EFFECTS OF COOKING ON THE NUTRITIONAL COMPOSITIONS OF WHEAT (*Triticum durum*)

BY

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NOVEMBER, 2008

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BEING A FINAL YEAR PROJECT SUBMITTED IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE AWARD OF BACHELOR OF ENGINEERING (B. ENG.) DEGREE IN AGRICULTURAL AND BIORESOURCES ENGINEERING, FEDERAL UNIVERSITY OF TECHNOLOGY MINNA, NIGER STATE

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DECLARATION

I hereby declare that this project is a record of a research work that was undertaken and written by me. It has not been presented before for any degree or diploma or certificate at any University at any Institution. Information derived from personal communication, published and unpublished works of others were dully referenced in the text.

Ismaila Isah	25-11-08 Date

CERTIFICATION

This project entitled "Effects of Cooking on the Nutritional Compositions of Wheat (*Triticum durum*)" by Ismaila Isah meets the regulations governing the award of the degree of Bachelor of Engineering (B.ENG.) of the Federal University of Technology, Minna and it is approved for its contribution to scientific knowledge and literary presentation.

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Head of Department

.... 19-11-08

External Examiner | Date

DEDICATION

This project is dedicated to God Almighty for giving me strength for the successful completion of my degree programme.

ACKNOWLEDGEMENTS

My sincere appreciation goes to God Almighty for his guidance and protection throughout my studies.

I also want to use this opportunity to thank my project supervisor Engr. Dr. O. Chukwu for his support and assistance. May Allah reward him abundantly?

Let me at this juncture extend my humble appreciation to my able Lectures for their support and knowledge imparted to me. May God bless you and your families?

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Let me also extend my greetings to my sister and her husband Mr. and Mrs. Daniel Yakubu; may Almighty God reward you all.

Finally I wish to extend my love to my friends: James, Stanley, Linus, Abdulwahab, Isaac and others numerous to mention.

ABSTRACT

In this work, the effects of cooking on nutritional compositions of wheat (*Triticum? durum*) were determined. Under approved standard laboratory conditions and using standard methods and instruments, experiments were conducted and results obtained. The compositions of uncooked wheat are: 55.59% moisture, 72.07% crude fibre, 2.70% crude protein, 7.20% carbohydrate and 71.30% Iron. The composition of Wheat cooked at various temperatures 80^0c, 100^0C and 120^0C are: 4.84% moisture, 3.63% crude fibre, 5.31% total lipids, 10.45% crude protein, 2.27% ash, 69.43% carbohydrate, 6.02% Calcium and 0.33% iron. From the results obtained it showed the there were decreases in carbohydrate, crude protein, moisture content after cooking wheat at various temperatures. From the analysis an increase for calcium content of the wheat was observed from the raw stage value of 1.16ppm to 6.02ppm. It was therefore concluded that cooking wheat could either increase or decrease its nutritional compositions.

TABLE OF CONTENTS

LIST OF TABLES

FIGURE

CHAPTER ONE

1.0 INTRODUCTION

1.1 Background to The Study

Wheat is one of the most widely produced cereals in the world, most of which is destined for human consumption (United States Department for Agriculture, USDA, 1993). Thus, its contribution to energy intake is significant, particularly in America and the Middle East. The processing of wheat to flour is generally concentrated in a few large mills; the resulting flour is used to make bread, biscuits, pasta and other products (USDA 1993) because of its nutritional value, wheat is a suitable vehicle for delivering micronutrients to mankind.

Wheat in its natural state, is a good source of vitamins B1 (thiamine) Vitamin B2 (Riboflavin), Niacin, Vitamin B6 *(Pyridoxine),* Vitamin E. as well as iron and zinc (USDA 1993). In foods, the stability of vitamins is more precarious than that of minerals because vitamins are sensitive to heat;

Wheat is classified according to the growing habits of the plant, colour of the wheat kernel and texture of the ripened grain. Wheat is also divided according to whether it is hard or soft. Hard wheat tend to be higher in protein content and find its principal use in bread flour. Softer wheat is lower in protein and is chiefly milled into flour for cakes, cookies, pastries and crackers. Durum wheat, a variety of hard wheat, is used for macaroni products (USDA 1993). In developed countries, wheat flour is generally fortified with vitamins B1, B2, niacin and iron.

Wheat seed comprises of different segments which include endosperm and germ that make up complete wheat seed. The endosperm is about 83 percent of the kernel weight and is a source of white flour. The endosperm contains the greatest share of protein, carbohydrates and iron as well as the major B-Vitamins, such as riboflavin, niacin and thiamine. It is also a source of soluble fibre (USDA 1993).

The Bran is 14½ percent of the kernel weight; bran is in wheat be bought separately. The bran contains a small amount of protein and the germ is about 2½ percent of the kernel weight.

Wheat is mostly grown in areas with moderate temperature and do not need high water requirement for planting (National Research for Cereals NRC, 2004). Wheat is planted mostly in West African region in Nigeria, Burkinafaso, and Mali because these are regions with moderate temperature. Wheat in Nigeria has much market value because of its importance to human consumption. Many houses in Nigeria use food product manufactured from wheat such as Macaroni, biscuits and crackers (NRC, 2004).

1.2 Statement of the Problem

In Nigeria and other countries in Africa people do not put much interest into the effect of cooking on the nutritional composition of wheat, although the products of wheat are sold in the market.

1.3 Objectives of the Study

1. To determine the nutritional compositions of uncooked and cooked wheat.
2. To determine the effect of cooking on the nutritional compositions of wheat.

1.4 Justification of the Study

It has been suggested that cooking changes the solubility characteristics of sorghum proteins in general and that of prolamin protein in particular (Rooney *et al.*, 1986). Heat processing is reported to improve the digestibility of seed protein by destroying inhibitors and opening the protein structure through denaturation However, heat processing can also cause a decrease in digestibility through non-enzymatic browning reactions and thermal cross linking. As a result this was carried out to determine how heat application at varying temperatures affects the nutritional compositions of wheat.

1.5 Scope of the Study

The scope of this work is limited to the effect of cooking on the nutritional compositions of wheat. Some of the parameters to be studied are: moisture content, Ash content, Crude fibre, protein content, Ether extract, carbohydrate content, Iron content and Calcium content.

CHAPTER TWO

2.0 LITERATURE REVIEW

2.1 Historical Evolution of Wheat

Wheat is also one of the most important domesticated crops grown around the world. Bread wheat plays a major role among the few crop species being extensively grown as food source. (Harlan, 1981). Wheat is considered as utmost among the cereals largely due to the fact, that its grain contains protein with unique chemical and physical properties. Besides being a rich source of carbohydrates, wheat contains other valuable components such as protein, mineral such as magnesium, iron, copper and Zinc and vitamins like thiamine, riboflavin, niacin and vitamin E. However, wheat proteins are deficient in essential amino acids such as lysine and threnine (Adsule and Kadam, 1986).

Global wheat productions is concentrated mainly in Australia, Canada, China, European Union, India, Pakistan, Russia, Turkey, Ukraine and the United States, accounting for over 80% of world wheat production. Pakistan is the 8^{th} largest producer, contributing about 3.17% of the world wheat production from 3.72% of the wheat growing area.

Wheat is the leading food grain and occupies a central position in agriculture and its economy (Shuai'b *et al.*, 2007). The wheat breeders corrected by pay more attention to evolve new varieties possessing an improved yield potential coupled with superior quality. However, Pakistan has been a food deficit country for long. The breeding effort in the past remained focused mainly on increasing the per hectare yield of wheat, thus the potential of grain quality improvement remained unexploited. Production is geared up to local market, which is neither quality conscious nor sufficiently diversified to demand exacting standards. Wheat varieties are grown over a wide agro-climatic range and as such are expected to exhibit yield and quality difference (Howdhy *et al.*, 1995). It is therefore necessary to investigate the biochemical composition of wheat varieties available for food and nutritional purposes in which would provide an opportunity to explore the available wheat varieties for greater excellence in their nutritional quality.

Wheat production during the 20th century includes improvement through the introduction of new varieties and strains; careful selection by farmers and seeds men, as well as by scientists; and crossbreeding by combined desirable characteristics.

The adaptability of wheat enables it to be grown in almost every country of the world. In most of the developed nations producing wheat, endeavours of both government and wheat growers have been directed toward scientific wheat breeding. In the late 1940s short stemmed wheat was introduced from Japan into a more favourable wheat growing region of the US (United States). The potential advantage of the short, heavy-stemmed plant is that it could carry a heavy head of grain generated by use of fertilizer, without falling over or "lodging" (being knocked down). (Encyclopedia Britannica, 2000).

By 1995 the New Mexican wheat was established and is gaining an international recognition, which dominate large expanses of the middle east countries and other places such as the North American Praines, South American Pampas, African veld, and Eurasian steppes. No single climate generates grassland; they develop in areas with ranges of rainfall (from semi-arid to sub-humid).

Cultivation of cereals began about 10,000 year ago as a major part of the shift from hunting and gathering to plant and animal husbandry, a transition that stimulated rapid and cultural evolution. From the beginning of their domestication, bread wheat *(Triticum aestivum)*, barley *(Horderm Vulgare)*, oats *(Avena Sativa)*, and rye (*Secale Cereale)* in the Middle East, sorghum (*Sorghum bicolor)* in Africa; rice (*Oryza sativa)* in Southeast Asia; and in Maize *(Zea mays)* in Central America have supported the rise of many civilizations. (Encyclopedia Britannica, 2000).

About 72 percent of the milled grain is recovered as white flour. When a higher percentage is extracted, the flour is darker in colour, the greatest portion of the wheat flour produced is used for bread making. Wheat grown in dry climates are generally hard types, having protein content of 11-15 percent and strong gluten (elastic protein). The hard type of wheat produces best flour suited for bread making. The wheat of humid area is softer, with protein content of about 8-10 percent and weak gluten. The softer type of wheat produces flour suitable for cakes, crackers, cookies, and pastries and household flours, Durum wheat semolina (from the endosperm) is used for making pastries, or alimentary pastes. Although most wheat is grown for human food and about 10% is retained for seed, small quantities are used by industry for production of starch, paste, malt, dextrose, gluten, alcohol and other products (Encyclopedia Britannica, 2000). Inferior and surplus wheat and various milling by products are used for livestock feeds. The composition of the wheat grain, a major source of energy in human diet, varies somewhat with difference in climate and soil. On an average, the kernel contains 12 percent water, 70 percent carbohydrates, 12 percent protein, 2 percent fat, 1.8 percent minerals, and 2.2 percent crude fibres. A convert to kg of wheat contains about 1,500 calories (100 grains contain about 330 calories). (Encyclopedia Britannica, 2000).

Thiamine, riboflavin, niacin, and small amount of vitamin A are present, but the milling processes remove the bran and germ, where these vitamins are found in the greatest abundance. More of the world's farmland are devoted to wheat than to any other food crop (Encyclopedia Britannica, 2000).

The kernel of wheat sometimes called the wheat berry, the kernel is the seed from which the wheat plant grows. Each tiny seed contains three distinct parts that are separated during the milling process to produce flour.

2.2 Wheat Components

The kernel of wheat sometimes called the wheat berry, the kernel is the seed from which the wheat plant grows. Each tiny seed contains three distinct parts that are separated during the milling process to produce flour.

Endosperm

The wheat contains about 83% of endosperm which is the source of white flour. The endosperm contains the greater share of protein, carbohydrates and iron, as well as the major B-vitamins such as riboflavin, niacin and thiamine. It is also a source of soluble fibre.

Bran

The wheat also contains about 14½% of bran. Bran is included in whole wheat flour and can also be bought separately. The bran contains a small amount of protein, large quantities of the three major B-vitamins trace minerals and diary fibre primarily insoluble.

Germ

The wheat also contains 2½% of germ. The germ is the embryo of sprouting section of the seed, often separated from flour in milling because the fat content (10 percent) limit flour's shelf life. The germ contains minimal quantities of high quality protein and grater share of B-complex vitamins and trace mineral. Wheat germ can be purchased separately and is part of whole wheat flour. (Grave *et al* 1982).

2.3 Processing of Wheat

Processing is complex and the principal procedure is milling, that is, the grinding of the wheat grain so that it can be easily cooked and rendered into attractive food stuff. Cereals usually are not eaten raw, but different kinds of milling (dry and wet) are employed, depending on the moisture content to prevent deterioration (Encyclopedia Britannica, 2000). Handling of grain received in

Europe from overseas is a large operation. The Tilbury Grain Terminal in London is a good example of modern grain handling capable of servicing bulk carriers of up to 65,000 tonnes (59,000,000 kilograms) at a maximum rate of 2,000 tonnes (1,800,000 kilograms) (Encyclopedia Britannica, 2000).

2.4 Uses of Wheat

The following are uses of Wheat:

- In making of Bread
- Preparation of fast food e.g. Macaroni, Spaghetti etc
- The by-products of the flour milling are used for livestock feed
- Making of beer, whisky and industrial alcohol

2.5 Wheat Varieties and their Characteristics

The three principal types of wheat used in modern food production are Triticum Vulgare (or aestivum), *Triticum durum* and *Triticum compactum* (Encyclopedia Britannica, 2000). *Triticum vulgare* provides the bulk of the wheat used to produce flour for bread making and for cakes and biscuits (cookies). It can be grown under a wide range of conditions and soils. Although the yield varies with climate and other factors, it is cultivated from the southern regions of America and almost to the arctic and at elevations from sea level.

Triticum durum, is longer and narrower in shape than *Triticum vulgare,* and is mainly ground into semolina (purified middlings) instead of flour. Durum semolina is generally the best type for the production of pasta foods. *Triticum compactum* is more suitable for confectionary and biscuits than for other purposes.

The wheat grain, the raw material of flour production and the sads planted to produce new plants consists of three major portions (Salmon *et a* 1985).

1. The embryo or grain;
2. The starchy endosperm, which serves as food for the germinating seed and forms the raw material of flour manufacture; and
3. Various covering layers protecting the grain.

2.6 Proximate Composition of Wheat

Nutrients can be seen as either important or non important. The following are examples of important nutrients: vitamins, fat, protein, carbohydrate and water. Non essential nutrients are manufactured in the body and do not need to be obtained from food. An example is cholesterol (a fat like substance present in all animal cells). An individual needs varying amounts of each essential nutrient, depending upon such factors as gender and age. Specific health conditions, such as pregnancy, breast-feeding, illness, or drug use, make unusual demands on the body and increase its need for nutrients. Dietary guidelines, which take many of these factors into account, provide general guidance in meeting daily nutritional needs (FAO, 1998).

Crude Protein

Protein, any of a large number of organic compounds that make up living organisms and are essential to their functioning. First discovered in 1838, proteins are now recognized as the predominant ingredients of cells, making up more than 50 percent of the dry weight of animals. The word *protein* is coined from the Greek *proteios*, or "primary."

Protein molecules range from the long, insoluble fibers that make up connective tissue and hair to the compact, soluble globules that can pass through cell membranes and set off metabolic reactions. They are all large molecules, ranging in molecular weight from a few thousand to more than a million, and they are specific for each species and for each organ of each species. Humans have an estimated 30,000 different proteins, of which only about 2 percent have been adequately described. Proteins in the diet serve primarily to build and maintain cells, but their chemical breakdown also provides energy, yielding close to the same 4 calories per gram as do carbohydrates (*see* Metabolism).

Besides their function in growth and cell maintenance, proteins are also responsible for muscle contraction. The digestive enzymes are proteins, as are insulin and most other hormones. The antibodies of the immune system are proteins, and proteins such as hemoglobin carry vital substances throughout the body. (Encarta, 2009)

Moisture Content

Determining moisture content is an essential first step in analyzing wheat or flour quality since this data is used for other tests. Flour millers adjust the moisture in wheat to a standard level before milling (Encyclopedia Britannica, 2000). Moisture content of 14% is commonly used as a conversion factor for either test in which the results are affected by moisture content.

Moisture is also an indicator of grain storability. Wheat or flour with high moisture content (over 14.5%) attracts mold, bacteria, and insects, all of which cause deterioration during storage (Encyclopedia Britannica, 2000), moisture content can be an indicator of profitability in milling. Flour is sold by weight;

grain is bought by weight, and is added to reach the standard moisture level before milling.

Carbohydrate

Carbohydrate portion of biological material is made up of two parts nitrogen free extract and crude fibre. Nitrogen free extract is also known as soluble carbohydrate which consists of water soluble vitamins, monosaccharide (simple pentose or hexose sugar), Oligosaccharides (compound sugars) and Polysaccharides?? (starches). Insoluble carbohydrate (crude fibre) is mainly polysaccharides consisting of hemicelluloses and cellulose. Actually, residue of feed that is insoluble after successful boiling with dilute alkali and dilute acid is known as a crude fibre and contains besides cellulose a part of nitrogen also. (Popkin *at al* 1993)

Ash Content

The ash content in wheat and its flour has significance for milling. Millers need to know the overall mineral content of wheat to achieve desired or specified levels in flour. Since it is primarily concentrated in the bran, ash content in flour is an indicator of the yield that can be expected during milling performance by indirectly revealing the amount of bran contamination in flour. Ash in 1 four can affect colour, imparting a dark colour to finished products (Encyclopedia Britannica, 2000). Some specialty products requiring particularly white flour call for low ash content while whole wheat flour has high ash content.

Calcium Content

Nutritionists recommend meeting our calcium needs with foods naturally rich in calcium such as rice. Adequate calcium intake in childhood and young adulthood is critical to achieving peak adult bone mass, yet many adolescent girls replace milk with nutrient-poor beverages like soda pop. The bone health requires a lot of nutrients and one is likely to get most of them in dairy products. They are a huge package rather than just a single nutrient. With so many low-fat and nonfat dairy products available, it is easy to make dairy foods part of a healthy diet. People who have trouble digesting milk can look for products treated to reduce lactose. A serving of milk or yogurt contains about 350 milligrams (mg) of calcium. Fortified products have even more. (Annegers, 1973)

Iron Content

Haemoglobin is contained entirely in the red blood cells, amounting to perhaps 35% of their weight. To combine properly with oxygen, red blood cells must contain adequate hemoglobin. Haemoglobin, in turn, is dependent on iron for its formation. A deficiency of haemoglobin caused by a lack of iron in the body leads to anaemia. (Annegers, 1973).

Crude Fibre Content

Vegetables, fruits, grains, and legumes constitute a rich source of dietary fibre. Composed of the indigestible cell walls of plant material, fibre acts like a scouring pad to cleanse and flush the digestive tract. Researchers claim it helps eliminate cancer-causing chemicals and may decrease the amount of cholesterol in the blood stream (Oyenuga, 1968).

Table 2.1

The table below shows the average nutritional composition of wheat.

Component (%)	Wheat	White Flour	Bran
Water or moisture	12.00	13.50	13.00
Mineral mutter or ash	1.80	40.00	5.80
Protein or nitrogenous	12.00	11.00	15.40
Cellulose or crude fiber	2.20	25.00	3.60
Fat or either extract	2.10	1.25	3.60
Nitrogen –free extract	69.90	73.60	53.20

Source: USDA, 1993

CHAPTER THREE

3.0 MATERIALS AND METHOD

3.1 Materials

Durum wheat sample (*Triticum durum)* used for the determination of cooking effect on the nutritional compositions of wheat was purchased from Minna Main Market, Niger State Nigeria. It was used as obtained without further treatment. The tests and analysis were carried out in the Animal Production Laboratory, Federal University of Technology, (FUT) Minna by Mr. Saidu Zegi of Agricultural and Bioresources Engineering Department, F.U.T Minna, and Mr Audu Yohanna of Animal Production Department, F.U.T Minna between 6th August, 2008 and 20^{th} August, 2008. The official method of analysis of Association of Official Analytical Chemist, AOAC (1980) Guidelines for Determining Moisture content, Ash content, Crude Fibre, Ether content, Crude Protein, Carbohydrate, Iron and Calcium content was used.

3.1 Reagents and Instruments

3.1.1 Reagents

The reagents used for the laboratory analysis are listed below:

1. 0.5N NaOH (Sodium hydroxide)
2. 0.5N H_2SO_4 (Tetraoxosulphate (VI) acid)
3. Boric acid
4. Methyl orange indicator
5. 2, 6 dichlorofinol

6. Indofinol

7. Acetic acid

8. Acetic anhydride

3.2.2 Instruments/Equipment

The equipment used for the analysis are:

1. Macro-Kjeidahl nitrogen digestion and distillation apparatus made in Switzerland by metler
2. Kjaldahl flask, 500ml
3. Burettes
4. Oven
5. Beakers
6. Gas cooker
7. Mucillin cloths/filter paper
8. Masking tape
9. Weighing balance (with sensitivity of 0.001g, Serial Number HS2764,metler (Switzerland))

CHAPTER FOUR

4.0 RESULTS AND DISCUSSION

4.1 Results

The results of this study based on the analysis of uncooked and cooked wheat samples at different temperatures are presented in Table 4.1

Table 4.1: Proximate Compositions of Uncooked and cooked Wheat at Different Temperature

Parameter	Uncooked Wheat	Cooked Wheat		
		80°C	100°C	120°C
Moisture content (%)	11.00	4.80	3.86	5.86
Ash (%)	3.50	2.64	1.84	2.33
Crude fibre (%)	13.00	4.00	3.33	3.55
Crude protein (%)	10.74	11.28	11.28	8.80
Ether extract (%)	3.00	5.87	5.22	4.83
Carbohydrate (%)	73.79	76.91	76.85	80.47
Iron, Fe (ppm)	1.15	0.28	0.42	0.30
Calcium, Ca (ppm)	1.16	3.87	5.64	8.53

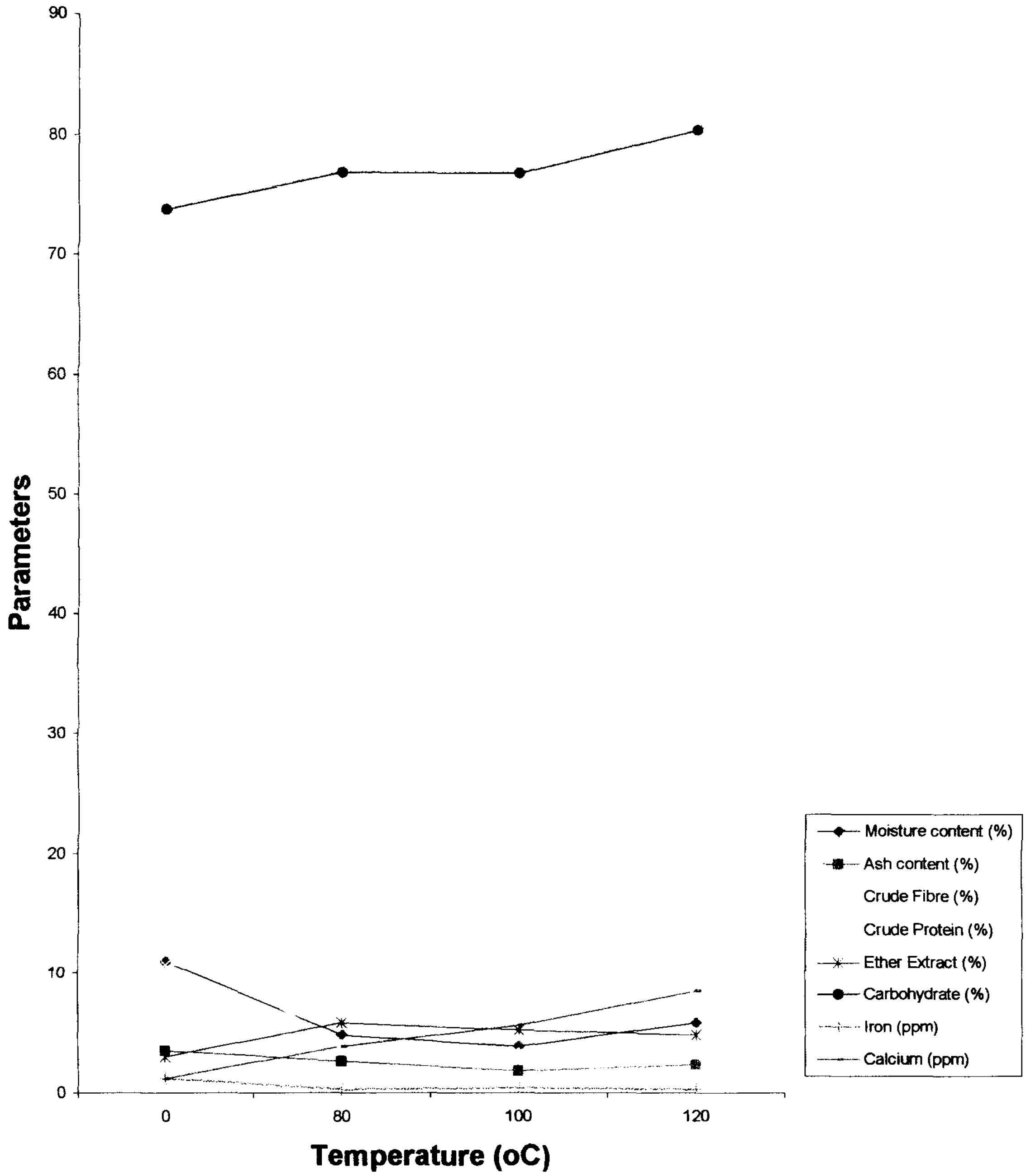

Figure 4.1: Proximate Composition of Wheat

4.2 Discussion of Results

From figure 4.1, it shows that at raw state, the carbohydrate contents is about 69.762%, percent at 80°C for 10min, the percentage composition of carbohydrates present in the wheat samples is 77.69% which means the carbohydrates content has increased from the initial raw state. At 80°C for 30min, the percentage composition of carbohydrates present in the samples is 73.796% at this level the carbohydrate content has decrease form the initial 80°C for 10min meaning due to increased in time the carbohydrate has reduced. At 80°C for 50min the percentage contents of carbohydrate (CHO) is 79.09% at this point in time the carbohydrate level has increased due to increased in time, it there means that at constant temperature and varying time the level of carbohydrates increases with time. At 100°C for 10min, the carbohydrate percentage contents is about 80.59% approximately 80.6% at this temperature the carbohydrate level has increased with about 10.84% from the raw state, and about 1.5% from 80^0C for 50minutes meaning has the temperature increases more carbohydrates is extracted from the sample. At 100°C for 30min the percentage proximate composition of carbohydrate is 77.464% at this point the carbohydrates content reaches from the initial 100°C for 10minutes which means as its increases the carbohydrate level reduces, may be at this point the carbohydrate content has been denatured. At 100°C for 50min the percentage proximate composition of carbohydrates is 82.09%, which means it increased from the previous one, which may be as a result of increase in time. At 120°C for 10min, the proximate percentage composition of carbohydrates is 82.1% there was increase in carbohydrates contents when the temperature increases because when the temperature increases the rate of carbohydrates present in the sample is extracted. At 120°C for 30min the proximate percentage composition of the sample is 80.906%, which reduces compare to the initial 10min at 120°C the reduction may due to increased in time. At 120°C for 50min the proximate percentage composition is 78.42%, it has also reduces compare to the initial 30minutes, which mean as its increases the carbohydrate content reduces. Generally from the result obtain from table 4.1 the proximate percentage composition of the wheat sample increases as the temperature increases, but reduces as the time increases too which is line with Chandrasekhar and Mulk (1970).

From figure 4.1, the proximate percentage composition of crude protein at raw state is 10.738%. At 80°C for 10minutes, the proximate percentage composition of crude protein is 11.564%, which is a bit higher than the raw state, because of the temperature increase and time, some percentage crude protein has be extracted from the sample. At 80°C for 30minutes, the proximate percentage composition of crude protein is almost the same value with the initial 80°C from 10minutes; the difference is negligible because there is no any significant difference or change. At 80°C for 50minutes, the proximate percentage composition of crude protein is 10.74%, which is a little bit lower than the previous once, as a result of this, its implies that as the temperature increases and the time increase two, the lower the crude protein, because the increase in temperature has denatured some amount of protein present in the sample. At 100°C for 10minutes, the proximate percentage composition of crude protein is just the same with that of 80°C for 50minutes, which may imply that is the maximum temperature for extracted of crude protein, because there was any change even after the temperature was increased which is in line with Popkin *et al* (1993).

From figure 4.1, the proximate percentage composition of crude protein is 9.086%, which is also lower compare to the raw state, which means that as the temperature is increased, less crude protein is extracted because part of it has been denatured my heat. At 100°C for 50minutes, the proximate percentage composition of crude protein is 9.58%, which is a bit a higher than that of 100°C for 30minutes, but is still low compare to the raw state, of the crude protein, meaning that less protein is extracted at this particular temperature and time compare to the raw. At 120°C for 10minutes, proximate percentage composition crude protein is 9.087%, which is still lower compare to the raw which is obvious that some amount of protein has undergone denaturization, because of the heat applied. At 120°C for 30minutes, the proximate percentage composition of crude protein is 7.434%, it even the lower of all that might be the maximum temperature for crude protein extraction. At 120°C for 50minutes, the proximate percentage composition of crude protein is 9.91%, it is still low compare to the raw value, which means there is decrease in protein contents as a result of temperature increase which is line with the findings of Bouis (1996).

From figure 4.1, at the raw state, the proximate percentage composition of crude fibre is 13.00%. At 80°C for 10min, the proximate percentage composition of crude fibre is 2.00%, which lower compare to the raw value, which means there is drastic reduction in crude fibre contents, because of the heat applied, some of the fibre contents has been destroy by heat. At 80°C for 30min, the proximate percentage composition of crude fibre is 7.33%, which still lower compare with the raw value but higher than the first one for 80°C for 10min, in this case, more crude fibre is extracted. At 80°C for 50min, the proximate percentage composition of crude fibre is 2.67%, it is very low compare to the raw value, and slightly higher than that one for 80°C for 10min. At 100°C for 10min, the proximate percentage composition of crude fibre is 1.33%, this is lowest amount of crude fibre contents, this might be maximum temperature for the extraction of crude fibre, because there is significant reduction of crude fibre content because of increase in temperature.

Also from figure 4.1, the proximate percentage composition of crude fibre is 6.00%, its still low compare to the raw value, more crude fibre has been reduce because of the application heat. At 100°C for 50min, the proximate percentage composition of crude protein is 1.33, this value is the same with that of 100°C for 10min, at this point, its also implies that might be maximum temperature for the extraction of crude fibre. At 120°C for 10min, the proximate percentage composition of crude protein is 3.33%, this value can not be compare to the raw value in terms of range because, the range difference is to wild, more of the fibre is been destroy from the application of heat. At 120°C for 30min, the proximate percentage composition of crude protein is 4.66%, this is also a low value compare to the raw value, is observed that most of the fibre contents is been heated up by increase in temperature. At 120°C for 50min. The proximate percentage composition of crude protein according to Dary (2001) an increase in temperature could either increase or decrease the protein content of wheat.

From figure 4.1, at raw state the value of ether extract is 3.00% but at 80°C for 10min, the proximate percentage composition of ether extract is 6.77%, which means there is an increase in the ether content, which might be as a result of increase in temperature compare to the raw value. At 80°C for 3omin, the proximate percentage composition of ether extract is 4.88%, which is also higher compare to the raw value, but lower compare to that of 80°C for 10min, this might be as result in the increase in temperature, more of the either is extracted from the sample. At 80°C 50min, the proximate percentage composition of ether extract is 4.00%, this is a bit higher compare to the raw value, but lower compare to that of 80°C 30min, probably more ether has been destroy by heat. At 100°C for 10min, the proximate percentage composition of ether extract is 4.50%, this value is higher compare to the raw value, the increase in the value could be amounted to the increase in temperature, and also increase in time too. At 100°C for 30min, the proximate percentage composition of ether extract is 4.00%, this value is the same with that of 80°C for 50min, which could imply that, the maximum temperature, for ether extract is 100°C for 30min, or 80°C for 50min. At 100°C for 50min, the proximate percentage composition of ether extract is 5.50%, which also high compare to the raw value, but at this point ether extract is high, it could be as a result of increase in temperature, and also increase in time too. At 120°C for 10min, the proximate percentage composition of ether extract is 3.50%, it also higher than the raw value, it is obvious that more ether is extracted as the temperature, of the sample is been increased, and the heat produces more ether extract from the given sample. This is the maximum temperature for the extraction of ether. At 120°C for 30min, the proximate percentage composition of ether extract is 4.50%, there is increase in ether from the sample compare to the raw value, the increase in the ether extract is probably because of the increase time some amount of ether is produced, but companying it with the previous value 120°C for 10min, more either is also produced, but comparing it previous value at 120°C for 10min, more ether is also produce too. At 120°C for 50min, the proximate percentage composition of ether extract is 6.50%, which is the highest value for extraction of ether from the sample.

Probably is this best temperature for extraction of ether, because of the increase in the value. Its generally implies that at certain temperature and time ether is extracted maximally and at certain temperature and time too, ether is extracted minimally

From figure 4.1, which shows the actual amount of calcium (Ca) content in ppm (part per million). At the raw state, the proximate composition of calcium is 1.16ppm (part per million) which is the same all through at various time. Its shows that, the amount of calcium present in the sample is very small. At 80°C for 10min, the proximate composition of calcium is 2.70ppm, which is a bit higher than the raw value, which implies that their is more calcium as the temperature is increased. At 80°C for 30min, the proximate composition of calcium is 4.46ppm, which means there is an increase in the amount of calcium compare to initial value. This increased is resulting from the increased in temperature. At 80°C for 50min, the proximate composition of calcium is the same with that of 80°C for 30min, 4.46ppm, which means that the increase in time do not have any effect on the composition at that temperature and time. At 100°C for 10min, the proximate composition of calcium (Ca) is 5.63ppm, which means that as the temperature increases the amount of calcium also increase too. At 100°C for 30min, the proximate composition of calcium is 4.56ppm, which means there is a reduction in the amount of calcium at that particular temperature and time. According to Brown and Wuehler (2000) The reduction in the amount may be as a result of inconsistency in temperature variation, and probably it does not favour the production of calcium. At 100°C for 50min, the proximate composition of calcium is 6.74ppm, which is higher compare to the previous ones, this increase probably because of increase in time. At 120°C for 10min, the proximate composition of calcium is 6.16ppm, it has reduced compare to that of 100°C for 50min, the changes could be as a result reduced time and increased temperature. At 120°C for 30min, the proximate composition of calcium is 9.72ppm, which is an increase, compare to the raw value, and the previous value, this could be attributed to increase in temperature. At 120°C for 50min, the proximate composition of calcium is the same with that of 120°C for 30min, this means that despite the increase in time their no increase in the amount of calcium.

From figure 4.1, it shows the actual amount of iron (Fe) content in ppm (part per million). From the raw state, the actual amount of from present is 1.15ppm, which also the same with that of 30 and 50min, which means that the effect of time is considerably negligible, because there is no any significant change. But at 80°C for 10min, the amount of calcium is 0.20ppm, which means as the temperature increases at this stage there is reduction in iron level which can be traced to increase in temperature. At 80°C for 30min, the amount of iron has increased to 0.30ppm, the increase is very negligible, because it's just about 0.10ppm increase which have no too much effect on the result. At 80°C for 50min, the amount of iron has also increased from 0.30ppm, to 0.35ppm, which also has no too much effect then is a fluctuation in the amount of iron from table 4.3 which is as a result of variation of temperature and time. According Banjong in 1995, the increase in the amount of iron is very infinitesimal, because no meaningful changes is observe. At 100°C for 30min, the amount iron content is 0.20ppm, which is very low compare with the raw value; this low value could be as a result of temperature increase. At 100°C for 50min, the amount of iron content is 0.60ppm, still low compared with raw value; this means that temperature increase as serious effects on the nutritional composition of iron in the dietary. At 120°C for 10min, the amount iron contents is 0.60ppm, which is also low compared with the raw value, but has the same value with that of 100°C for 50min, which can be said that the amount of heat applied at this particular temperature and time has no effect, no any amount of iron is traced. At 120°C for 30min, the amount of iron content is 0.05ppm; very low compare to the raw value, infact at this temperature the iron content is very small. At 120°C for 50min, the amount of iron content is 0.25ppm, which is also low compare to the raw value, which means at the raw state, there is more iron concentration that when it has undergone heat.

CHAPTER FIVE

5.0 CONCLUSION AND RECOMMENDATIONS

5.1 Conclusion

From the research work carried out, it can be concluded, that heat has serious effects on the nutritional composition of wheat, because some of the vital nutrients of the samples either increases or decreases due to variation in temperature.

5.2 Recommendations

1 It is recommended that cooking of wheat should be done at a particular Temperature (80^{0}C) not to reduce the nutritional content of wheat.

2 It is recommended that people should be informed on how to utilize the available nutrients for maximum and efficient growth and good health.

3 It is recommended that wheat varieties should be ernest upon by an Agricultural and Bioresources Engineers to promote and improve the value of wheat.

REFERENCES

AOAC (Association of official Analytical Chemistry). Approved method of analysis St. Paul, MN: AACC, 1995.

Adsule RN, Kadam, SS. Quality of wheat. In: Salunkhe DK, Kadam SS, Austin A., editors. Quality of wheat and wheat product. New Delhi, India: Metropolitan Book Co., 1986 pp1-6.

Annegers J, F 1973. Ecology of dietary patterns and nutritional status west, Africa.1: Distribution of starchy staples. Ecology food Nutr.2. 107-19

Banjong, O., Viriyapalich, T. and Chitchang, U. 1995. Hand book for dietary evaluation Institute of nutrition, Mahidol University, Thailand.

Brown, K. and Wuehler S editors 2000. Zinc and Human Health Micronutrient Intiative Ottawa, Canada.68 pp.

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Chandrasekhar, U. and Mulk, N. 1970. Nutritive value of High Yielding Wheat varieties Jaya, Padma and Hamsa. India Journal of nutrition and Dietetics 7:240-242.

Diary, O., 2001. Techlical and Practical Barriers to sereal Food Fortification (Wheat flour, Maize flour and Rice) Conference proc. Forging Effective Strategies to Combat Iron Deficiency held in Atlanta, Georgia, May 7-9, 2001.

Graveland, A., Bosveld, P., Liethendonk. W.Y. Moonen, H.E and Scheepstra, A (1982) Extractionation of Wheat flow protein J. Sci. Food Agric, 33.1117-28.

Hendrix, May Lynn'' Protein'' Microsoft ® Encarta 2009 (DVD) Redmond, WA:Microsoft Corporation 2008.

Harlan, J.R. The early history of wheat. In: Evans LT, Peacock WJ., editors. Wheat

Science today and tomorrow. Cambridge, U.K: Cambridge University Press., 1981. pp.1-9.10

Howdhy *et,al* Bread wheat varieties has influenced by different mineral level Univ Sci B.2006,.7(1):70-80. doi:10.1631/jzus.2006. B0070.(PubMed).

NRC 2004, Grain Quality Evaluation of World Wheat, National Wheat Research Institute

Oyenuga, VA 1968 Nigeria Food and Feeding Stuffs (their chemistry nutritive value) (3rd edn) Ibadan University Press, Nigeria

Popkin, B, Keyou, G. Fengying, Z. Guo, X. Haijiang, M. and Zohoori, N. 1993. The Nutrition Transition in China: A cross sectional analysis. European Journal of clinical nutrition 47, 333-346.

Rooney *et al* Yield performance and grain quality of wheat varieties growing under rain Fed and educated condition. Asian J plant Sci 2007., 2(3): 358-360.

Shuai'b *et al* Mzeb, Aliz W, Ahmad T, Khan I. characterization of wheat varieties by Seed storage protein electrophoresis. Afr J. Biotechnol. 2007,.6(5):497-500.

Salomon S.E and Burbridge, K.M 919850 Wheat Varieties Identificatiopm by Polyacryamide gel, electrophoresis. Flour milling abd Baking Research Association Bulletin, No.2 (FMBA) Chorlaywood, UK, PP. 78-88.

U.S Department of Agriculture, Agricultural Research service. 1993. USDA Nutritient Database for Standard Reference, Release 13. Nutrient Data Laboratory House page, http://www.nal.usda.gov/finic/foodcomp.

APPENDIX A

3.3 EXPERIMENTAL PROCEDURES

The AOAC (1980) guidelines for determining nutritional parameters were followed (Appendix A).

3.3.1 Determination of Moisture Content

Air oven method is used based on weight loose as a result of drying the samples of rice to an acceptable weight in an air oven at a specific temperature and time.

Procedure:

Two Petri dishes were put in an oven at 80°C for 20 minutes, cooled in a desiccators and weighed (W_1).

5g of the samples of rice were put into the dish and then weighed (W_2)

The dish and the sample were then put in an oven to dry at 80°C for 10hours.

The dish were removed from the oven, cooled in a desiccator and reweighed (W_3).

The loss in weight is the moisture content of the rice samples.

$$\text{Moisture content } \% = \left(\frac{W_2 - W_1}{W_3 - W_1}\right) \times 100$$

3.3.2 Determination of Ash

Principle

The residue of ash consists of the inorganic component in the form of their oxides.

Procedure

The crucibles used were cleaned, dried, cooled in a desiccator and weighed (W_1), 5g of the rice samples for both the white and brown was put in the crucibles and weighed (W_2). The samples and the crucibles were heated on a hot Bunsen burner in a fume cupboard until smoking ceased, or until no more soot is given off. It was then transferred to a muffle furnace heated to about 500°C. This heating continued for 24 hours before all the carbon were burnt off. The furnace was then switched off and the crucibles were taken out, covered immediately and placed inside a desiccator and weighed (W_3)

$$\% \text{ Ash content} = \left(\frac{W_3 - W_1}{W_2 - W_1}\right) \times \frac{100}{1}$$

3.3.3 Determination of Crude Fibre

The crude fibre of the samples was determined using AOAC (1980) guidelines (Appendix A).

Procedure:

A container (conical flasks), were weighed (W_1), 2g of the samples were put in the conical flasks and weighed (W_2). H_2SO_4 and NaOH were added to the conical flasks with the samples, which were then put in an oven at 50°C for 6 hours. It was then removed from the oven, cooled in desiccators and reweighed (W_3). Crude fibre is the loss in weight during incineration.

$$\text{Crude fibre content (\%)} = \left(\frac{W_2 - W_3}{W_2 - W_1}\right) \times 100$$

3.3.4 Determination of Crude Protein

Preparation of reagent; was dissolved 0.4g of NaOH in 50ml of distilled water and shaken properly to give 0.2M solution of NaOH.

Procedure

1g of rice samples was taken 5mlsof NaOH solution and 0.5M H_2SO_4 were added to the samples. The samples and the reagents were mixed thoroughly and allow settle for 15minutes. This was then filtered using filter paper. 5ml of filtrate was put into clean conical flask, and 5ml of distilled water was added. 2drops of methyl orange indicator was added and shaken. This was titrated against 0.5M. H_2SO_4.

Equation of reactions:

$$2NaOH + H_2SO_4 \rightarrow (Na)_2\,SO_4 + 2H_2O$$

$$\frac{Titre\ value \times molarity\ of\ acid \times \times 0.014 \times 10}{weight\ of\ sample} \times 100 = Nitrogen\ (N)$$

Crude Protein = Nitrogen × 5.90

3.3.5 Determination of Lipid Content

The lipid content of biological materials can be estimated by directly extracting the dry materials exhaustively using suitable lipid content like petroleum ether at 40 - 60°C.

Lipids in a convenient continuous extractor, such as soxhlet, Bolton type. Direct extraction gives a portion of free fat.

Procedure

Two containers (thimbles were cleaned and weighed (W_1), 5g of the samples was taken into a thimble (container) and weighed. (W_2). Petroleum ether was added to the thimbles with samples. The thimbles or containers with sample were placed inside a soxhlet extractor. The soxhlet extractor with the thimble plus sample is filled into the flask, which is sitted in Bunsen burner. Heat was increased carefully and slowly until the solvent boils. (Condensed solvent vapours were collected in the thimble and dissolve the lipid in the sample. The solvent with dissolved lipid continuously ran back into in the flask). The process was continued for 6 hours when the thimble with contents were removed, dried in an oven at 50°C for 8hours, cooled in a desiccator and reweighed (W_3).

$$\text{Lipid (\%)} = \left(\frac{W_1 - W_3}{W_2 - W_1}\right) \times 100$$