time to make the switch. The texture of whole-grain pasta isn't as soft as regular pasta, but whole-grain pasta provides more vitamins, minerals and fiber per serving than regular pasta. You'll also get fewer calories per serving from whole-grain pasta.

Refined Grain Pasta

Removing a grain's bran layer and oil-rich germ gives traditional pasta an indefinite shelf life, a quick cooking time, a familiar texture and a mild, versatile flavor. Depending on the type, however, 50 to 90 percent of a grain's nutrients and phytonutrients are removed during processing. To address this substantial loss of nutrients, the United States government requires refined flour to be enriched with specific vitamins and minerals, including iron and the B vitamins folic acid, thiamine, riboflavin and niacin. As a result, enriched pasta made from refined flour is generally higher in B vitamins and iron than pasta made from whole-grain flour. Traditional pasta is not a good source of dietary fiber, however, unless fiber is added during processing.

Whole-Grain Pasta

Whole-grain pasta is still an excellent source of B vitamins and iron, and provides significantly higher levels of the essential trace mineral selenium a nutrient with antioxidant properties. Whole-wheat pasta also contains appreciable levels of alpha-linolenic acid, a compound that converts to beneficial omega-3 fatty acids in the body. The most common whole-grain pastas are made from whole wheat, brown rice or buckwheat, but quinoa, spelt, farro and kamut are also routinely used to make whole-grain pasta. Not all whole-grain pasta is made from 100 percent whole-grain flour, however. Some are made from a mixture of whole-grain flour and ground legumes and flax, ingredients that improve a product's texture while boosting its protein and omega-3 fatty acid content.

Fiber Content

Whole-grain pasta contains the bran and germ of the grain, which contribute dietary fiber. You'll get 6.3 grams of fiber from a serving of whole-wheat spaghetti and only 2.5 grams of fiber from regular pasta, according to the U.S. Department of Agriculture. Dietary fiber is indigestible so it adds bulk to your meal, which helps you feel satisfied after eating and helps regulate your digestive system. According to MayoClinic.com, dietary fiber may also aid in lowering your cholesterol and regulating your blood sugar.

Calorie Content

Because whole-grain pasta has more indigestible fiber, it's lower in calories. One cup of regular spaghetti provides 221 calories, while 1 cup of whole-grain spaghetti provides only 174 calories, according to the USDA. That's a savings of 47 calories per cup when eating whole-grain pasta. If you're trying to lose or maintain your weight, these little calorie differences help you meet your daily calorie goals.

Vitamin and Mineral Content

Some nutrients are lost when grains are milled to make regular pasta. Eating whole-grain pasta gives you more of the minerals potassium, magnesium and phosphorus. You'll also get more of the B vitamins thiamin, riboflavin, niacin, pantothenic acid and B-6 from whole-grain pasta than regular pasta. These B vitamins are essential for converting food you eat into usable energy, for regulating enzymes and chemicals in your body and for keeping red blood cells healthy.

Why You Should Give Up Wheat

A growing number of people are switching to wheat free diets for good reasons. Wheat is used for a wide range of products which include biscuits, bread, cakes, pastas, bagels, cereals , semolina etc. It can actually be nutritious when grown and prepared in the appropriate manner. Unfortunately, modern farming techniques have reduced the quality of wheat we get these days. When grown in well- nourished fertile soil, whole wheat is rich in many vitamins . Modern farming practices use high-tech methods to control pests and diseases, leading to overdependence on chemicals. Modern wheat is loaded with amylopectin which is worse than table sugar. Even before they are planted in the ground, wheat seeds receive an application of fungicides and pesticides. Rather than focus on soil fertility and careful selection of seeds, chemicals are introduced for greater yield. The following reasons will make you have a rethink before buying wheat flour or wheat products. The chemicals used to grow wheat for commercial purposes contribute to the toxic load in the human body, thereby increasing their susceptibility to neurotoxic diseases like cancer. Many of the pesticides used function as xenoestrogens that can mess up our hormone balance and lead to abnormalities like breast cancer, endometriosis etc. After harvesting the wheat, chemicals are again used for the storage process to protect the grains from moths and other insects. A threshold test is also done and if there is one insect per quarter of sample, fumigation will be done. The fumigation entails maintaining a toxic concentration of gas long enough to kill the pests. The heat processing of the grain destroys the bulk of vitamin E and other vital nutrients. The presence of gluten in wheat is a growing concern. A lot of people do not have the enzymes to break it down and the effects vary from person to person. This leads to Celiac disease for those with strong sensitivity to gluten. The glycemic index of wheat is very high. Wheat spikes up blood sugar and insulin and promotes growth of visceral fat around the internal organs and stomach. Wheat has been shown to advance aging and causing wrinkles. Culled from ‘rodale wellness' It could cause frail bones . Grains are the only plant foods that generate acid by-products. The body starts pulling calcium from the bones to maintain a healthy ph when it is chronically acidic.

Today's wheat is a far cry from what it was 50 years ago. Due to cross- breeding (hybridization), certain compounds that are not human friendly have been introduced to wheat. An example is sodium azide which is a toxin.

Wheat Is An Addictive Appetite Stimulant.

The solution is buying whole wheat berries that are grown organically and grinding them to make homemade flour for breads and other uses. Another solution is to buy organic 100% ground whole wheat at natural food stores. Since obtaining organic wheat may be difficult in Nigeria, other options to wheat flour should be explored. These include plantain flour, millet flour, milled brown rice, sweet potato flour, sorghum etc.

Legumes in human nutrition.

According to National Academy of Science (NAS) (1997), a legume is a simple dry fruit that develops from simple carpel and usually opens along a seam on two sides. Grain legumes are plants belonging to the legume family with papilionaceous flowers and pods containing seeds. Most legumes do not need industrial fertilizers this is because of their natural symbiosis with Rhizobium which provides them with organic proteins made directly from atmospheric nitrogen (NAS, 1997). Grain legumes are cultivated primarily for their seeds which are rich in energy and protein. Legumes are seeds that grow in pods; they are high in fibre, low in fat and a good source of protein. Beans, lentils, peas, soybeans, and peanuts are all examples of some major common legumes. Lesser known legumes are African yam beans, baobab among others (Obiakor & Nwanekezi, 2008). A legume is a simple dry fruit that develops from a simple carpel and usually opens on two sides. The seeds are hard and dried and cannot be eaten unless prepared in the kitchen. For quite some time, legumes were considered a rather lowly food; their food is increasing with recent discoveries concerning their many nutritional and health properties (Pamplona-Roger, 2006). Crosby (2009) stated that the plants show great diversity in both vegetative and floral

form; woody, perennial species predominate, but numerous herbaceous forms and even a few aquatics also occur. The fruit is the feature by which the family is best characterized. Technically known as a legume, it is a single-chambered, flattened seedpod with two sutures. It usually splits open along the two sutures, as in the common pea. The seeds are attached along one of the sutures. The legume may be indehiscent (not splitting), as in the peanut, which matures underground; or explosively dehiscent, as in broom or lupine. It also may range from only a few millimeters long to more than 30 cm (more than 12 in) and may be single or many seeded and brightly or dully colored.17According to Crosby (2009) the family of legume is divided into three closely related subfamilies, which are often treated as three separate families. One subfamily is mostly herbaceous and is characterized by simple leaves and highly irregular flowers with ten stamens in two clusters. About 12,000 species exist, including such plants as peas, beans, peanuts, and soybeans; clover and alfalfa; and sweet pea, broom, and lupine. The second subfamily contains mostly trees and shrubs and is characterized by bipinnately compound (doubly branching) leaves and regular (radially symmetrical) flowers with ten or more stamens extending beyond the petals. This subfamily contains about 3,000 species and includes acacias and mimosas. The third subfamily is also mostly woody, but with leaves pinnately compound, and slightly too highly irregular flowers with ten stamens in one cluster. This subfamily contains about 3,000 species and includes such plants as brazil wood, carob, honey locust, Judas tree, logwood, and tamar (Crosby, 2009).

2.2.1 Functional properties of legumes.

Legumes contains large group of non nutritive compounds known as photochemical that are biologically active in the body, and they act as antioxidants, these photochemical were earlier thought to be harmful to the body, but, with the recent research research, they were discovered to have healing and protective properties. This phytochemicals fall in the class of phenolic acids, saponins, isoflavones, phytates among others (Gropper, Smith, & Groff, 2005). Legumes are low in fat and carbohydrate and high in protein, they can be used as substitute for animal protein, they are equally rich in magnesium, iron, copper and folic acid. Vitamins such as B1 B2 B6 niacin, folates have been associated with legumes; the iron in legumes is two to three times more than that found in meat though not absorbed readily, and vitamin C from other foods in the meals of legumes increases the absorption to levels similar to heme iron in meat (Pamplona-Roger, 2006; Gropper, Smith, & Groff, 2005). Pamplona-Roger (2006) reported that 15% to 30% of legumes' dry weight is fibre and this amount is superior to whole grains. It has been documented that they contain 2-3 times the 17protein of cereal grains and no other plant food is as rich in protein as legumes in their natural state (National academy of Science, 1997, Pamplona-Roger, 2006).

2.2.2 Bean as a legume.

According to Microsoft Encarta (2009) most bean belong to the subfamily Papilionoideae of the family Fabaceae and bean is common name widely applied to many plants of the legume family. The seeds and pods of these plants are used for food and forage.The seeds themselves are also called beans and are valuable as food because of their high protein content. The term bean is also applied to plants of other families, such as the Indian bean, which is a North American species, and the sacred bean, or Indian lotus. The seeds or fruits of certain other plants, such as the coffee tree and the castor-oil plant are also called beans.

Origin Of African Yam Bean

The African yam bean originated in Ethiopia. Both wild and cultivated types now occur in tropical Africa as far as Zimbabwe, throughout West Africa from Guinea to Southern Nigeria, being especially common in the latter and in Togo and Ivory coast, and in East Africa from northern Ethiopia (Eritrea) to Mozambique, including Tanzania and Zanzibar The centre of diversity of African yam bean is only in Africa. Nigeria has the highest production of African yam bean. (Potters, 1992; Abbey and Berezi; 1988).

2.3.1 African yam bean (AYB) (Sphenostylis stenocarpa)

African yam bean is known and called different names by different tribes in Nigeria, some of the names are Azama, Ijiriji, Azam, and Uzaaki in Igbo; Girigiri in Hausa; Akpaka in Delta and Nsama in Ibibio. Other names are Okpodudu, Ahaja, Nzamiri, Odudu and Sese.in Igala. In some parts of Ghana, it is called Kulege or Kutreku. AYB belong to the family: Fabaceae (alt. Leguminosae) subfamily: Faboideae tribe: Phaseoleae subtribe: Phaseolinae., also placed in: Papilionaceae. It is also called yam pea in English and it is usually cultivated in the following African regions Northeast Tropical Africa: Chad; Ethiopia East Tropical Africa: Kenya; Tanzania; Uganda, West-Central Tropical Africa: Burundi; Central Africa Republic; Zaire West Tropical Africa: Cote D'Ivoire; Ghana; Guinea; Mali; Niger; Nigeria; TogoSouth Tropical Africa: Angola; Malawi; Zambia; Zimbabwe (USDA, 2007).AYB is grown both for its edible seeds and its tubers (Klu et al., 2001). The seeds are mostly used in some regions. It is a vigorous vine which twines and climbs to heights of about 3m and requires staking, with its prolific spattering of large flowers which may be pink, purple, or greenish with white, making it an attractive ornamental (NAS, 1979). The slightly woody pod which contains 20 to 30 seeds is up to 30cm long and mature within 170 days (Klu et al., 2001). The seeds of AYB vary in sizes and shapes. The seed coat has a range of colours from pale white to black with spotted or mottled grey, cream and brown in between. In Nigeria, it is grown

mostly in the northern part where it is grown mainly for its seed (Alozie, et al., 2009).18According to Eneche (2006), African yam bean though deficient in methionine and cystine, has a high protein content of 21.6% and high in lysine. AYB can also be utilized as complementary protein in our carbohydrate based foods to enhance their demand and improve their quality. Incorporation of AYB flour into wheat based products greatly reduces the cost of 18importation of wheat and increases the utilization of this lesser known legume as well as the protein content of our carbohydrate wheat-based foods.18

Proximate analysis of AYB according to Onyechi, et al., (2008) showed that it contains 21.2g of protein, 1.9g fat, 3.5g ash, and 6.05g dietary fibre, 46.0g of sugars and 52.1g of total carbohydrates. Obiakor (2008), stated that AYB has a high lysine content, the crude protein vary from 21-29% of which lysine comprises of up to 8% of the protein, 50% of carbohydrates and 5-6% of fibre. Evans and Bouttler (1974) stated that amino acid of AYB analysis indicate that the lysine content is equal to or higher than that of soybean while most of the other essential amino acids corresponds to the WHO/FAO recommendation.The raw seeds contain on the average 21.29% crude protein, with mean cystine value of 1.28 implicating it as the limiting amino acid in AYB, however, the other essential amino acids were present in higher concentrations when compared to other legumes (Uguru et al., 2001).18

Economic importance/ uses of AYB

It was reproted that storage roots of AYB can be processed into 'yam bean gari.' This is similar to the current staple of West Africa, 'cassava gari,' granular flour. The bean could make a significant contribution to the improvement of food support, especially where resources arepoor (The American Society of Agronomy, (ASA) (2007). In Ghana, the water drained after boiling may be drunk by lactating mothers to increase their milk production (Klu, Amoatey, Bansa and Kumaga, 2001). AYB seed can be used as ornaments for decoration (USDA, 2007).

Constraints in the use of AYB

AYB is one of the lesser-known legumes and has the peculiar problem associated with legumes, It has high antinutrient content and hard to cook (HTC) phenomenon. It has beany flavour which hinders its extensive utilization, coupled with the increase in the cost of domestic fuel. African yam bean belong to the family of legumes. Legumes generally contain anti nutritional factors and toxic compounds like trypsin inhibitor, tannins, phytates, hemaglutinin and oligosaccharides. These inhibit the bioavailability of nutrients. AYB is also reported to be associated with flatulence caused by flatulence inducing oligosaccharides (Nnam, 1999., Ene-Obong & Obizoba, 1995).

Nutritional Quality Of African Yam Bean

The nutrition quality of the grains and tubers of African yam bean are immense. The African yam bean (Sphenostylis Stenocarpa) provides two consumable products. The tuber which grows as the root source and actual yam bean which develop in pods above ground. The protein in both tuber and seed is comparatively higher than what could be obtained in most tuberous legumes and tubers. The protein in the tuber of African yam bean is more than twice that in sweet potato (Ipomeas batatas) or irish (Solanum tuberozsum) potatoes. National Research Conucil (NRC, 1979) and very much higher than those of yam and cassava (Amoatery et al, 2006). The proportion of the essential amino acids in the protein of African yam bean is over 32% wit lysine and Leucine being predominant (Onyenekwe et al, 2000). Crude protein content is up to 19% in the tuber. The crude protein in African yam bean seed is lower than in soybean. However, the amino acids spectrum indicates that most of the essential amino acids especially Lysine and methionine levels in African yam bean are higher than those in other legumes including soybean (NRC, 1979), Evans and Haismer, 1979, Abbey and Berezi, 1988, Ihekoronye and Ngoddy 1985; Kay, 1987. As reported by Ekpo 2006 the amino acids profile in African yam bean compares favourably with the whole chicken's egg and meets the daily requirements prescribed by Food and Agriculture Organisation (FAO) and World Health Organisation (WHO). "The protein concentrations are used in fortification of starchy food like Maize, Cassava and Akamu flour (Eneche 2005)".

Processing Of African Yam Bean

Many food researchers (Njoku et al; 1989; Wokoma and Aziagba, 2000; Aminigo and Meizger, 2005) have employed various processing methods including soaking, blanching, dehulling, heating, soaking with potash etc to attain satisfactory cooking, reduces the ANF content, overcome the harden of the seen coat and improve (by shortening) the cooking time of the seeds. Maximum hydration of the seed was attained at 12 hours of soaking in water. Cooking time could be lowered with 12 hours pre-soaked treatment, moreover, a dramatic 50% reduction in cooking time with attained for seeds pre-soaked treatment with 1% potash or 4% sodium chloride (Njoku et al; 1989). Food processing techniques provides alternative means of improving the quality of foods (Agboola, 2007) and the digestibility of protein in leguminous grains (Abbey and Berezi, 1988). Long time cooking gives the

highest digestibility value in African yam bean, the thermal process destroys protease inhibitors and opens the protein structure through denaturation (Abbey and Berezi, 1988), breaks down ANF, denatures the protein/enzymes and gelatinized the starch for adequate digestibility (Agunbiade and Longe, 1999). In essence, long cooking using moist heat treatment is a way to rid African yam bean seeds from ANF (Abbey and Berezi, 1999; Aputa and Ologhobo, 1997; Agunbiade and Longe, 1999; Fasoyiro et al, 2006).

Dehulling of the seeds significantly improved the digestibility of African yam bean protein compared to whole seed (Abbey and Berezi, 1988). Roasting the bean at 160oc for 30 minutes and the pre-soaking treatment in water alkali, brine and alkali brine water solution for 24 hours (Agunbiade and Longe, 1999), followed by autoclearing was optimally effective and non-vulnerable to the protein quality of African yam bean (Nwinuka et al, 1997; Agunbiade and Longe 1999). Although the various processing techniques positively influence the physicochemical properties of African yam bean, such that the processed meal were of significant nutritional superiority over the unprocessed ones (Agunbiade and Longe, 1996), nevertheless most of the techniques significantly caused high loss in protein, calcium, phosphorus compound (e.g phytin-phosphorus) and phytic acide.

Roasting

Roasting is a traditional processing technique, it has the capacity to develop attractive flavours in foods so treated. It also induces important functional properties, attributes that should be compatible with nutritional value (Bressani, 1983).

African Yam Bean Flour

African yam bean flour can be obtained from the seed by the preparative method described by (Eneche 2006). This composite flour will reduce gluten content is limiting in sulphur containing amino acids, Methonine and Cystine and rich in lysine and tryptophan. (Ene-Obong and Corrovale, 1992). African yam bean flour are suitable for pasta, breads, cakes and biscuits incorporating the flour into wheat-based products make the foods useful protein and energy sources with good nutritive value. The supplementation of cereal-based weaning foods with adequately processed African yam bean flour would help to improve their protein content and quality. The flour of African yam bean can be fortified with other flour sample to produce a good quality bakery products, the flour gives a better colour than other samples dues to the ability of african yam bean products to retain some of the colour pigments found naturally in their seeds on exposure to heat during processing (Banigo et al., 2004).

Limitations In The Utilization Of African Yam Bean

Some negetive conditions have influenced the production and acceptability of African yam bean among cultivators, research scientists and consumers. The potential constrains include;

1. The seed contains anti-nutritional factors (ANF) or secondary metabolites (Machuka, 2009; Akinmtimi et al, 2006).
2. The agronomic demand for stakes, the long maturation period (National Research Council, 1979).
3. The characteristics hardness of the seed coat raise high demand on the cost and time of cooking (Oshodi et al, 1995 and Ene-Obony et al, 1993).

References

[1] Aacc. (2001). Approved Methods Of The Association Of Cereal Chemist (11th Ed., Method 61-02.01. Determination Of The Pasting Properties Of Rice With The Rapid Visco Analyzer). St. Paul, Mn: Author.

[2] A.O.A.C. Official Methods Of Analysis, 15th Edn. Association Of Official Analytical Chemists Washington D.C.,Usa. 1990.

[3] Abbey, B. W., And Berrzi, P. E, (1998). Influence Of Processing On The Digestibility Of African Yam Bean (Sphenostylis Stenocarpa (Hoechst Ex. A Rich) Harms) Flour. Nutritional Report International 37:819-824.

[4] Abdelghafor, R. F., Mustafa, A. I., Ibrahim, A. M. H., & Krishnan, P. G. (2010). Quality Of Bread From Composite Flour Of Sorghum And Hard White Winter Wheat. Advance Journal Of Food Science And Technology, 3, 9-15.

[5] Adebowale A.A And Sanni, S.1. (2009). Acetylated And Succinylated Derivative Of African Yam Bean Protein Isolate. Journal Of Food Technology, 2, 34-46.

[6] Adewale B.D, Dume D.J, Vroh-Bi I, Kehinde O.B, Ojo D.K, Adegbite A.E And Franco J (2012). Morphological Diversity Analysis Of African Yam Bean And Prospects For Utilization In Yermplasm Conservation And Breeding. Genetic Resources And Evolution, 59(5), 927-936.

[7] Agunbiade, S. O, And Longe O. G (1999). Essential Amino Acid Composition And Biological Quality Of African Yam Bean Sphenostylis Stenocarpa (Hoechst Ex. A. Rich) Harms 43(1):22-24.

[8] Ajibade, S. P., Omole A. J., Adeneyan, O. N., Farinde, E. O (2006). Proximate, Minerals And Anti Nutritional Factors Of Some Underutilised Grain Legumes In South-Western Nigeria. ! Nutri Food Sci, 36:18-23.

[9] Aletor, V. A. & Aladetimi, 0. 0. (1989). Compositional Eval- Uation Of Some Cowpea Varieties And Some Under-Utilized Edible Legumes In Nigeria. Die Nahrung, 33(10), 999-1007.

[10] "All About The Grains Group". Us Department Of Agriculture, Myplate. 2016. Retrieved 6 December 2016.

[11] Aminigo, E. R., Lehtola, P. S., And Metzger, L. E (2007). Nutritive Composition And Physical Characteristics Of Supplemented Limitation Milk Form African Yam Bean (Stenostylis Stenocarpa). Global Journal Of Pure And Applied Science 13:457-462.

[12] Amoatey. H Om. Klu, G. Y. P., Bansa, D., Kimaga, F. K., Aboagye, L. M., Bennett, S. O And Gamedoagbo, D. R. (2000). African Yam Bean (Sphenostylis Stenocarpa) A Neglected Crop In Ghana. West African Journal Of Applied Ecology, 1:53-60.

[13] Andrae, G., & Beckman, B. (1985). The Wheat Trap: Bread And Underdevelopment In Nigeria (P. 180, Third World Books). London: Zed Books.

[14] Apata, D.F. And Ologhobo, A.D. (1990). Some Aspects Of Biochemistry And Nutritive Value Of African Yam Bean Seeds (Sphenostylis Stenocarpa) Food Chem; 36:271-280.

[15] Asuzu, I. U., Undic A (1986). Some Observations On The Toxic Effect Of The Seed Extract Of (Sphenostylis Stenocarps (Hoechst Ex. A Rich) Harms) On Intestinal Muscles, P1 Food Hum Nutri.

[16] Aune, D; Keum, N; Giovannucci, E; Fadnes, L. T.; Boffetta, P; Greenwood, D. C.; Tonstad, S; Vatten, L. J.; Riboli, E; Norat, T (2016). "Whole Grain Consumption And Risk Of Cardiovascular Disease, Cancer, And All Cause And Cause Specific Mortality: Systematic Review And Dose-Response Meta-Analysis Of Prospective Studies". Bmj. 353: I2716. Doi:10.1136/Bmj.I2716. Pmc 4908315 Freely Accessible. Pmid 27301975.

[17] Banigo, E. J., Mepba, I. I. D., And Duru, S. N., (2004). Pasting Characteristics Of African Yam Bean (Sphenostylis Stenocarps) Starch Proceedings Of The Nigeria Institute Of Food Science And Technology. Pp.210-211.

[18] Bates, D.M. (1985). Plant Utilization: Patterns And Prospect. Economic Botany 39: 241 265.

[19] Bctsche, T, Azeke M, Buening-Pfaue E. I, Fretzdorff B., (2005). Food Safety And Security: Fermentation As A Tool To Improve The Nutritional Value Of African Yam Bean, Conference Proceedings Of The International Agricultural Research For Development October 2055, Stuttgart Hohenbeim. Pp, 1-5.

[20] Bugusu, B. A., Campanella, O., & Hamaker, B. R. (2001). Improvement Of Sorghum-Wheat Composite Dough Rheological Properties And Breadmaking Quality Through Zein Addition. Cereal Chemistry, 78, 31-35. Http://Dx.Doi.Org/10.1094/Cchem.2001.78.1.31

[21] Dendy, D. A. V. (1992). Composite Flour-Past, Present, And Future: A Review With Special Emphasis On The Place Of Composite Flour In The Semi-Arid Zones. In M. I. Gomez, L. R. House, L. W. Rooney, & D. A. V. Dendy, (Eds.), Utilization Of Sorghum And Millets, (Pp. 67-73). Patancheru: International Crops Institute For The Semi-Arid Tropics.

[22] Dendy, D. A. V. (1993, May). Review Of Composite Flour Technology In The Context Of Tanzania. A Paper Presented At The Workshop. Sorghum And Millets Marketing And Utilization (Pp. 3-5). Arusha Tazania.

[23] Edema, M., Sanni, L. O., & Sanni, A. I. (2005). Evaluation Of Maize-Soybean Flour Blends For Sour Maize Bread Production In Nigeria. African Journal Of Biotechnology, 4, 911-918.

[24] Ekpo A. S. (2006). Changes In Amino Acid Composition Of African Yam Bean (Sphenostylis Stenocarps) And African.

[25] Emiola I.A (2011). Processed African Yam Bean (Sphenostylis Stenocarpa) In Broiler Feeding: Performance Characteristics And Nutrient Utilization. Journal Of Environmental Issue And Agriculture In Developing Countries, 3(3), 123-131.

[26] Ene-Obong, H. N., Carnovillie E. A., (1992). Composition Of The Proximate Mineral And Amino Acid Composition Of Some Known And Lesser Known Legumes In Nigeria Food Chem, 43:169-175.

[27] Enwere, J.N. (1998). Foods Of Plant Origin: Processing And Utilization With Recipes And Technology Profiles. 1st Eds. Afro-Orbis Publications Ltd, Pp: 50-60.

[28] Evan, 1-1., I-Iaismer, D. R., (1979) Rheology Of Gelatinized Starch Suspension, J Text Stud, 10:347-370.

[29] Guidance For Industry: A Food Labeling Guide (11. Appendix C: Health Claims)". Bethesda, Md: Food And Drug Administration, Us Department Of Health And Human Services. January 2013.

[30] "Health Claim Notification For Whole Grain Foods". Bethesda, Md: Food And Drug Administration, Us Department Of Health And Human Services. July 1999. Retrieved 4 December 2016.

[31] ^Hefferon, K. L. (2015). "Nutritionally Enhanced Food Crops; Progress And Perspectives". International Journal Of Molecular Sciences. 16 (2): 3895–914. Doi:10.3390/Ijms16023895. Pmc 4346933 Freely Accessible. Pmid 25679450.O

[32] Ihekoronye, A. I., Ngoddy P. O., (1985) Integrated Food Science And Technology For The Tropics. Macmillian Publishers London.

[33] Kay, D. E., (Revised By Gooding, F. G. B) (1987). Crop And Product Digest No. 2 Root Crops. London.

[34] Machuka J. S., Okeola O. G., Chrispects M. J., Jackai L. E. N., (2000). The African Yam Bean Seed Lectin Affects The Development Of The Cowpea Weevil But Does Not Affect The Development Of Larvae Of The Legume Pod Borer, Phytochem, 53:667-674.

[35] Nas (1979). Tropical Legumes: Resources For The Future. National Academy Of Sciences, Washington D.C. Pp. 331.

[36] National Research Council (1979). Tropical Legumes: Resources For The Future. National Academy Of Sciences , Washington Dc.

[37] Njoku, H. O., Eli I, Ofuya C. O., (1989). Effect Of Pretreatment On The Cooking Time Of The African Yam Bean (Sphenostylis Stenocarps), J Food Sci, 54:758-759.

[38] Nwinuka, N. M., Abbey B. W., Ayalogu E. Q., (1997). Effect Of Processing On Flatus Producing Oligosaccharides In Cowpea (Vigria Unguiculata) And The Tropical African Yam Bean (Sphenostylis Stenocarps), P1 Food Hum. Nutri, 51:209218.

[39] Nwokolo. E. A., (1996). The Need To Increase Consumption Of Pulse In The Developing World In Nwokolo, E. And Smart Journal (Eds). Food And Feed From Legumes And Oil Seeds. Chapman And Hall, London 3-11.

[40] Nwosu, J. N., Ahaotu, I., Ayozie, C., Udeoozor, L. O., & Ahaotu, N. N. (2011). The Proximate And Functional Properties Of African Yam Bean (Sphenostylis Stenocarpa) Seeds As Affected By Processing. Nigerian Food Journal, 29, 39-48.

[41] Oboh, H. A, Muzquiz M, Burano C, Cuadrade C, Pedrosa M. M, Ayet G, Osagie A. U., (1998). Anti-Nutritional Constituents Of Six Underutilised J Legumes Growth In Nigeria. J Chromato, 82:307-312.

[42] Ohimain, E. I. (2014). The Prospects And Challenges Of Composite Flour For Bread Production In Nigeria. Global Journal Of Human-Social Science: H Interdisciplinary, 14, 42-52.

[43] Oke M.O, Sobowale S.S And Ogunlakin G.O (2013). Evaluation Of The Effect Of Processing Methods On The Nutritional And Anti-Nutritional Compositions Of Two Under-Utilized Nigerian Grain Lugumes. Pakistan Journal Of Biological Sciences, 16, 2015-2020.

[44] Okeola, O. G, Machuka, J., (2001). Biological Effects Of African Yam Bean Lectin Clavngralla Tomentosiollis (Hem; Ptera:Coreidae), J Econ Ent, 94:28-34.

[45] Okigbo B.N (1973). Introducing The Yam Bean (Sphenostylis Stenocarpa) (Hochst Ex. A. Rich) Harms. Proceeding Of The First Iita Legume Improvement Workshop, 29th Oct., - 2nd Nov., 1973, Ibadan, Nigeria, 224-238.

[46] Olayide, S.O. (1982). Food And Nutrition Crisis In Nigeria. Ibadan University Press, Ibadan. 112p.

[47] Onyenckwc, P. C., Njoku C. C., Amch D. A., (2000). Effect Of Cowpea Processing Methods On Flatus Causing Oligosaccharides Nutri Res, 20:349-358.

[48] Onwuka, G. I. (2005). Food Analysis And Instrumentation: Theory And Practice (P. 68). Lagos: Naphthali Prints.

[49] Oyeku, O. M., Kupoluyii, C. F., Osibanjo, A. A., Orji, C. N., Ajuebor, F. N., Ajiboshin, I. O., & Asiru, W. B. (2008). An Economic Assessment Of Commercial Production Of 10% Cassavawheat Composite Flour Bread. Journal Of Industrial Research & Technology, 2, 20-30.

[50] Potter, D., (1992) Economic Botany Of Sphenostylis (Leguminosac), Econ Bot, 40:262-275.
[51] Priebe, M. G.; Mcmonagle, J. R. (2016). "Effects Of Ready-To-Eat-Cereals On Key Nutritional And Health Outcomes: A Systematic Review". Plos One. 11 (10): E0164931. Doi:10.1371/Journal.Pone.0164931. Pmc 5066953 Freely Accessible. Pmid 27749919.
[52] Sanni, L. O., Christiana, A. B., & Silifat, A. S. (2004). Production Of Instant Cassava Noodles. Journal Of Food Technology, 2, 83-89.
[53] Seibel, W. (2006). Composite Flours. In L. Popper (Ed.), Future Of F Lour: A Compendium Of Flour Improvement (Pp. 193-198). Verlag Agrimedia.
[54] Shewry, P. R.; Halford, N. G.; Belton, P. S.; Tatham, A. S. (2002). "The Structure And Properties Of Gluten: An Elastic Protein From Wheat Grain" (Pdf). Philosophical Transactions Of The Royal Society B: Biological Sciences. 357 (1418): 133–142. Doi:10.1098/Rstb.2001.1024. Pmc 1692935 Freely Accessible. Pmid 11911770.
[55] Shewry Pr, Hey Sj (2015). "Review: The Contribution Of Wheat To Human Diet And Health". Food And Energy Security. 4 (3): 178–202. Doi:10.1002/Fes3.64. Pmc 4998136 Freely Accessible. Pmid 27610232.
[56] Shewry, Peter R (2009), "Wheat", Journal Of Experimental Botany, 60 (6): 1537–1553, Doi:10.1093/Jxb/Erp058, Pmid 19386614
[57] Sinha, S.K. (1977). Food Legumes: Distribution Adaptability And Biology Of Yield Fao Plant Production And Protection Paper 3. Fao. Rome.
[58] Tindall, H.D. (1983). Vegetables In The Tropics. Ii. Avi, Westport Ct. 323p.
[59] Tindall, Iita, Ibadan, Nigeria. Orr, L. & Watt, B. K. (1957). Amino Acid Content Offoo& Usda Home Economics Research Report 4, Washington, Dc, Usa. Oshodi, A. A. & Hall, G. M. (1993). In-Vitro Multienzyme Di- Gestibility Of Protein Of Some Plant Source Flours Blended H. D. (1986). Vegetables In The Tropics. Elbs/ Macmillan, Houndmills, Uk.
[60] Uguru M.I And Madukaife S.O (2001). Studies On The Variability In Agronomic And Nutritive Characteristics Of African Yam Bean (Sphenostylis Stenocarpa Hochst Ex. A. Rich. Harms). Plant Production And Research Journal, 6, 10-19.
[61] Ukpabi, U. J., & Ndimele, C. (1990). Evaluation Of The Quality Of Garri Produced In Imo State. Nigerian Food Journal, 8, 105–109.
[62] Uncst (July 2007). "The Biology Of Bananas And Plantains" (Pdf). Uganda National Council For Science And Technology In Collaboration With Pbs – A Us Agency For International Development (Usaid).
[63] "Whole Grain Fact Sheet". European Food Information Council. 1 January 2009. Retrieved 6 December 2016.
[64] "Whole Grain Resource For The National School Lunch And School Breakfast Programs: A Guide To Meeting The Whole Grain-Rich Criteria" (Pdf). Us Department Of Agriculture, Food And Nutrition Service. January 2014.
[65] "Whole Grains And Fiber". American Heart Association. 2016. Retrieved 1 December 2016.
[66] Williams, P. G. (2014). "The Benefits Of Breakfast Cereal Consumption: A Systematic Review Of The Evidence Base". Advances In Nutrition. 5 (5): 636s–673s. Doi:10.3945/An.114.006247. Pmc 4188247 Freely Accessible. Pmid 25225349.
[67] Wokoma, E. C., Aziagba G. C (2001) Sensory Evaluation Of Dawadawa Produced By The Traditional Fermentation Of African Yam Bean (Sphenostylis Stenocarps Harms) Seeds, J Appl Sci Environ Man, 5:85-91.