PRODUCTION AND EVALUATION OF COMPOSITE BREAD FOR MANAGEMENT OF TYPE II DIABETIC PATIENTS IN YUSUF DANTSOHO MEMORIAL HOSPITAL, KADUNA, NIGERIA

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FACULTY OF LIFE SCIENCES

AHMADU BELLO UNIVERSITY, ZARIA

NIGERIA

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MAY, 2017.

APPROVAL PAGE

This is to certify that this is an original work undertaken by Haruna Aishatu Msc/Scie/21344/2012-2013 has been prepared in accordance with the regulations governing the preparation and presentation of project in Ahmadu Bello University, Zaria.

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DEDICATION

This dissertation is dedicated to God for His kind protections and provisions.

DECLARATION

I declare that the work in this project report /thesis/dissertation entitled "PRODUCTION AND EVALUATION OF COMPOSITE. BREAD (FOR MANAGEMENT OF TYPE II DIABETIC PATIENTS IN YUSUF DANTSOHO MEMORIAL HOSPITAL, KADUNA", has been performed by me in the Department of Biochemistry Ahmdu Bello University, Zaria under the supervision of Prof. Sani Ibrahim and Prof. H. M. Inuwa. The information derived from the literature has been duly acknowledged in the text and a list of references provided. No part of this Project Report/Thesis/Dissertation was previously presented for another Degree or Diploma at any university.

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CERTIFICATION

This Project Report entitled "PRODUCTION AND EVALUATION OF COMPOSITE BREAD FOR MANAGEMENT OF TYPE II DIABETIC PATIENTS IN YUSUF DANTSOHO MEMORIAL HOSPITAL, KADUNA" by Haruna Aishatu meets the regulations governing the award of the degree of MSc Nutrition of Ahmadu Bello University, and is approved for its contribution to knowledge and literary presentation.

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ABSTRACT

The aim of this present research is to produce and asses the use of composite bread as part of dietary management of type 2 diabetes mellitus patients at Yusuf Dantsoho memorial hospital tundun wada, Kaduna. Ethical clearance and approval for the study was obtained from Kaduna state Ministry of Health, Scientific and Technical Committee. Informed verbal consent in the language understood by the patients or caregivers were obtained by giving questionnaires. The product was prepared by using wholewheat, banana, orange, salt, sugar, yeast, margarine and water. The product was prepared by mixing, moulding, kneading, cutting, shaping, proofing, baking, cooling and packaging. The product was subjected to sensory evaluation and overall acceptability range from 7 – 8. Diabetic patients were fed with bread samples, fasting blood glucose level, 2 hours postprandial, physiochemical properties, proximate analysis were evaluated and glycated haemoglobin (HbAic) test were carried out. Results of physiochemical properties of the composite bread, wholewheat bread and white bread indicates appearance to be brown in colour, taste sweet, pH ranges from 5.58 – 5.74, average weight of loaf 543. 34 – 585. 23g, ascorbic acid for composite bread, (0.41mg/g), energy ranges 1165. 21 – 1205.32kj/100g, brix content 2% - 22%. Proximate analysis indicates percentage moisture 34.14% - 38.74%, ash 0.75 – 1.52%, acid insoluble ash 0.26% - 0.38%, crude fat 5.00% - 6.50%, crude protein 2.88% - 4.33%, crude fiber 0.5% - 6.00%, total carbohydrates 51.25 – 56.73%. Among the 64 diabetic patients, 30 patients were under control. Insulinogenic indices were analysed for both diabetic and non-diabetic patient. The research shows that enriched composite bread have higher nutrients content and can be used to manage type 2 diabetes mellitus.

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DEFINITION OF TERMS/ABBREVIATION

Diabetes Mellitus	(DM)
Insulin Dependent Mellitus	(IDDM)
Non insulin dependent mellitus	(NIDDM)
Protein energy malnutrition	(PEM)
Oral glucose tolerance test	(OGTT)
Glycemic Index	(GI)
Glycated Haemoglobin	(HbAic)
Insulinogenic Index	(II)
Fasting blood sugar	(FBS)

CHAPTER ONE

1.0 INTRODUCTION

Diabetes mellitus (DM), commonly referred to as diabetes, is a group of metabolic diseases in which there are high blood sugar levels over a prolonged period. Symptoms of high blood sugar include frequent urination, increase thirst and increased hunger (Passmore,1989). If left untreated, diabetes can cause many complications. Diabetes is due to either the pancreas not producing enough insulin or the cells of the body not responding properly to the insulin produced (Passmore,1989).There are four main types of DM.Type 1 DM results from the pancreas failure to produce enough insulin. This form was previously referred to as "insulin dependent diabetes mellitus (IDDM) or juvenile "diabetes" (Passmore,1989). Type 2 DM begins with insulin resistance, a condition in which cells fail to respond to insulin properly. As the disease progresses a lack of insulin may also develop. This form was previously referred to as "non insulin dependent diabetes mellitus" (NIDDM) or "adult – on set diabetes." The primary cause is excessive body weight and no enough exercise (Passmore,1989).

Gestational diabetes, is the third main form and occurs when pregnant women without a previous history of diabetes develop high blood sugar levels. Malnutrition related diabetes which occur due to protein energy malnutrition and also found in patient with history of childhood malnutrition due to poor socio-economic status. As of 2014, an estimated 387 million people have diabetes worldwide, with type 2 DM making up about 90% of the cases. (W.H.O, 2014) This represents 8.3% of the adult population, with equal rates in both women and men from 2012 to 2014, diabetes is estimated to have resulted in 1.5 to 4.9 million deaths each year. The number of people with diabetes hasbeenforecasted to increase to 592million by 2035 (W.H.O, 2015). DMis a significant contribution to medical morbidity and mortality risk worldwide. Many factors

are involved in the etiology of DM. The general risk factor include age, obesity, physical inactivity and family history/previous history of gestational diabetes and poor eating habit. Diet supplies a significant portion of nutrients required for growth, maintenance of health andwell being. Dietary management is safer and cheaper.The use of special diabetes imported food supplement and drugs appear to be of no additional advantages in the management of diabetes, dietary control can be met with locally available commonly used foods which are more economical.Plant based diets (especially whole foods) may successfully prevent, treat and even reverse type 2 diabetes including in children. Michael G, (2016) Composite bread is bread produced from mixtures of two or more flours. Composite bread produced from wholewheat flour, soyabean flour, banana and orange is highly nutritious and anti-diabetes. Dietary fibers in cereal, legumes, vegetable and fruits, contribute bulk to the diet and therefore helps in keeping calorie intake low at the same time promoting weight loss (Eleanor et al., 2013).

1.1 STATEMENT OF THE PROBLEM

DM is a severe major health problem that is increasing rapidly both in developed as well as developing countries predisposing suffers increase to cardiovascular mortality and serious morbidity and mortality related to development of nepropathy, neuropathy and retinopathy.The production of wheat in Nigeria is extremely low, compositing wheat flour with locally available cereals and fruits have been reported to be desirable (Adebowale et al., 2012). Diabetes drugs, on the other hand, have been found to increase the risks of heart attack, heart failure and death. Diet, regular exercise and weight loss may work just as well against diabetes. Michael G, (2016).There is a need to substantiate general claims in the society that locally produced foods can be used in the management of diabetes mellitus. There is a need to reduce ill health that result from dietary management hence this study. (Atlay and Laksonen, 2012).

1.2 JUSTIFICATION

Diet therapy has the double advantage of ameliorating DM while preventing hyper cholesterolaemia. There is a need to reduce complications that result from poor control of DMusing dietary management. Locally produced foods can be used in the management DM. Ideally, the initial management of NIDDM should be based on dietary therapy combined with increased physical activity. (Diabetes Prevention and Control 2012).

1.3 AIM

The aim of this research is to assess the use of composite bread as part of dietary management of type 2 diabetes mellitus patients.

1.4 SPECIFIC OBJECTIVES

The specific objectives are to;

i. Determine demographic and socio-economic status of type 2 diabetic patients.
ii. Document the knowledge attitude and practice of diabetic patients regarding dietary management.
iii. Determine physcochemical properties and sensory evaluation of formulated composite bread.
iv. Determine the glyceamic index of the formulated composite bread inType 2 diabetic patients.
v. Determinethe insulinogenicindex of the composite bread in type 2 diabetic patients.

1.5 SCOPE OF THE STUDY

The scope of the study has to do with the area coverage. The scope of this research work covered Tudun Wada, Kaduna South Local Government, Kaduna.

1.6 LIMITATIONS OF THE STUDY

Constraint encountered while conducting the study

a) The researcher identified monetary constraint or financial disability which is needed from the beginning to the end of the research work.

b) Also, combining domestic and office work with study has not been quite easy as a researcher

c) Political instability/strike action by the staff of Yusuf Dantsoho hospital.

CHAPTER TWO

2.0 LITERATURE REVIEW

2.1 Diabetes Mellitus

Diabetes mellitus (DM) or simply diabetes is a chronic disease that occurs when the pancreas is no longer able to produce insulin, or when the body cannot make good use of the insulin it produces. Insulin is a hormone made by the pancreas, that acts like a key to let glucose from the food we eat pass from the blood stream into the cells in the body to produce energy. All carbohydrate foods are broken down into glucose in the blood. Insulin helps glucose get into the cells (W.H.O, 2012).

Diabetes occurs when the body becomes unable to handle glucose (sugar) which builds up to dangerous levels in the blood. A diagnosis of diabetes is usually made when a blood sugar test is consistently above (7.0mmol/l after an eight-hour fast). Fasting blood sugar (FBS) levels of (5.6-6.9mml/l) are known as pre-diabetes.Of the 16 million diabetics in America it is estimated that 17million don't know that they have the disease.As the disease progresses, its effects are devastating, affecting all organs of the body and gradually destroying them. Considering the risks of unrecognized or poorly controlled diabetes (W.H.O, 2012)`:-

i. Eight out often diabetes develop eye problems.Diabetes is the leading cause of new blindness in developed countries.
ii. Diabetics are 18 times more likely to experience serious kidney damage than non diabetics.Some 25 percent of kidney dialysis patients are diabetics.
iii. Diabetes is a potent promoter of atherosclerosis (plugging of the arteries). The result is that diabetes doubles the risk of heart attack and stroke. It can also lead to sexual impotence, hearing impairment, intermittent claudication (disabling leg cramps) and gangrene (half of all foot and leg amputations in adults are from this cause).

iv. The estimated Nigeria and global prevalence of diabetes mellitus are 1,707,000 and 170,000 respectively the figure has been estimated to increase to about 438 million by the year 2025. (W.H.O, 2012).

2.2 Types of Diabetes Mellitus

Diabetes mellitus are classified, basically into the following groups. Type 1 diabetes, Type 2 diabetes, malnutrition related diabetes mellitus and Gestational diabetes mellitus

2.2.1 Type 1 diabetes mellitus

Type 1 diabetes commonly known as insulin dependent diabetes mellitus (IDDM), immune mediated or juvenile onset diabetes. Occurs as a consequence of an autoimmune mediated, destruction of pancreatic β-cells (I.D.F, 2009). It is believed that a combination of genetic and environmental factors such as certain viruses may also contribute to the development of the disease particularly in people who already have a genetic predisposition for the disease. Type 1 diabetes is a major metabolic disorder in childhood or adolescent irrespective of gender, young individual typical have a rapid rate of β-cell destruction and present with ketacidosis, affected individual require daily administration of insulin injection (Moussa, 2010).

2.2.2 Type 2 diabetes mellitus

Type 2 diabetes generally known as non – insulin dependent diabetes mellitus (NIDDM), occur in individual over 40 years of age or those with a family history of diabetes (W.H.O, 2012). In these case the pancreas produce insulin but the body is absolutely incapable of utilizing it and with time however, there is progressive β-cell failure and absolute insulin deficiency. Type 2 diabetes is associated with a decreased of glucose into muscles and adipose tissues which lead to chronic extracellular hyperglycemia resulting in tissue damage and pathophysiological

complications involving heart diseases, atherosclerosis, cataract formation, retinopathy and others. Several possible factors leading to the development of NIDDM include Obesity, diet and physical inactivity increasing age, insulin resistance, family history of diabetes, less than optimum intrauterine environment and ethnicity. (I.D.F, 2009).

Studies demonstrates a strong relationship to fat-both fat in the diet and fat on the body. The disease is rare in areas of the world where fat intake is low and obesity uncommon. Normally insulin, a pancreatic hormone, enables body cells to use glucose and controls blood sugar levels. But most of the time the problem is adult onset diabetes is not a defective pancreas unable to produce sufficient insulin, but a lack of sensitivity to insulin. This resistance of the cells to insulin appears to relate directly to obesity and to excess fat in the diet and possibly in the liver.

2.3 Treatment of Diabetes

Several treatment have convincingly demonstrated that most type 2 diabetic can normalize their blood sugar levels, often within weeks, by following a simple diet, very low in fat and high in fiber, coupled with daily exercise lowering the amount of fat, oil and grease in the diet play the crucial role. (W.H.O, 2012). When less fat is eaten, less fat reaches the blood stream and the liver hence begins a complicated process that gradually restores the sensitivity to insulin which can then facilitate the entry of sugar from the blood stream into the body cells. The effect is often dramatic. A type II diabetic who lowers daily fat intake to about 10 percent of total calories can often brings blood sugar levels to normal ranges in less thaneight weeks. Many are eventually able to get off diabetic medication entirely both pills and injections.

Eating more natural fiber rich foods, plays an important role, by helping stabilize blood sugar levels. When foods are eaten without their normal complement of fiber, blood sugar levels can quickly shoot up. Normally a surge of insulin counteracts this. People who consume refined

foods, drinks and snacks high in calories but low in fiber may experience hikes and dips in blood sugar level all day long. High fiber foods, on the other hand, smooth out these blood sugar, fluctuations and stabilize energy levels.

Active physical exercise has an insulin like reaction in that it burns up the excess fuel (blood sugar and fatty acids) more rapidly.

The foremost recommended lifestyle modification for diabetes, however is loosing weight. Obesity is far and away the most common non-genetic component contributing to the development of diabetes.

Normalizing body weight is often all that is necessary to bring the blood sugar back to normal. The low fat, high fiber diet will greatly aid this effort, as with regular, active exercise. (Dr. Ealearnor 2009)

2.4 Consumptionof Fiber

The human intestine can break down, digest and absorb any food ingredients except vegetable fiber. Fiber is eliminated with stool exactly the way it entered through the mouth, only larger due to its ability to retain water.About 25g of vegetable fiber is required for stool to be sufficiently large and for proper bowl function of the two type of fiber-insoluble (bran) and soluble (mucilage and pectin) the latter is most recommended. (Jean, C. 2009).

2.5 The Benefit of Fiber

i. Promote the fullness, thereby preventing obesity.
ii. Keeps stools soft and voluminous, facilitating its journey through the bowels.
iii. Regulates glucose entering the blood, and thereby reducing insulin needs.

iv. Reduces reabsorption of biliary acids, making the liver utilize more cholesterol for bile production and reducing its level in the blood.

v. Stimulate growth of bacterial flora in the bowel (beneficial intestinal bacteria) causing more vitamins to be produced.

vi. Prevents the following diseases. Diverticulosis and diverticulitis, inflammatory bowl disease, gallstones, hemorrhoids and colon cancer and diabetes.(Jean, C. 2009).

2.6 Symptoms of High or Low Blood Glucose

According to the American Diabetes Association. Some of the most common symptoms of high blood glucose or low blood glucose

High Blood Glucose	**Low Blood Glucose**
Frequent urination	Shakiness
Excessive thirst	Sweating
Blurred vision	Fast heart beat
Increased fatigue	Blurred vision
Irritability	Passing out
Ketones (ketoneacididosis)	Seizure
Shortness of breath	Hunger
Nausea and vomiting	
Very dry mouth	

If you are experiencing any of these symptoms test your blood glucose. If your test result is below 2.8mmol/l or above 13.9mmol/l contact your health care professional immediately. (American Diabetes Association, 2013).

Table 2.1: Diabetes in the W.H.O (2012)Prevalence in African Region

Country	2000	2030
Algeria	426,000	1,203,000
Angola	51,000	140,000
Benin	87,000	266,000
Botswana	25,000	45,000
Burkina Fatso	124,000	388,000
Burundi	26,000	72,000
Cameroon	70,000	24,000
Cape Verde	7,000	24,000
Central African Republic	18,000	38,000
Chad	97,000	269,000
Comoros	4,000	15,000
Congo	14,000	39,000
Cote d'ivoire	264,000	636,000
Democratic Republic of the Congo	291,000	910,000
Equatorial Guinea	8,000	21,000
Eritrea	47,000	142,000
Ethiopia	769,000	1,820,000
Gabon	8,000	14,000
Gambia	22,000	61,000
Ghana	302,000	89,000
Guinea	34,000	89,000
Guinea- Bissau	17,000	44,000
Kenya	183,000	498,000
Lesotho	31,000	42,000
Liberia	40,000	154,000
Madagascar	100,000	301,000
Malawi	55,000	118,000
Mali	140,000	405,000
Mauritania	34,000	103,000
Mauritius	111,000	233,000
Mozambique	133,000	273,000
Namibia	25,000	60,000
Niger	108,000	382,000
Nigeria	1,707,000	4,835,000
Rwanda	30,000	77,000
Sao Tome-Principe	1,000	2,000
Senegal	143,000	421,000
Seychelles	8,000	19,000
Sierra Leone	65,000	178,000
South Africa	814,000	1,286,000
Swaiziland	13,000	21,000
Togo	64,000	184,000
Uganda	98,000	328,000
United republic of Tanzania	201,000	605,000
Zambia	70,000	186,000
Zimbabwe	108,000	265,000
Total	**7,020,000**	**18,234,000**

Source: W.H.O (2012)

2.7 Causes of Diabetes Mellitus

The multifactor causes of diabetes depend on the interactions between environmental and genetic factors. It is a combination of these factors that determine whether or not diabetes will develop in any individual (Oli and Nwokolo, 2009).

However the underlying causes of diabetes are the defective production or action of insulin and this could be due to the following agents.

(a) **Genetic factors or defects**

Genetic factors or defects such as mutations of insulin gene are involved in the pathogenesis of diabetes mellitus (Katzenand Matiler 2008). Inborn errors of metabolism such as those associated with pancreatic disorders, mutation of insulin gene as mentioned above, thereby resulting to defects in the formation of insulin molecule etc. Diabetes mellitus is thought to be inherited as recessive characteristics as there is marked increase in its occurrence in the offspring of parents who are both diabetic and in monozygotic twins (Bimblc 2010).

(b) **Environmental factors**

Susceptibility to diabetes mellitus appears to be unmasked by a number of environmental factors acting especially on genetically succeptible individuals. These environmental factors include;

(i) **Viral infection**

Viral infection may trigger in immunologically susceptible people as a sequence of events resulting in B-cell destruction. Among the viruses that have been implicated are rubella, mumps, humancoxacke virus. (Oli and Nwokolo, 2009) described eleven (11) Nigeria patients who developed diabetes after an attack of infectious Hepatitis.The pancreas was probably damaged by the virus (Oli and Nwokolo, 2009). (Passmore, 2009)

proposedthat infection causes a non specific outpouring of catabolic hormones which antagonize insulin action and this triggers the onset of the disorder.

(ii) **Chemical Agents**

A number of chemical agents are known to be toxic to β-cells e.g. Alloxicin, streptozotocin, the rodenticide valcor etc. A high intake of cyanide producing food e.g. certain beans and cassava, may also have toxic effects on β-cells. Other environmental risk factors are sedentary lifestyle, excessive intake of alcohol etc.

(iii) **Auto Immune Factors**

Current immunological theories suggest that diabetes may be an auto immune disease in which the body attacks and destroys its own pancreatic β-cell. Autopsy studies of patients dying of insulin deficiency diabetes have shown that early in the course of the illness, the histology of the pancreas is characterized by intense lymphocytic infiltration surrounding the islet of Langerhans for weeks to months, the inflammatory process being is replaced by damaged tissue and eventual loss of most of the insulin producing β-cells (Katzen and Matiler 2010).

2.8 Malnutrition

There is a widespread of protein energy malnutrition (PEM) in Africa, particularly in the young.Glucose intolerance may result from PEM because of low insulin output. (Nwokolo and Oli, 2009). have recently put forward the hypothesis that secretions in the pancreatic ducts are due to pancreatic disrupt resulting from prolonged lack of food in the stomach and dehydration from gastroenteritis. Low protein diet eaten during convalescence produce a sluggish flow of pancreatic juice which may not dislodge the plugs. Repeated infection and anorexia can enlarge

the plugs which ultimately calcify (Oli2009). PEM in early infancy and childhood may result in partial failure of beta cell function especially in genetically predisposed individual.

Obesity, which could also occur due to malnutrition is a risk factor for NIDDM and the risk is related to both the duration and degree of obesity.

2.9 Signs and Symptoms of Type 2 Diabetes

The sign and symptoms of type II mellitus are as follows (Redwell William, 2004).

1. Increased in thirst (polydipsia)
2. Increased urination polyuria
3. Increased hunger (polyphagia)
4. Weight loss
5. Obesity
6. Glycosuria (sugar in the urine)
7. Hyperglycaemia (elevated blood sugar)
8. Blurringof vision
9. Constipation
10. Weakness, loss of strength
11. Skin irritation or infection
12. Lack of libido (poor sexual performance in men)
13. Acidosis/keto acidosis (accumulation of fatty acid in the blood)
14. Pains in the leg in form of pins and needles
15. Inability of tissue to heal and degenerative changes occurs
16. Recurrent miscarriages and babies dying shortly after birth
17. Dizziness

2.10 Diagnosis of Diabetes Mellitus

Random blood sugar: In many cases diabetes can be diagnosed by single blood glucose estimation. Which may be used as confirmatory test which is the classical symptoms that suggest the diagnosis. A random blood glucose exceeding 11.0mmol/l (200mg/dl) is almost certain to

indicate diabetes. However lower random blood glucose does not exclude it, and some degree of standardization of the condition under which the blood glucose is measured is necessary (Guthrie, 2010).

2.11 Surrogate Markers

The oral glucose tolerance test (OGTT) is an easy, and is commonly used in medical practice as well as type 2 diabetes. It involves the administration of glucose to find out how rapidly it is cleared from the blood stream. It implicates the efficiency of the body to utilizesglucose after glucose load (Guthrie, 2010).

2.12 Food from Studied Group

In 1550BC, the famous Papyrus advised treating diabetes with high fiber wheat grains.Plant foods are still the drug of choice, but now scientists have more sound reason for thinking that they work. In Europe, Asia and Middle East, raw onion and garlic have long been favorite anti-diabetic drug.Ginseng is popular in China. The common edible mushroom is widely used in some parts of Europe to control blood sugar. Barley bread is a common treatment in Iraq for diabetes. Cabbage, lettuce, turnips beans, juniper berries, alfalfa and corianders, Zogole, Accha,seed, trip up as diabetes treatment in many cultures (Guthrie, 2010).

2.13 Dietary Management of Type 2 Diabetes Mellitus

The nutritional management of diabetes mellitus is inseparable from the overall management of diabetes. The balancing of energy expenditure and nutrients involves activities and deeply ingrained habits fundamental to life. Therefore, crucial to the overall management program are the patients attitudes, motivation, knowledge and environment, which must be such that can be incorporated into the patients daily routine permanently. Education of the patient is thus an inseparable component of management (Katzen and Matiler 2010).

There are three methods for treatment and each involves an obligation for the patient to address to a dietary regiment for the remainder of his life.

a) Diet alone

b) Diet and insulin

c) Diet and hypoglycaemic drugs

Approximately 40% of new cases of diabetes can be controlled adequately by diet alone.About 30% require insulin and another 30% will need hypoglycaemic drugs, insulin is needed for juvenile onset cases, While older patients often do not require insulin except when control of their diabetes is disturbed by an illness, infectionor operation (Cook et al 1993). The ultimate goal of management in type 2 diabetesmellitus is the control of blood glucose levels so that food can be metabolized and the patient provided with sufficient energy, adequate nutrition and good nutritional status, thereby preventing diabetes complications. The principle here is to modify the diet as required by the individual.

Type 2 diabetes mellitus could be managed by diet alone or by diet combined with insulin and hopefully exercise. The method of diet therapy most commonly used by diabetes patients is that based on exchange list. Each list including serving size or weight of food and numbers of kcal in addition to the grams of carbohydrates, protein and fat, sodium and dietary fiber content of the food may also be indicated (Guthrie 2011).

2.14 Nutrient Requirement of Type 2 Diabetes Patients

Diabetes patients require the same nutrients as everyone else, however percentage of the nutrients in diabetes diet may differ from normal diet. Although most aspect of dietary management are discussed, the calories restriction may be all that is required to normalize plasma glucose and lipid level (David 2013).

Weight reduction and achievement of ideal body weight is the desired goal in type 2 diabetes this measure alone usually will result in a marked improvement in blood glucose level, a glucose tolerance due to increased insulin sensitivity. In many instances, new level will result in complete normalization of blood glucose level. Even in severe cases of type 2 diabetes weight reduction often allows insulin therapy or oral agent to be discontinued or the dose to be reduced drastically. In addition to correcting hyperglycemia and glycosurea weight reduction is associated with reduced plasma triglyceride and cholesterol level and hypertension, and of which may be important in preventing the development of atherosclerosis complication. Since weight reduction alone improve all the metabolic disturbances that can be influenced by diet, this maneuver becomes a logical goal of therapy in obese diabetes. Weight loss can be achieved by reducing caloric intake (David 2013). It is also recommended that individual using insulin therapy eat at consistent time with the time of actions of the insulin preparation used. The timing and composition of meal and snack must be consistent from day to day and should be eaten at about the sametime each day. The timing and distribution of meal for person with maturity onset diabetes is not critical but concentrated sweets are limited and kilocalories intake must be consistent with diet plan. Usually three meals are recommended to prevent weight gain (Howard, Richard 2013). The daily energy requirement of patients need is determined by age, sex, actual weight in relation to desirable weight, occupation and other physical activities. An approximate range for various group might be considered.

a. An obese middle age or elderly patients with mild diabetes (1000-1600kcal) daily.

b. An elderly diabetes but not overweight (1400-1600kcal) daily.

Once the proportion of carbohydrates, protein and fat are determined for a particular patient, the total daily intake should be divided into meal and snack. The distribution, often consists of three

meals, snack, depending on individual blood glucose level. The principal purpose of snack is to prevent hypoglycemia especially in insulin dependent diabetes mellitus by decreasing the interval of food deprivation and providing calories at the time of peak action of administered insulin.

Carbohydrate Allowance: Recommendations of carbohydrates range from 34-70% of the total kilo calories (Guthric2010). Carbohydrates recommended are complex carbohydrates and fruits that delay the absorption of glucose thereby limiting blood glucose fluctuation. The addition of certain fiber to the diet of diabetes has been reported to lower postprandial glucose level significantly (David 2013) by delaying intestinal absorption of sugar in diet.High fiber content has proved a valuable addition to the dietary management of type 2 diabetes patients,particularly those on insulin treatment. A further potential advantage of food containing fiber is that they tend to be rich in carbohydrates as well, thus the substitution of such high fiber foods promote feeling of fullness because they absorb water thereby reducing energy consumption by displacing dense calories and sweet from diet while donating little energy. Fiber therefore, can help in weight control.High fiber meal eaten for breakfast continue to exert regulatory effect on blood glucose even after lunch. In addition complex carbohydrates also contain vitamins and minerals. However fiber should not be taken in excess as it can create intestinal discomfort even though there is no recommended dietary allowance for fiber but the committee on RDA acknowledged the need for fiber and specify the need should be met for by eating unprocessed fiber containing food (David 2013).

TheWorld Health Organization (WHO, 2004) recommends a daily intake of 27-40gram of dietary fiber (Eleanor et al 2013). A study has also shown that incorporation of 12gram dietary fiber into a breakfast meal decreased postprandial glucose response as seen. In type 2 diabetes

where it has become increasingly evident that addition of dietary fiber reduces the amount of insulin needed (Guthrie2010).

Protein Allowance: The recommended daily intake for protein in diabetic patients in 2-20% (Guthrie 2010). The requirement should be calculated based on ideal bodyweight and the protein intake should be simple particularly since some may be used up in gluconeogenesis. Protein should be of high quality providing all the essential amino acids necessary for adequate nutrition.

Fat Allowance: About 20-30% fat is recommended for diabetic patients (Guthrie 2010). The fat content of diabetic diet should be moderately controlled in the hope of preventing the development of atherosclerosis, cardiovascular and renal diseases.Therefore more recent approaches to the diabetic diet reach beyond a short term objective of preventing hyperglycemia and glycosuriaand aim to delay and minimize micro-vascular complications. It seems prudent to control dietary fat by 10% for the polyunsaturated fat and greater than 10% for monounsaturated fat. The distribution of calories from fat is individualized based on the nutritional assessment and it is dependent on identified lipid.

Vitamins And Minerals: Type 2 diabetes patients like non-diabetic should receive a diet that contains adequate amount of micronutrients like chromium, zinc, potassium, calcium etc. which have been reported to influence insulin secretion and glucose metabolism. Several reports suggest that osteoporosis occurs more commonly in diabetics than in non-diabetics.Thus an adequate intake of calcium should be provided in an attempt to prevent osteoporosis.Fruits and vegetables may be ample. Fruits are generally sweetened with fructose, which can be metabolized without insulin (Guthrie 2010).

2.15 Other Factors that Influence Dietary Management are;

1. Exercise

Fitness-participation in a particular exercise program is a valuable adjunct to therapy regular exercise increase calorie expenditure and is valuable in achieving weight loss in overweight patients. Exercise is therefore recommended for diabetic patients as it enhance glucose utilization thereby reducing the need for it. In addition to keeping muscles, in good condition it should be considered when the diabetic diet is planned so that sufficient calories as well as appropriate amount of food and insulin can be prescribed (W.H.O, 2015).

2. Timing

Release of insulin from its subcutaneous deposit occur continuously and cannot be regulated in response to physiological needs,For this reason the timing of food intake is critical for all diabetics taking insulin injection. Inadequate attention to this aspect of the diet is wide spread among both physicians and patients.It is almost certainly the cause of some diabetes appearing to be “brittle” and many hypoglycemic episodes.It is very important to spread the calories content more evenly over the day.

Wide explosion in blood glucose level can be avoided.Therefore all diabetics receiving insulin should consume some carbohydrate at interval of not more than 3-4hours during the time of the day when they are awake.However the distribution of calories among these meals as a snack before going to bed. However the distribution of calories among these meals and snack must be tailored to individual or patients need. Factors such as timing, type and dose in insulin need should be considered as well as patient life style, work, physical activities, age, habit etc.

Coffee, tea, lime, lemon, cheese (Awara), meat, fish, margarine, vegetable oil, herb, whole-wheat bread,composite bread, fruits and vegetables and spices are allowed to eat in moderate quantity.

Food Not Allowed- are sugar, glucose, honey, cookies, candies, jam, jelly and mammalade, condensedmilk, wine, beer, pork, white flour.

2.16 Prognosis and Complications of Type 2 Diabetes Mellitus

The diabetic patients are twice more likely to develop certain complication than people without diabetes. These long term complication, which may occur later in life include diabetic retinopathy, neuropathy and nephropathy. Clinical evidence of eye disease (retinalhemorrhage, detachment and other changes) may appear in patients that have had the disease for 3-12years. If untreated it can progress rapidly to blindness, myocardial infarction, atherosclerosis, hypertension and stroke among others. The life expectancy for a diabetic child may thus be shortened by 15-19years. (Miller, *et al.*, 2002).

2.17 Some Ways Food Can Affect Diabetes

Overloads of certain foods such as a cause sharp spurts of blood sugar and put a burden on insulin, restricting such foods keeps blood sugar level more even.Other foods like certaincompounds that stimulate the activity and potency of insulin or act directly to regulate blood sugar.Antioxidants in foods such as vitamin C and E may ward-off free radicals. (James, 2002).

2.18 Milk: A Cause of Juvenile Diabetes

Drinking cow's milk during infancy may trigger type 1 diabetes years later in genetically prone youngsters.Evidence that milk can incite juvenile diabetes is mounting. Certain protein in cow's milk provide the antigen (foreign substance) that fools the immune system into attacking tissue, the crucial beta cells in the pancreas, destroying those cells ability to make insulin.Furthermore, infants who are breast fed and deprived of cow's milk for longer periods are much less apt to develop diabetes. New study discovered antibodies indicating an immune reaction to specific

milk proteins in blood of 100 percent of a group of children with type 1 diabetes. The researcher have no doubt that protein could have triggered allergic immune reactions leading to diabetes. In laboratory rats, milk protein trigger diabetes by destroying insulin secreting beta cells. (Harris, *et al.*,2005).

2.19 Fish Forestalls Diabetes

Eating fish may cut in half the chances of developing type II diabetes. That stated fact comes from dutch researchers at the federal institute of public health and environmental protection. They tested 175 normal healthy elderly men and women to be sure they were free of both diabetes and impaired glucose tolerance.A condition that often conclude that fish eaters were only about half as likely to develop diabetes as non fish eatersThe clear message is that something in fish, perhaps the omega 3 ability to handle glucose, staving off diabetes. The amount of fish needed for protection was extremely small, one ounce a day of fish.

2.20 Fat not a Friend of Insulin

Fat restriction can quicken the descent into diabetes. Doctor Lovejoy say's that normal individual who eats lots of fat, notably animal fat, decrease their insulin efficiency and boost their vulnerability to diabetes.If you have diabetes be extra sure to eat foods high in antioxidants such as vitamin E and C and beta carotene.(According toJames 2009).

2.21 Diet for a Diabetic Patient

a. Diabetic patients may take fruits like apple, grape fruit, lime, peaches, you must divide fruit and vegetable diet in five portions through all the day by spreading the food eaten through the day helps to avoid a sudden rise in blood sugar levels.

b. Diabetic patients must take high fibre diet, fibrous diet are cereals, fruits, nuts, pulses, seeds, vegetables. Fibrous diet not only lowers your glucose level but also decreases blood cholesterol.

c. Always try to take whole grain rather than processed food and take things like whole wheat spaghetti and brown rather than white rice (Indian Pakistani). Pakistani and India people do like white rice very much, but if you are diabetic, please avoid these.

d. You may take meat of lamb, beef once or twice a week. Organ meat can also be taken like kidney and heart to meet your vitamin needs.

e. Try to take white meat like poultry, duck meat, etc. in moderate quantity.

f. You may take fish and sea foods of all types. It is recommended to boil, steam, bake or grill fish rather than frying it.

g. Always prefer non-fatty dairy products such as "skimmed milk" non-fat cheese and yoghurt.

h. You may take eggs as well but try to take whitish part not the yellow one as it may increase your cholesterol level.

i. All cheeses can be taken except cottage cheese.

j. You may take all vegetables, onion and garlic as these may lower blood glucose level (Robin, Nwakko Cassandra L, Verd; *et al.*, Diabetes care, volume 36 November, 2013)

Food to Avoid if you are a Diabetic Patients.

a. Sugar, artificial sweetners and honey. It is difficult to omit sugar from your diet at once. I will recommend you to decrease sugar in your diet gradually.

b. Avoid sweet cakes, biscuit, pies white flour from wheat, rye, barley, corn, rice, white bread and pastries.

c. Avoid vegetables which contain larger amount of starch and carbohydrates like potatoes, yam, parships, beef etc.

d. You may take milk, but in small quantity. Avoid fat yoghourt and cheese also be careful not to drink too much coffee and tea and add only as much sugar as is needed fortaste.

e. Avoid fresh fruit juices as these are highly concentrated carbohydrates if you like fruit juices you may dilute one part of juice with 3 or 4 parts of water.

f. Always avoid saturated fats like fatty meat, full fat dairy products, butter, lard. Try to prefer unsaturated fats like olive oil, corn oil, canola oil, sunflower oil, soy oil, avoid cottage cheese as it has a high carbohydrates content and very little fat.

2.22 Bread

Bread is a staple food stuff and is eaten in most countries around the world. It may be described as a fermented confectionery product produced mainly from wheat flour, water, yeast and salt by a series of processes involving mixing, kneading, proofing, shaping and baking (Dewettink*et al.*, 2008). Composite flour had advantage for developing countries as it reduces the importation of wheat flour and encourage the use of domestic agricultural product as flour.

The use of white flour derived from the processing of whole wheat grain by eliminating the outer bran and the components which was aimed at improving the aesthetic value of white bread has also led to drastic reduction in the nutritional quality when compared to bread made from whole grain cereals (Dewettinctet al 2008, Mangu*et al.*, 2011). Recently consumer's awareness of the need to eat foods that have positive impact on health (functional foods) is increasing. Therefore the trend is to produce special bread made from whole ground flour and other functional ingredients known as health bread or functional foods. The development and consumption of such functional foods that contain whole wheat grains not only improve the nutritional status of

the general population but also have been shown to have beneficial effects in the prevention of several diseases, such as cardiovascular diseases, constipation, irritable colon, colon cancer, obesity and diabetes (Rodriquez *et al.,* 2006, Schatzkin*et al.,* 2001, Jideani and Onwubali 2009).

Wheat is a good source of calories and other nutrients but its protein is of lower nutritional quality when compared to milk, soyabean, pea and lupin proteins as its protein is deficient in essential amino acids such as lysine and threonine (Bakke and Vickers, 2007; Dewettink*et al.,* 2008; Jideani and Onwubali 2009).

Recently consumers awareness of the need to eat high quality and healthy foods known as functional foods, that is foods which contains ingredients that provide additional health benefits beyond the basic nutritional requirements is increasing (Ndife and Abbo 2009). Therefore, the trend is to produce specially breads made from whole grain flour and other functional ingredients known as health breads or functional foods (Denettinck*et al.,* 2011).

Jideani and Onwubali (2009) reported that the development and consumption of such functional foods not only improves the nutritional status of the general population but also help those suffering from degenerative diseases associated with today's changing life style and environment. The whole wheat flour has been shown by many researchers to be a rich source of these functional ingredient such as fibre, phytochemicals, minerals, essential amino acids that are located in the bran and fat soluble vitamins contained in the germ of the whole wheat grain (Dewettinck et al, 2011).

The enrichment of bread and other cereal based confections with legumes flours particularly in regions where protein utilization is inadequate has long been recognized. This is because legume, nutritionally proteins are high in minerals, vitamin B and lysine, an essential limiting amino acid in most cereals. (Jideani and Onwubali 2009).High protein soy breads form a popular carrier of

nutrition to vulnerable groups like pregnant and nursing mothers, young and school children in reducing the incidence of malnutrition and at the same time encourage the farmers to grow more soybeans due to the increased utilization (Islam *et al.,* 2012).

2.23 Whole Wheat

A grain of wheat is made up of outer covering (bran) and embryo (wheat germ) and the endosperm. The bran contains most of the fiber, generous amounts of the vitamins and minerals and a bit of protein. The germ is a rich source of B and E vitamins, several minerals and fiber. The endosperm which makes up roughly four fifths of the whole wheat kernel contain mostly starch. It is the only part in making white flour. Ironically, the nutritious bran and wheat germ, which are removed during the milling process are sold for animal feed. The food industry further compound the nutrition problems by adding several artificial chemicals such as propylene (antifreeze to keep bread white),diacetyl tartaric (an amulsifier) to save shortening, calcium sulphate (plaster of Paris) to make it easier to knead large batches of dough.

2.24 Orange

Orange Sweet is known throughout the world. The sweet orange was adopted as an edible fruit. The fruit of the citrus saneness is considered a sweet orange.

Nutritional Importance of Orange

Oranges are the citrus fruit that belong to family of a flowering plant family which also includes pomelo, grape fruit and tangerine/mandarin orange). As native to southeast Asia and now has been cultivated worldwide in warm climate regions. Oranges are classified into general categories, sweet orange and bitter orange. The sweet variety are usually more fragrant, the include navel, Persian, Valencia variety and blood orange. Orange is one of the most common and popular fruit in the world. It is well liked because of its easy availability all year round and it

tastes good. Apart from its delightful taste, oranges also many essential nutrients like vitamin A, B1 and C. One orange supplies nearly 100% of the recommended daily dietary intake of vitamin C. According to caloric count the nutritional value of one orange (131gram). In addition to that, oranges are good sources of amino acids, beta-carotene, folic acid, pectin, potassium, calcium, iron, iodine, phosphorous, manganese, sodium chloride and zinc. An orange packs have been shown to have anti-cancer, anti inflammatory and strong antioxidant properties.

The combination of the high amount of phyto-nutrients and flavonoids in oranges make it one of the best fruits in helping to promote optimal health. Here are four benefits or oranges.

i. Proper brain development: oranges are a good source of folate or folic acid which helps in the proper development of brian.

ii. Strengthen immune system: the strong content of vitamin C in orange stimulates the production of white cells in our body, thus improving the immune system.

iii. Lower high blood pressure; studies have shown that a flavonoid called hesperidin and magnesium in oranges can lower high blood pressure.

iv. Maintain bones and teeth health: oranges are also rich in calcium, which helps protect and maintain bone and healthy teeth.

v. Prevent constipation: fruit contain fiber which help in the elimination of stool.

2.25 Banana

The banana is an edible fruit, botanically a berry produced by several kinds of large herbaceous, flowering plants in the genus musk. The banana fruits develop from the banana heart, in a large hanging cluster made up of tiers (called “hand”) with upto 20 fruits to a tier.

Nutritional Importance of Banana

Banana has a great nutritional significance. The fruit is composed mainly of water as well as carbohydrates which provides energy in the human body. The unripe contains more starch and less sugar as compared to the ripe fruits, its edible portion is easily digestible. Banana contains vitamin A, B and C. Although fat and protein contents are very low, banana are rich in some minerals, notably phosphorus which is essential for bone development and calcium. Chemical composition varies among the different cultures. Nutritional value of banana for 100g; energy 371kj/100g, carbohydrates 22.84g, sugars 12.23g, dietary fiber 2.6g, fat 0.33g, protein 1.09g, vitamin A equivalent 3µg, thiamine (Vitamin B1) 0.031mg, riboflavin (vitamin B2) 0.073mg, niacin (vitamin B3) 0.665mg, pantothenic acid (B5) 0.334mg, (vitamin B6) 0.367mg, folate/vitamin B9 2µg, vitamin C 8.7mg, calcium 5mg, iron 0.26mg, magnesium 27mg, phosphorus 22mg, potassium 353mg, zinc 0.15mg. Banana do not contain sodium, fat or cholesterol. The vitamin C which is found in banana helps the body to defend and heal against infections. This vitamins is also valuable in the synthesis of the connective tissue, absorption of iron and the formation of blood. As banana are free from sodium and very rich in potassium, they can be included in the diet to reduce the risk of high blood pressure. Banana contains natural sugars sucrose, frustose and glucose along with fiber which gives an instant and substantial boost of energy. Banana contains vitamin B6, which helps in the synthesis of antibodies in the immune system. No other fruit contain more digestible carbohydrates than bananas. This is advantageous because the body burns off calories from carbohydrates more easily and quickly than calories from fat or protein. Health and nutrition benefits of eating banana the fiber content present in banana helps in lowering cholesterol level in the body. Banana helps in soothing in upset stomach and is also beneficial for those suffering from diarrhea, the vitamins and minerals present in banana make it a good post-exercise snack. The potassium content in banana regulates

blood pH and prevent from becoming acidic. Banana have been associated with brain stimulation. Banana also have been positive effect in relation to the following ailments; anemia, blood pressure, bowel problems, constipation, depression, heart problems, morning sickness, nervous disorder, stress an ulcer.

2.26 Soybean

Soybean is one of the most important oil and protein crops of the world (Islam, 2007). Soybean contain 30 to 45% protein with a good source of all indispensable amino acids (Serrem, 2011). The protein content of soybean is about 2 times of other pulses 4 times of wheat, 6 times of rice grain, 4 times of egg and 12 times of milks. Soybean has 3% lecithin, which is helpful for brain development. It is also rich in calcium, phosphorous and vitamin A,B,C and D.It had been referred to as "the protein hope of the future" (Islam, 2012).Moreover, 150 flavones contained in soybeans are effective cancer preventive agents for lowering risks of various cancers (Serrem, 2011). Evidence also pointed to the beneficial effects of soy 150 flavones in the prevention of cardiovascular disease (Serrem, 2011)The potential health benefits of soy- 150 flavones, include prevention of osteoporosis via phytoestrogen, effects of 150 flavonesin prevention of revascularization in ocular conditions (Serrem, 2011). The need for strategic development and use of inexpensive local resources in the production of popular foods was recognized by the Food and Agricultural Organization (FAO), the International Institute for Tropical Agriculture (IITA) Nigeria and the Federal Institute for Industrial Research Oshodi, (FIIRO) Nigeria. This led to the initiation of the composite flour program, the objective of which was to seek ways of substituting flours, starches and protein concentrates from indigenous crops for as much wheat as possible in baked products.

2.27 Insulinogenic Index (II)

The term insulinogenic index refers to the ratio obtained by dividing increament of serum insulin levels above fasting values by the relative net increase of serum glucose level, which reflects dynamic interactions between plasma insulin and glucose levels (Seizier*et al.,* 2007). The index could therefore provide an insight regarding the pancreatic beta cell response to changing levels of plasma glucose. Hot *et al.,* (2010) have noted that the glucose and insulin scores of most foods are highly correlated. In other words a low –GI food has a low Insulin Index value and a high GI food has a high G-Insulin Index value. Furthermore the level of glucose in the blood is directly related to adverse reactions such as proteins glycocylation (linkages between glucose and protein). There are some instances, however, where a food has a low glycemic value, but a high insulin index value such as diary foods and to some highly palatable energy dense foods.Some food (such as meat, fish and eggs that contain no carbohydrate essentially have a G-I value of zero) still stimulate significant rise in blood insulin.

2.28 Glycaemic Index(GI)

There has been great interest in G.I. values in food and is defined as the International Area under the blood glucose response curve expressed as a percentage of the response to the same amount of carbohydrate from a standard food taken by the same subject.

Calculation of Glycaemic Index of a Food

The glycemic index is measured by giving a certain quantity of food to subjects (animals) for examples, 50g of a test food and then measuring their blood glucose response over period of two

hours. That response is the compared against a reference food (glucose or white bread) and the average reading gives the glycaemic index of that food. (Jennie Brand *et al.,* 2013).

Glycaemic Index	**Ranking**
Low	0 – 55
Moderate	56 – 69
High	70 or more

The Effects of GI of Food

The glycaemic response to food, which in turn affects the insulin response depends on the rate of digestion and absorption of carbohydrates from the small intestine (Jenkins *et al.*,2010).Legumes compared to cereals raise the blood sugar level slowly (Jenkins *et al.*,Kartas*etal.*,2010, Torsdottire*et al.*,2010). Legumes are rich sources of viscous dietary fiber which in addition have lowering effect on GI. It is important to note that although the addition of fat and protein to a meal containing carbohydrates may result in a lower glucose response (Bjorck&Eimstahl 2013).

The Glycaemic Index of Food Can Help to Lose Weight

The glycaemia index (GI) is a measure of how much a carbohydrate containing food is likely to raise a person's blood sugar, carbohydrate foods can be divided into high, medium, and low GI foods. A food with a high GI will raise blood sugar more than a food with a low GI. Cooking and processing methods also affect the GI value.

Studies have found that a low GI diet may offer health benefits, including:

- Lowered risk of type 2 diabetes
- Better control of blood sugar in people with diabetes.
- Improved blood cholesterol levels in individuals with diabetes.

- Reduced risk for obesity.

Foods that have a high GI include sugars, jams, jellies, and other sweets along with several grain products. These also include foods made with white flour such as white bread, bagels, crackers, pancakes, waffles, and many processed breakfast cereals. Instant rice, short-grain white rice, pasta, French pies, and baking potatoes (russet) are also examples of food with a high GI.

Low GI Foods

Most fruits and vegetables, such as broccoli, spinach, sweet potatoes, cucumbers, lettuce, peppers, apples, oranges, plums and berries, milk and milk products such as yoghurt and cheese, legumes such as chickpeas, beans and lentils, some high fibre breads like heavy mixed grains or 100% stone-ground whole wheat, some high-fibre cereals like all-bran buds and old fashioned oatmeal, whole grains such as barley, bulgar and quinoa pasta.

Low GI foods, such as vegetables and fruits, are often higher in fibre which can help feel full. That means it may take fewer calories when these foods are eaten. Keep in mind that although foods high in protein (e.g. meat, fish, poultry, cheese) will not affect blood sugar much, they still contain calories, so eating too much of these foods can also affect body weight.

The GI is one factor to be considered when planning a healthy diet; however, it is not the most important factor. Nutritious foods with a high GI value do not always need to be avoided. Choosing a healthy diet and physical activity level that you can stick with is associated with successful weight loss.

Table 2.2: Glycaemic Index of Some Foods

Foods	GI
Roasted and salted peanuts	14
Low-fat yoghurt with sweetener	14
Cherries	22
Grape fruit	25
Pearl barley	25
Red lentils	26
Whole milk	27
Dried apricots	31
Butter beans	31
Fettucine pasta	32
Skimmed milk	32
Low-fat fruit yoghurt	33
Whole meal spaghetti	37
Apples	38
Pears	38
Tomato soup, canned	38
Apple juice, unsweetened	40
Noodles	40
White spaghetti	41
All bran	42
Chick peas, canned	42
Peaches	42
Porridge made with water	42
Lentil soup	44
Oranges	44
Macaroni	45
Green grapes	46
Orange juice	46
Peas	48
Baked beans in tomato sauce	48
Carrots, boiled	49
Milk chocolate	49
Kiwi fruit	52
Stone ground whole meal bread	53
Crips	54
Special K	54
Banana	55
Raw oatbran	55
Sweet corn	55

Source: (Jennie Brand *et al.*, 2013)

Medium Glycaemic Index Foods (56 to 69)

Include a few of these foods each day, but again limit portion sizes if you want to lose weight.

Table 2.3 Moderate Glycaemic Index Foods

Muesli, non toasted	56
Boiled potatoes	56
Sultanas	56
Pitta bread	57
Basmati rice	58
Honey	58
Digestive biscuit	59
Cheese and tomato pizza	60
Ice cream	61
New potatoes	62
Coca cola	63
Apricots, canned in syrup	64
Raisins	64
Shortbread biscuit	64
Couscous	65
Rye bread	65
Pineapples, fresh	66
Cantaloupe melon	67
Croissant	67
Shredded wheat	67
Mars bar	68
Ryvita	69
Crumpet toasted	69
Whole meal bread	69

Source: (Jennie Brand *et al.*, 2013)

High Glycaemic Index Foods (70 Or More)

Swap these foods for those with a low GI value or eat them together with a low GI food. Having a jacket potato with baked beans, for example, will lower the GI value of that whole meal.

Table 2.4: High GI Foods

Mashed potato	70
White bread	70
Water melon	72
Swede	72
Bagel	72
Branflakes	74
Cheerios	74
French fries	75
Coco pops	77
Jelly beans	80
Rice cakes	82
Rice krispies	82
Corn flakes	84
Jacket potato	89
Puffed wheat	95
Baguette	97
Parsnips, boiled	97
White rice, steamed	98

2.29 Guide to Glycated Hemoglobin(HbAIc)

The term HbAIc refers to glycated hemoglobin. It develops when hemoglobin, a protein within red blood cells that carries oxygen throughout the body, joins with glucose in the blood, becoming 'glycated'. By measuring glycated hemoglobin (HbAIc), clinicians are able to get an overall picture of what our average blood sugar levels have been over a period of weeks/months. For people with diabetes this is important as the higher the HbAIcthe higher the risk of developing diabetes complications.

How Does Glycated Hemoglobin(HbAIc)Return an Accurate Average Measurement of Average Blood Glucose?

When the body processes sugar, glucose in the blood stream naturally attaches to hemoglobin. The amount of glucose that combines with this protein is directly proportional to the total amount of sugar that is in the system at that time. Because red blood cells in the human body survive for 8-12 weeks before renewal, measuring glycated hemoglobin (HbAIc) can be used to

reflect average blood glucose levels over that duration, providing a useful longer-term gauge of blood glucose control. If the blood sugar levels have been high in recent weeks, theHbAIc will also be greater.

Table 2.5: HbAIc Target

HbAIc target	Mmol/mol	%
Non-diabetes	20-41mmol/mol	4% - 5.9%
Diabetes	48mmol/mol	6.5%
Diabetics at higher risk of hyperglycemia	59mmol/mol	7.5%

HbAIc levels between 5.7% and 6.4% indicate increased risk of diabetes (prediabetes).

What are the benefits of lowering HbAIc?

Two large-scale studies the UK prospective diabetes study (UKPDS) and the diabetes controls and complications trial (DCCT) demonstrated that improving HbAIc by 1% (or 11mmol/mol) for people with type 1 diabetes or type 2 diabetes cuts the risk of micro vascular complications by 25% (UK Diabetes Association, 2014)

Micro-vascular complications includes;

- Retinopathy
- Neuropathy
- Diabetic nephropathy (kidney disease)

Research has also shown that people with type 2 diabetes who reduce their HbAIc level by 1% are;

- 19% less likely to suffer cataracts
- 16% less likely to suffer heart failure
- 43% less likely to suffer amputation or death due to peripheral vascular diseases.

How Does HbAIc Differ From A Blood Glucose Level?

HbAIc provides a longer term trend, similar to an average, of how high blood sugar levels have been over a period of time. An HbAIc reading can be taken from blood from a finger but is often taken from a blood sample that is taken from the arm. Blood glucose level is the concentration of glucose in the blood at a single point in time, i.e. the very moment of the test. This is measured using a fasting plasma glucose test, which can be carried out using blood taken from a finger or can be taken from a blood sample from the arm. However, fasting glucose tests provide an indication of the current glucose level only, whereas the HbAIc test serves as an overall marker of what the average levels are over a period of 2-3months.

When Should HbAIc Levels be Tested

Everyone with diabetes mellitus in the United Kingdom and Nigeria should be offered an HbAIc test at least once a year. Some people may have an HbAIc more often. This may be more likely if you have recently had your medication changed or your health team are otherwise wishing to monitor your diabetes control more than once a year. Although HbAIc level alone does not predict diabetes complications, good control is known to lower the risk of complication.

CHAPTER THREE

3.0 MATERIALS AND METHODS

3.1 Materials

3.1.1 Measuring Equipment for Blood Sugar Level

Glucometer, Contourstrips, Contour needles were all from Bayer plc, diabetes care, Bayer house strawberry Hil, Newbury, Bert, RG,14.1.JA.UK.

HbAic Meterwas fromMay and Bakers, UK

pH meter (CheckmiteScientific Ltd)

Dryer (Neldon DY 180-200)

Murfle furnace (1200^0C, Rangs, Staurt Scientific)

Kjelddahl heater units Kj 120-150 (CentionScientific Ltd. UK)

Water bath (Stuart scientific, (capacity 24 liters)

Bussen burner (Hp 405-3.Jenway)

3.1.2 Materials for Production of Composite Bread

Materials for the production were purchased from Central Market (Abubakar Gumi Market) Kaduna.

Wholewheat flour, Soyabean flour, Orange, Banana, Yeast, Salt, Vegetable oil, Water

3.2 Study Area

The study was conducted at YusufuDantsoho Hospital, Tudun Wada, Kaduna South Local Government. This hospital is in the heart of Kaduna metropolitan.Major tribes attending this hospital are Hausa, Yoruba, few Igbo, Igala, Gwari and others.

3.3 Sampling

The survey design is based on simple random sampling, cross sectional-descriptive, comparative and analytic based study. The subjects of study were volunteers from population of type 2 diabetic patient attending Yusuf Dantsoho Memorial Hospital and healthy volunteers. The patients were forty years and above. Those with other types of diabetics and/or under the age of forty are excluded.

The sample size of this study was determined using the following formula Fisher Karchals.

$$n = \frac{Z^2pq}{d^2}$$

n = sample size

z = standard normal deviation (1.96)

p = population in target or prevalence

q = I-P

d = degree of accuracy desired (0.5)

n = 150

(Onwuka, 2005)

3.4 Ethical Clearance

Ethical clearance for the study was obtained from Kaduna State Ministry of Health scientific and ethical committee (Appendix I).Informed verbal consent in the language understood by type 2 diabetic patients was obtained before administering questionnaire and collection of sample (Appendix II).

3.5 Methods

3.5.1 Pre-Tested Semi-structured questionnaire was used to obtain information from health workers and patients to document demographic, socio-economic status and dietary habit (Appendix III).

3.5.2 Production of Composite Bread

Exactly 1kg of whole wheat flour and 200g of soyabean flour was weighed into a clean dry mixing bowl, 100g of banana and 100g of sweet orange, 20g of yeast, 20g of salt and 100ml of vegetable oil were mixed, 500ml of clean water was added and mixed thoroughly until a smooth dough was obtained, the dough was cut and moulded into desired shapes and kept in greased pans, allowed to prove (double in size) for 1 hour and baked in an oven at a temperature of 230^0C for 30 mins. Brown baked bread obtained was allowed to cool for 2hours, packed in polythene bag and kept until needed for analysis.

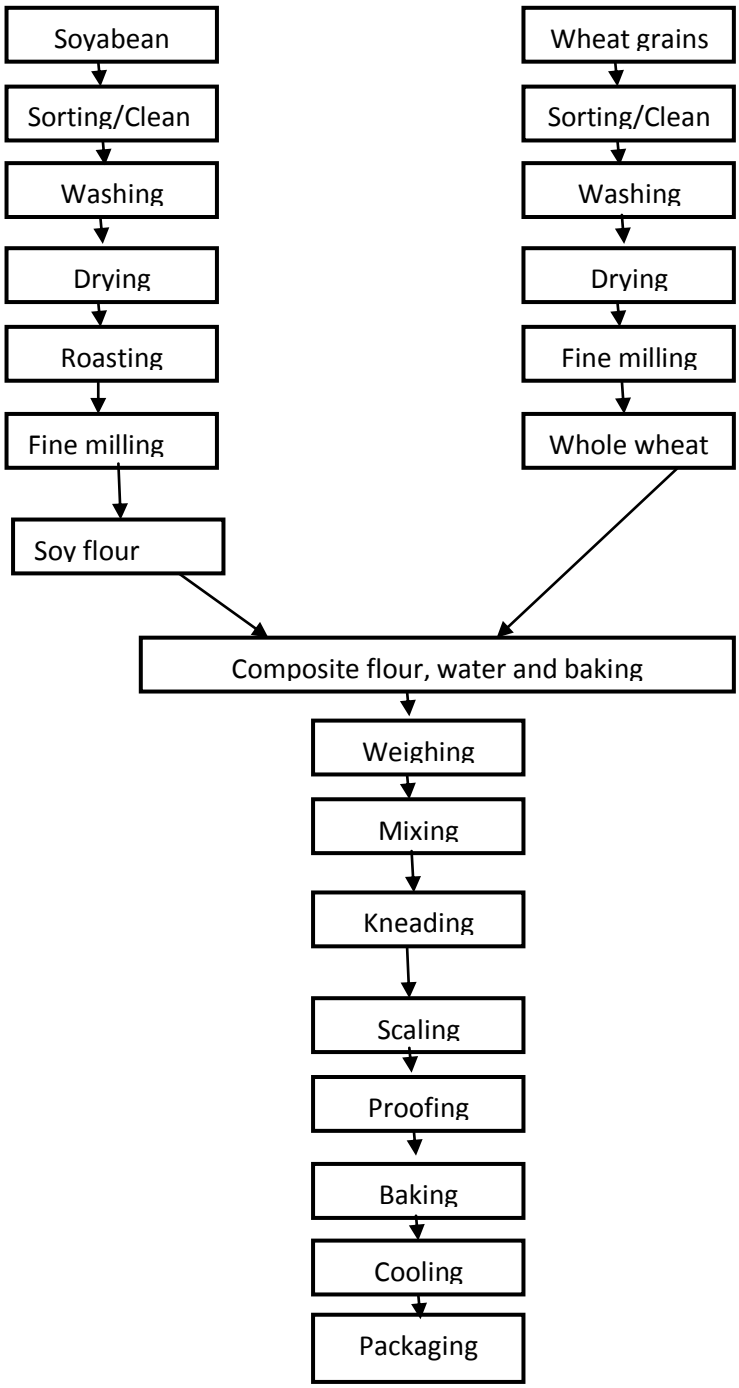


Figure 3.1Flow Chart for Production of Composite Bread

3.5.3 Assessment Physiochemical Properties of Bread

3.5.3.1Assessment of Chemical Properties

A. Assessment of Proximate Composition

(i) Determination of Moisture

Exactly 2g of the bread sample was weighed into a previously pre-weighed dry dishes. Placed in an oven at 103°C for 3 hours. The dishes were transferred into desicators, allowed to cool and weighed until constant weight was obtained (AOAC, 2005)

Calculation weight of the sample

$$\% \text{ Moisture} = \frac{\text{Loss in weight of the sample}}{\text{Weight of the original sample}} \times 100$$

Total solid was obtained by subtracting % moisture from 100

(ii) Determination of Ash Content

Principle

Organic matter in sample is oxidize by combustion in a murfle furnace and remaining residue as the ash.

Procedure

Cleaned crucibles were heated at a temperature of 500°C for 1 hour. 2g of sample (bread) was weighed into crucible, transferred to a murfle furnace, ignited at 550°C for 2 hours until complete ashing. Crucibles were allowed to cool to room temperature then weighed and percentage of the residue was calculated (AOAC, 2005).

$$\% \text{ Ash of Sample} = \frac{\text{Weight of residue after igniting}}{\text{Weight of sample}} \times 100$$

(iii) Determination of Acid Insoluble Ash

To the resulting ash in porcelain dish, 25ml of dilute Hcl 0.5M was added, covered with a watch glass and heated on a water bath for 10minutes. The dish was allowed to cool and the content was filtered using Whatman filter paper no 42. The filter paper was washed with distilled water and the residue were returned to the dish kept in an electric air oven maintained at 130^0C. For about 3hours the residue was transferred into a murtle furnace and the temperature was raised to 600^0C for 1hour, the residues were transfered to the desiccators, cooled and weighed(AOAC, 2005).

% insoluble ash = $\frac{wt\ of\ the\ residue}{wt\ of\ the\ sample}$x 100

(iv) Determination of Crude fat Content in Bread (Rose Gotterb Method)

Procedure

Exactly 2g of bread sample was weighed and transferred into a conical flask, then 10ml distilled water and 10ml concentrated hydrochloric acid were also added The mixture was heated using a heating mantle for 15 minutes until the formation of clear solution, then removed and allow to cool. Absolute ethanol 10ml, was added, allowed to cool completely and 30ml of diethyl ether was added, shaked and transferred into a separating bottle. The mixture was shaked vigorously and separated (AOAC, 2005).

(v) Determination of crude protein by Kjeldahl method

The process involves basically three processes - digestion, distillation and titration. Digestion: The organic matter is oxidized by concentrated H_2S0_4 in the presence of catalyst such as copper, mercury, selenium oxide and nitrogen is converted to ammonium sulphate (NH4) $2S0_4$.

Distillation:-This involves liberation of the ammonia by sodium hydroxide. Ammonia is liberated and distilled into a standard quantity of boric acid.

Titration: The ammonium in acid is then back titrated with standard acid (Hcl). The ammonia is then estimated.

Procedure:

Exactly 2g sample (Bread) was weighed into Kjeldahl digestion flask and antibumbinggranulae (fused alumuna), one gram of catalyst and 20ml of concentrated H_2S0_4 were added. The digestion flask was fixed on the Kjeldahl digestion rack and heated until heating subsided and then heated vigorously with occasional rotation of the flask to ensure even digestion and avoid over heating of content. Heating was stopped when clear solution was obtained. The digest was transferred into 100mi volumetric flasks and dilute to mark with distilled water.

The distillation apparatus was arranged, the comical flask was filled with boric acid. The content was fixed in such a way that it allowed the distillate to pass to the boric acid. The ammonia was absorbed by boric acid. 30ml of the liberated ammonia in the boric acid was collected and titrated with O.lm HCL using methyl red as indicator. The titration was continued until the mixture became pinkish in colour.

The volume of acid used (titre value) was recorded.

Calculation

$$\% \text{ Nitrogen} = \frac{\text{Tritre Value} \times 0.0014}{\text{Weight of sample}} \times 100$$

% Crude proton = N x 6.25 (General factor)

(vi) Determination of Crude Fibre Content in Bread

Procedure

Two grams of sample was placed in a round bottom flask. 100ml of 0.025m H_2S0_4 was added and the mixture boiled under reflux for 30 minutes. The insoluble matter was washed several times with hot water until it was free from acid after filtering. Thereafter, it was transferred into a flask containing 100ml of hot 0.312 m NaOH solution. The mixture was boiled under refluc again for 30 minutes and filtered under suction. The residue was washed with hot water until it was base free. It was dried to constant weight in an oven at 100°C, cooled in the desicators and weighed (C_2). The weighed sample was incinerated in a furnace at 550°C for 2 hours. It was put-off and allowed to cool down. It was removed, cooled in a desicator and weighed (C_3). The crude fibre was calculated(AOAC, 2005).

$$\% \text{ Crude fibre} = \frac{C_2 - C_3}{W} \times 100$$

Where W = Weight of original sample

(vii) Determination of Total Carbohydrate

The carbohydrate was determined by calculation (By differences) (AOAC, 2005).

Calculation

% Carbohdyrate = 100 -(% moisture +%crude Fat + % crude protein + % ash)

(**viii) Determination of Energy Content**(kj/100g)

It was determined by calculation

Energy (Kj/100g) = 4.186 (% crude protein x 4) + (% crude fat x 9) + (% carbohydrates x 4)

B. Determination of Ascorbic Acid, Content Using (Spectronic 21 Spectrophotometer)

Spectrophotometer is an instrument for measuring the intensity of light at various wavelengths transmitted by a solution both at visible and ultraviolet range of radiation. In this method the intensity of light is determined by electric detectors which convert radiant energy to electrical energy. It measures the absorption of a solution at a suitable wavelength of 450 nanometer. This absorbed light is actually what spectrophotometer picks up as current, amplified and recorded by instrument as chart recorder or digital meter.

Procedure

Exactly 2g of bread sample was weighed and 10ml of distilled water was added and mixed thoroughly. The mixture was allowed to stand for 15min, then filtered and filtrate was poured into a curvette and then inserted in the cell of the spectrophotometer connected to electricity which measured the transmittance or absorbance. The concentration of a substance in a solution was calculated and recorded.

C. Determination of Brix in Bread (Using Abbey Refractometer)

Brix refractometer measures the concentration of sucrose in water and used for many sugar-related application. They are used for fruit and juice quality analysis, beverages and food processing, packaging and chemical processing. The refractometer measures percentage sugar in a variety of samples and can measure from brix 0.0 to 85.0%.

Procedure

A sample (bread) moistened with distilled water was inserted on the surface of a glass prism and closed back. Interface was observed through the eyes piece at the top of the refractometer to see the result on the scale and result was recorded.

D. pH Determination

Procedure

Exactly 10g bread sample was "weighed, ground, 100ml distilled water was added and mixed thoroughly. The mixture was allowed to stand for 15 minutes, filtered and filterate collected in a beaker. The pH meter was set and allowed to stablise. The electrode was dipped into water for calibration. The electrode was removed and wiped with cotton wool and inserted into the filterate and the readings were taken.

E. Total Solids

Procedure

2g of Bread samples (2g) was dried in an oven at 105^0C for 2hours. It was removed, cooled in a desicator and weighed. Calculated as % total solid.

3.5.3.2Assessment of the Quality of Bread

A. Appearance of the Composite Bread

This is the most important quality as it is that which first attracts the customer and the patients. Usually it embraces how well the loaf is shaped, the size, and appearances of the crust. The appearance of composite bread was good and attractive with brown golden colour and desirable smoothness by mere seeing, touching, eating and thoroughly looking.

B. Taste of the Composite Bread.

Composite bread had a good smell and an appetizing taste, not too salty or too sweet finally composite bread taste well baked.

3.6 Sensory Evaluation of the Composite Bread

Sensory Evaluation is a subjective food analytical tool that uses the five human senses, sight, hearing, feeling, smell and taste to assess food quality in terms of acceptance or rejection. Sensory evaluation is of great importance in new product development, product improvement, quality maintenance and market research. Human senses have the capacity to perceive organoleptic properties of food such as colour, flavor, texture, taste and appearance. The method adopted was that 20 panelists were provided with Bread samples. A= composite bread, B= whole wheat bread and C= white bread. They were asked to eat each bread, used water to rinse their mouth between tasting and scores the samples based on their degree of likeness and dislikeness and tick as appropriate using 9-point hedonic scale (Appendix v).

3.7 Determination of Blood Sugar Using Glucometer

Blood samples were obtained from the finger tip by pressing the punctured site. Test was carried out immediately after blood drop has formed with a counter strip. Counter strips are intended for self testing by people with diabetes and health care professional to monitor glucose concentration in whole blood. The test provides a quantitative measurement of glucose in blood from 0.6 to 33.3 mmol/l, result in mmol/l (millimoles of glucose per liter). Hands were washed with soap and warm water. this helps increase blood flow to the fingertips. Rinsed and dried thoroughly to help form the blood drop.

3.8 Determination of Glycemic Index of Bread

The method described by (Kenneth 2005) was used. Blood samples were collected and analysed for fasting blood glucose level. 50g of test bread samples were given to the

subject and blood glucose response were measured over a period of 2 hour. Glycemin index was calculated using the following formula.

$$\text{Glycaemic index (GI)} = \frac{\text{Blood Glucose Response test}}{\text{Blood glucose response to the reference food}}$$

3.9 Determination of Insulinogenic Index

Insulin assay was done using a commercially available enzyme linked immunosorbent assay (ELISA) human insulin kit. (centurion scientific Ltd)

Principle

Human insulin ELISA kit is based on simultaneous binding of human insulin from sample to two-antibodies one immobilized on mcirolites well places and other conjugated to the enzyme peroxidase. After a washing step chromaogenic substrate is added and colour developed. The enzymatic reaction (colour) is directly proportional to the amount of insulin present in the sample. Adding stopping solution terminates the reaction. Absorbance was then measured on a microwell strip reader at 450mm and concentration of insulin in samples and control is read off the standard.

Test Procedure

The micro well strips was labeled and 2.5 µl of standards and serum samples were pipetted into appropriate wells in duplicate, then 100µl of diluted-enzyme conjugate were dispensed into each well. The content were gently mixed, the plates were covered and incubated at room temperature 20 - 25°C for 60 mins. The plates was washed 5 times with wash buffer (300µl) using automated plate washer and 100 µ/l substrate was poured into each well, then mixed gently for 10 mins. Blue colour developed in positive wells and reaction was stopped by adding 50 µl of stop solution to all wells, mixed gently for

10 seconds, blue colour turned yellow. The absorbance was read at 450nm using an Elisa Reader within 30 mins).

3.10 Determination of GlycatedHaemoglobin(Using HbAiC Kit)

Glycatedhaemoglobin test serves as an overall marker of persons average blood glucose level over a period of 2 - 3 months. the higher the blood sugar level, the higher the glycatedhaemoglobin.

Procedure

Blood samples were collected from the vein. Blood was placed in the special blood key; clicked to the catridge. Placed in the analyses the reactions automatic, readings was observed and recorded.

3.11 Data Analysis

Statistical Analysis of the obtained data was carried out using descriptive Text, student t-test, analysis of variance and SPSS package.

CHAPTER FOUR

4.0 RESULTS

4.1 Demografic and Socio-Econommic Characteristics of Respondents

Table 4.1 shows demographic and socioeconomic characteristics of respondents. Sex of the respondent were 45 (30%) males and 105 (70%) females.Age distribution of the respondents, 36 (24%) were within age 40-47 years, 41 (27%) of the respondents were within age 48-57 years and 73 (49%) were above Age 57year.Education status of the respondents indicated that 23% of the respondents attended primary schools, 18% attended secondary schools, 12% attended tertiary institutions and 43% of the respondents education attainment was Islamic education.It is clear in table 4.1 that 15% of the respondents religion was Christianity and 85%of the respondents religion was Islam. Table 4.1 also shows occupation of the respondents,14% are civil servants, 26% are traders, housewives are 59%.

Table 4.1:Demographic and Socio-Economic Characteristic of Diabetic Patients

PARAMETERS		FREQUENCY	PERCENT (%)
AGE	40 – 47	36	24
	48 – 57	41	27
> 57		73	49
SEX	Male	45	30
	Female	105	70
EDUCATION	Primary	35	23
STATUS	Secondary	27	18
	Tertiary	18	12
Islamiyya		70	47
	others	Nil	Nil
RELIGION	Christianity	23	15
	Islam	127	85
	Others	Nil	Nil
OCCUPATION	Civil Servant	21	14
	Traders	40	26
	Housewives	89	59
	Others	Nil	Nil

Fig 4.1 shows respondent knowledge of diabetes and its management. From this research findings 61% have knowledge of diabetes while 37% have no knowledge until when they were tested and diagnosed in the hospitals. Knowledge is an essential component of diabetes W.H.O (2012).

4.2 Attitude

It is shown in Table 4.2 the factors that contribute to non adherence to dietary management. Result in table 4.2 shows that 30% of the respondents lack support from spouse and friends.

100% of the respondents said they eat out from homes especially when they travel or during occasions so they eat whatever food comes their way.

47% of the respondents lack self discipline as they said they cannot avoid eating certain foods in large quantities e.g. eggs and refined sugar. It is clearly indicated in table 4.2 that non of the respondents takes alcohol and cigarette. 68% of the respondents are low income earners who practiced petty or small trade.

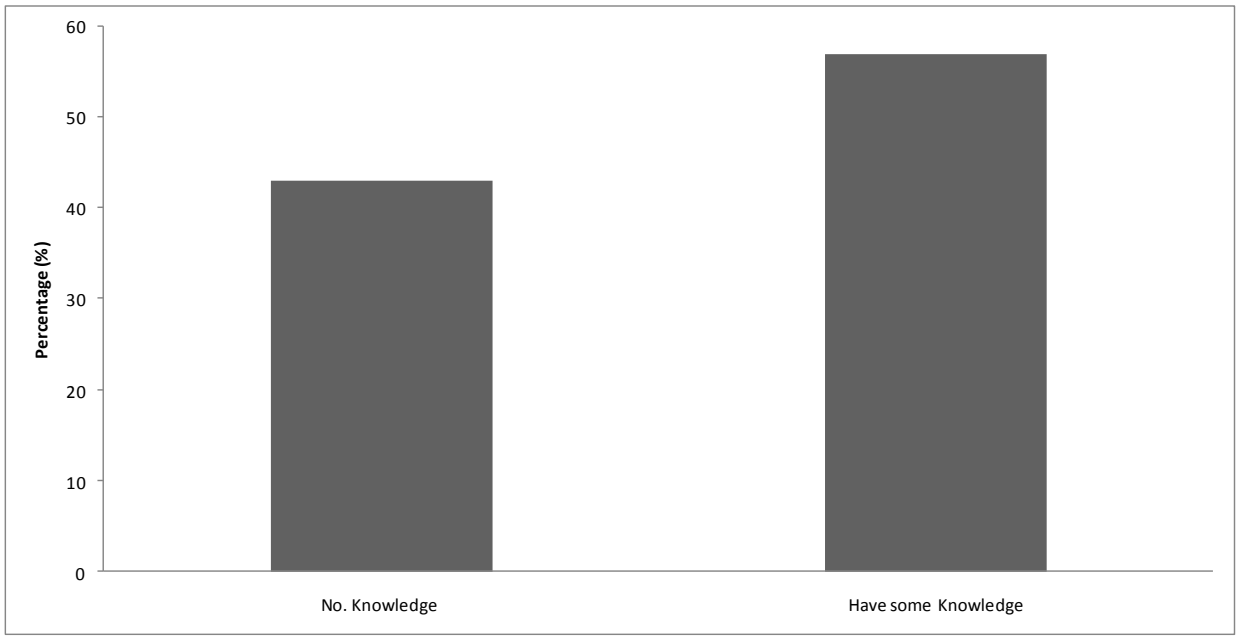


Fig 4:1 Respondents' Knowledge of Diabetes and its management

Table 4.2: Factors That Contribute to Non Adherence to Dietary Management

Factors	Frequency	Percent (%)
Lack of support from spouse and friends	45	30
Eating away from home	150	100
Lack of self discipline	70	47
Taking alcohol and cigarette smoking	-	-
Low income	129	68

Table 4.3 shows the physiochemical properties of the composite bread, whole wheat and white bread. It is clearly indicated that composite bread, whole wheat bread and white bread are brown in colour, the texture soft with porous structure, light in weight not heavy and have sweet taste. The pH of the bread ranged from 5.58 – 5.74. Composite bread had the lowest pH value of 5.58. The values are within the standard pH limits (5.3 – 6.0) for whole wheat composite bread (SON, 2004).Composite bread had the highest average weight of loaf (645.01g) due to dilution of fibre and glutein network. Composite bread also contains (0.4mg/g) of ascorbic acid and are considered functional food with additional health benefits based on their contents of fiber and phytochemicals which have antioxidant potentials.The brix is an indication of the sugar content of the bread samples. The brix value ranged from 2-22%, Hence, composite bread sample with lesser sugar content would be suitable for diabetic diet.

Table 4.4 shows proximate analysis of the baked diabetic bread. The composite, whole wheat bread had the higher value for crude fat (6.50%), ash (1.58%), acid insoluble ash (0.39%), protein (4.33%), than the values in white bread, fat (5.50%), ash (0.73%), crude protein (0.5%), crude fibre (0.5%). respectively. Moisture content of composite, whole wheat bread ranges between (34.14% - 38.74%). The higher presence of fat in the whole wheat composite bread derived from the bran, and germ inclusion, would help to increase fat soluble vitamins. The crude fibre contents of the composite, whole wheat breads were also within the recommended range of not more 6g dietary fiber. High dietary fiber diets from whole grain are associated with the prevention, reduction and treatment of some diseases such as cardiovascular diseases, diverticulosis, constipation irritable colon, cancer and diabetes. The ash content of the bread ranges from (1.50 – 1.58%) and the ash content is an indication of mineral contents of food. Carbohydrates was calculated by difference and energy was calculated using ant water conversion factors. Carbohydrates and energy contents of the bread samples were within the regulatory specifications. Carbohydrates (36.5 – 40%) and energy 1000kj/100g minimum (SON 2004).

Table 4.3: Physcochemical Properties of the Composite Diabetic Bread

Parameter	Whole-wheat bread	Composite bread	White bread
Appearance	Brown	Brown	Brown
Taste	Sweet	Sweet	Sweet
pH	5.69 ± 1.70^{b}	5.58 ± 1.90^{a}	5.74 ± 1.90^{c}
Average weight of loaf (g)	585.23 ± 19.75^{b}	645.01 ± 20.74^{c}	543.34 ± 6.23^{a}
Ascorbic Acid (mglg)	N.D	0.41 ± 0.52^{c}	N.D
Energy (kj/100g)	1165.21 ± 27.85	$1180.03 \pm + 28.05^{b}$	1205.32 ± 34.65^{c}
Brix (%)	18 ± 3.46^{b}	2 ± 1.49^{a}	22 ± 7.3^{c}

n = 3 = Number of bread samples

Values are mean ± SD

N.D = not detected

Table 4.4: Proximate Composition of the Baked Diabetic Bread

Parameters	Whole-wheat bread	Composite bread	White bread
Moisture (%)	38.74±5.01	36.08±4.90[b]	34.14±4.8[a]
Ash (%)	1.52 ± 1.00[b]	1.50±1.20[c]	0.73±0.69[a]
Acid insoluble ash (%)	0.38±0.49[b]	0.39±0.58[c]	0.26±0.14[a]
Crude fat (%)	5.00 ± 1.83[a]	6.50±2.08[c]	5.50±1.91[b]
Crude protein (%)	3.25±1.49[b]	4.33±2.88[c]	2.88±1.37[a]
Crude fiber (%)	3.50 ± 1.53[b]	6.00 ±2.00[c]	0.5 ± 0.57[a]
Total carbohydrates (%)	51.25 ± 4.28[b]	51.52 ± 3.81[a]	56.73 ± 5.08[c]

n = 3 = Number of bread samples

Values are mean ± SD: Values with different superscript across the rows are significant different.

Table 4.5: shows organoleptic properties of the composite bread, whole wheat bread and white bread. The consumer acceptance of the product was tested for the following attributes, taste, texture, colour, aroma and overall acceptability. A nine point hedonic scale was used to score the samples (see Appendix v). Score from the 9-point hedonic scale descriptive test were averaged to obtain mean score.

In terms of the score, the mean score of samples (composite bread) was 8 which means that the panelists like composite diabetic bread very much and it was generally acceptable because of the banana flavour and its slight sweet taste.

Sample B (whole wheat bread) had mean score of 7 which means it was liked moderately by the panelist.Sample C (white bread had mean score of 8 which means it was liked very much by the panelist because it contains higher amount of sugar content and is the sweetest.

As shown in table 4.6: result on the effect of consumption of composite bread, whole wheat bread and white bread on 2hour postprandial blood glucose test, were averaged to obtained mean score. The result showed a decrease in blood glucose level of diabetic patients after consumption of composite bread on 2hour postprandial blood glucose test. There was also a slight decrease in patients blood glucose concentration after consumption of whole wheat bread on 2hour postprandial blood glucose of type 2 diabetic patients. But there was an increase in blood glucose of diabetic patients two hours postprandial test after the consumption of white bread.

Number of patients in each group are 120 patients consumed composite diabetic bread, 30 patients consumed wholewheat bread and 15 patients consumed white bread.

Table 4.5: Organoleptic Properties of the Composite Diabetic Bread

Attributes	Taste	Texture	Colour	Aroma	Overall acceptability
A	8	8	8	8	8
B	7	7	8	7	7
C	9	8	8	8	8

The mean scores of samples using a nine point hedonic scale (See Appendix v)

Sample A = composite Bread

B = whole-wheat bread

C = white bread

Score A – Like very much

B – like moderately

C – Like very much

Table 4.6: Effect of Consumption of the Composite, Wholewheat and White Bread on Postprandial Blood Glucose of Type 2 Diabetic Patients(Mmol/L).

GROUP	Fasting Blood Glucose	Postprandial Blood Glucose
Composite Diabetic bread	12.10 ± 6.59^{b}	11.60 ± 6.42^{a}
Whole wheat bread	9.35 ± 2.31^{b}	9.03 ± 2.43^{a}
White bread	11.53 ± 4.74^{a}	14.49 ± 6.78^{b}

n = 3

Values are mean ± SD. Mean with different superscripts across the row are significantly ($P<0.05$) different

n = 3 = Number of Bread Samples

n = 120 – composite diabetic bread

n = 30 – wholewheat bread

n = 15 – white bread

Figure 4.2 Shows variation in blood glucose (with time) of healthy subject that consumed the bread sample. The maximum increase in the blood glucose level was lower in healthy subjects that consumed composite.Whole wheat and white bread and the blood glucose level of healthy patient decreased and dropped back to normal after 2hour postprandial test. The blood glucose level test was carried out at an interval of 0hours, 0.5hours, 1hour and 2hours.

Figure 4.3 ShowsGlycaemic Index of healthy subjects that consumed bread samples, white bread had glycaemic index of 100, whole wheat had glycaemic index of 61 and composite bread had glycaemic index of 59.

Figure 4.4 Shows variation in blood glucose (with time) of diabetic patients that consumed bread samples. In the diabetic patients composite bread and whole wheat had significant effect in decreasing blood glucose level. The incremental value of blood glucose was higher in diabetic patients that consumed white bread and the blood glucose level could not drop back to normal after 2hour postprandial test. There was an increment in blood glucose level of type 2 diabetic patients at 0hour, 0.5hour, 1hour, 1.5hour and 2hours blood glucose test.

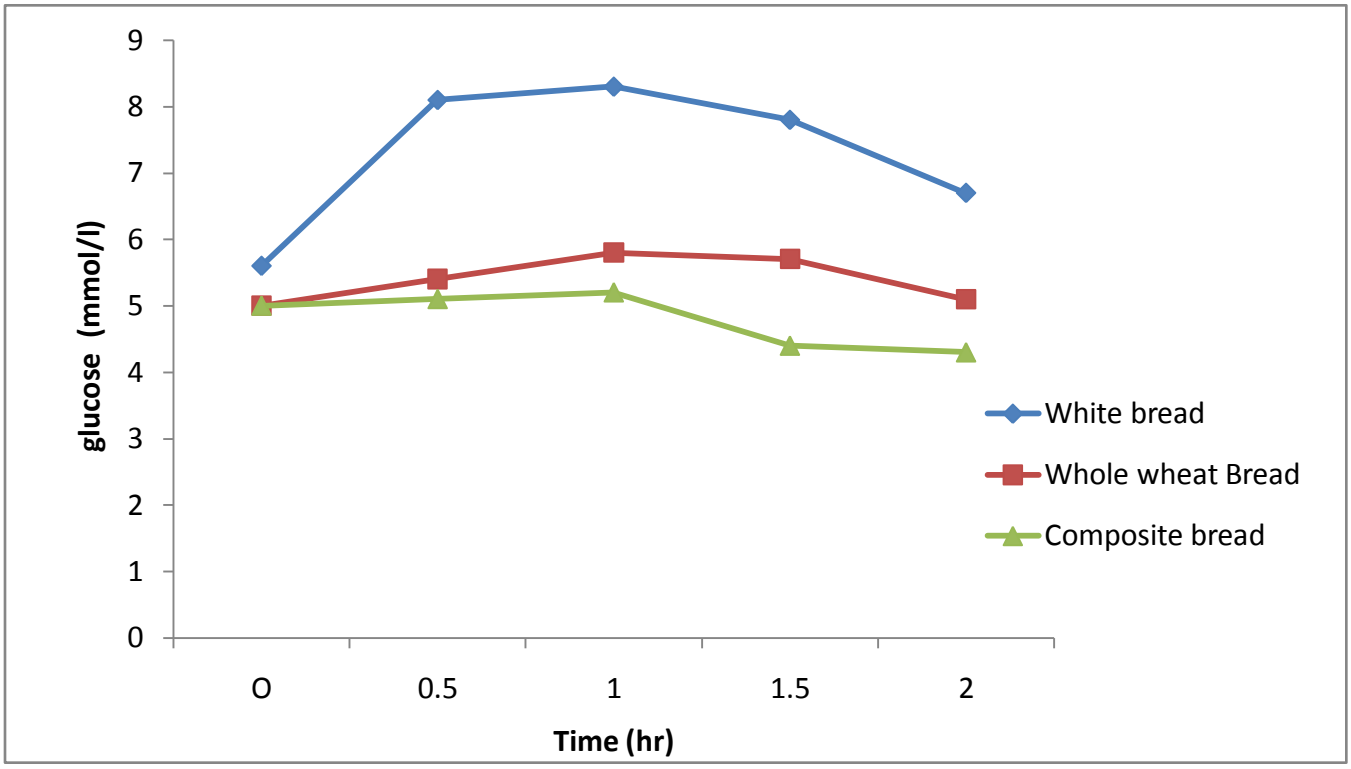


Figure 4:2Variation in Blood Glucose (with time) of Healthy Subject that Consumed the Bread Samples.

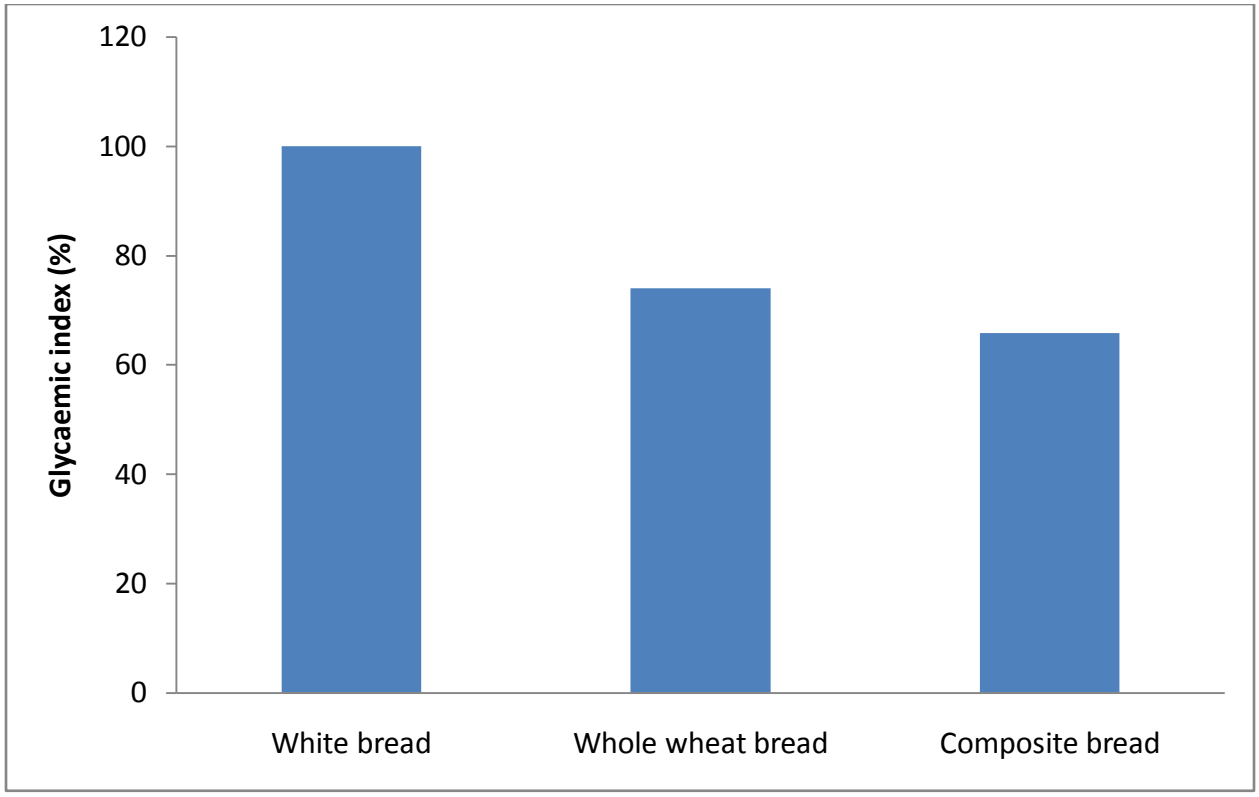


Figure 4:3Glycaemic index of Healthy subjects that consumed white bread, whole wheat bread and composite bread.

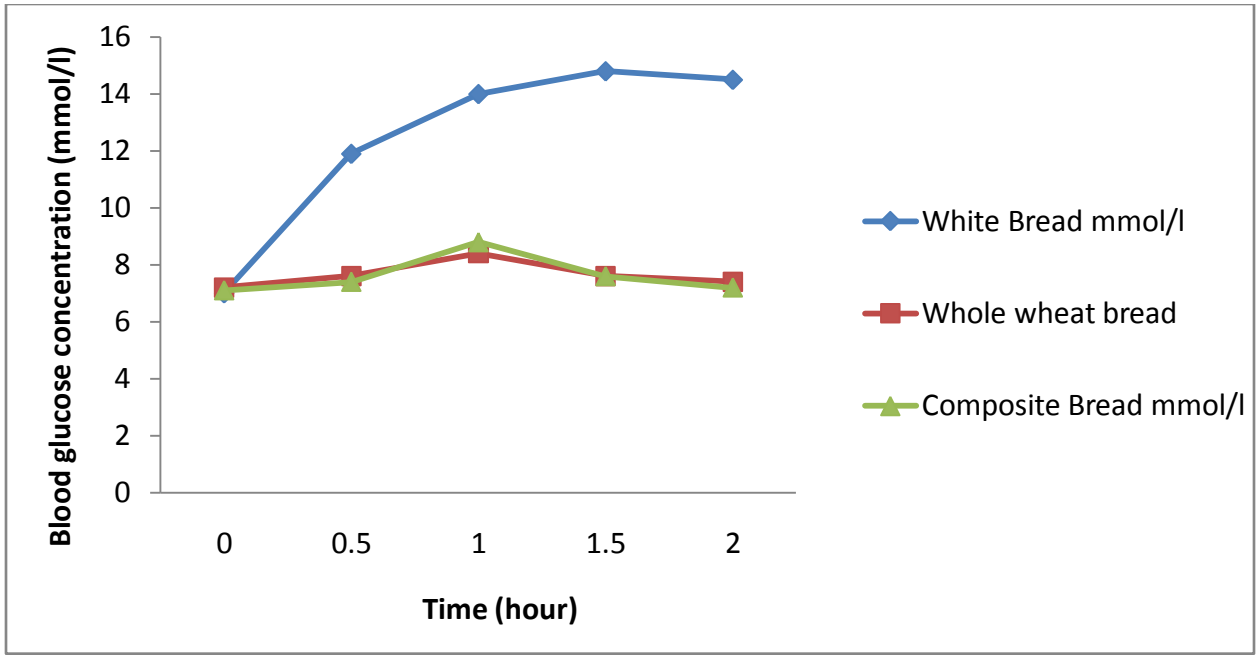


Figure 4:4Variation in Blood Glucose (with time) of Diabetic Subjectsthat Consumed White Bread, Whole Wheat Bread and Composite Bread.

Table 4.7 Shows variation of blood glucose and insulin level in diabetic and healthy subjects. The result indicated that mean serum glucose was higher in diabetic patients (12.87mmol/l) than in healthy subjects (6.9mmol/l). Diabetic patients had lower insulin level (3.93μu/ml) than healthy subjects (5.54μu/ml).

Figure 4.5 shows Insulinogenic Index of type 2 diabetic patients and healthy subjects. The result indicates that diabetic patients exhibit lower insulinogenicindex than healthy subjects. insulinogenic index is a frequently used index of βeta-cell function. Diabetic patients exhibited lower insulinogenicindex suggesting poor pancreatic beta cell functions.

Figure 4.6 Shows distribution of diabetic patients based on glycatedhaemoglobin (HbAIC) target. HbAIC shows an overall pictures of what the average blood sugar level have been over a period of weeks /months. HbAIC has a target of which 0 – 4% is non diabetic, 4-5% is prediabetic 5-7% means a person is still diabetic but when a patientsHbAIC is greater than seven (>7), the patient is at risk of developing diabetic related complications.

From the result findings in figure 47 indicated that among type 11 diabetic patients tested for HbAIC two patients were able to control their diabetic and their HbAIC fell between 0-4% 18 patientsHbAIC were between 4-5% meaning they are pre-diabetic, 10 patients have their HbAIC between 6-7% meaning they are still diabetic but 34 patients whose HbAIC are still greater than (>7%) are at risk of complication and need control. Therefore HbAIC measurement provides an effective tool for evaluating long term management and degree of control of type 2 diabetic patients.

Table 4.7: Variation of Blood glucose and Insulin Levels in Diabetic Patients

Parameter	Group	Fasting Levels	Blood Glucose Concentration after Consumption of White Bread
Serum glucose (mmol/l)	Diabetic	10.26 ± 1.72^{a}	12.87 ± 1.71^{b}
	Healthy	5.34 ± 1.06^{a}	6.90 ± 0.75^{b}
Insulin (µIU/ml)	Diabetic	2.32 ± 1.29^{a}	3.93 ± 2.50^{b}
	Healthy	2.48 ± 0.58^{a}	5.54 ± 1.19^{b}

Values are mean ± standard deviation. Mean with different superscripts across the row are significantly ($P<0.05$) different

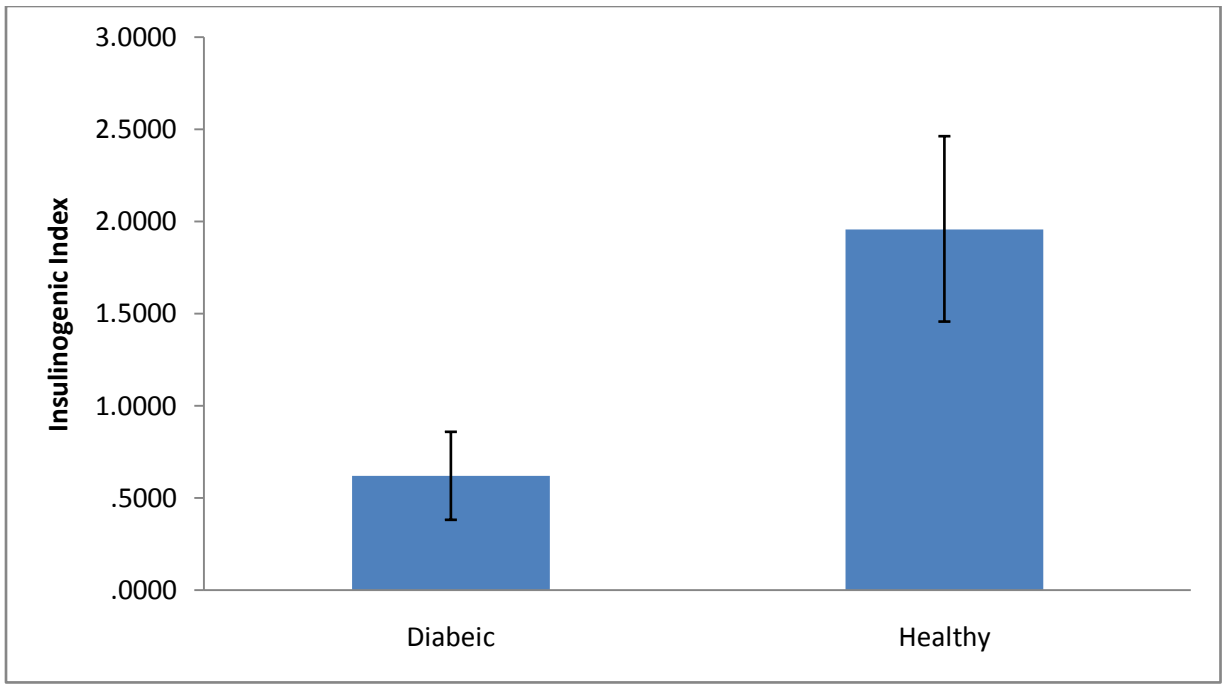


Figure 4:5InsulinogenicIndex of Type 2 Diabetes Patients and Healthy Subjects

Values are mean ± standard deviation.

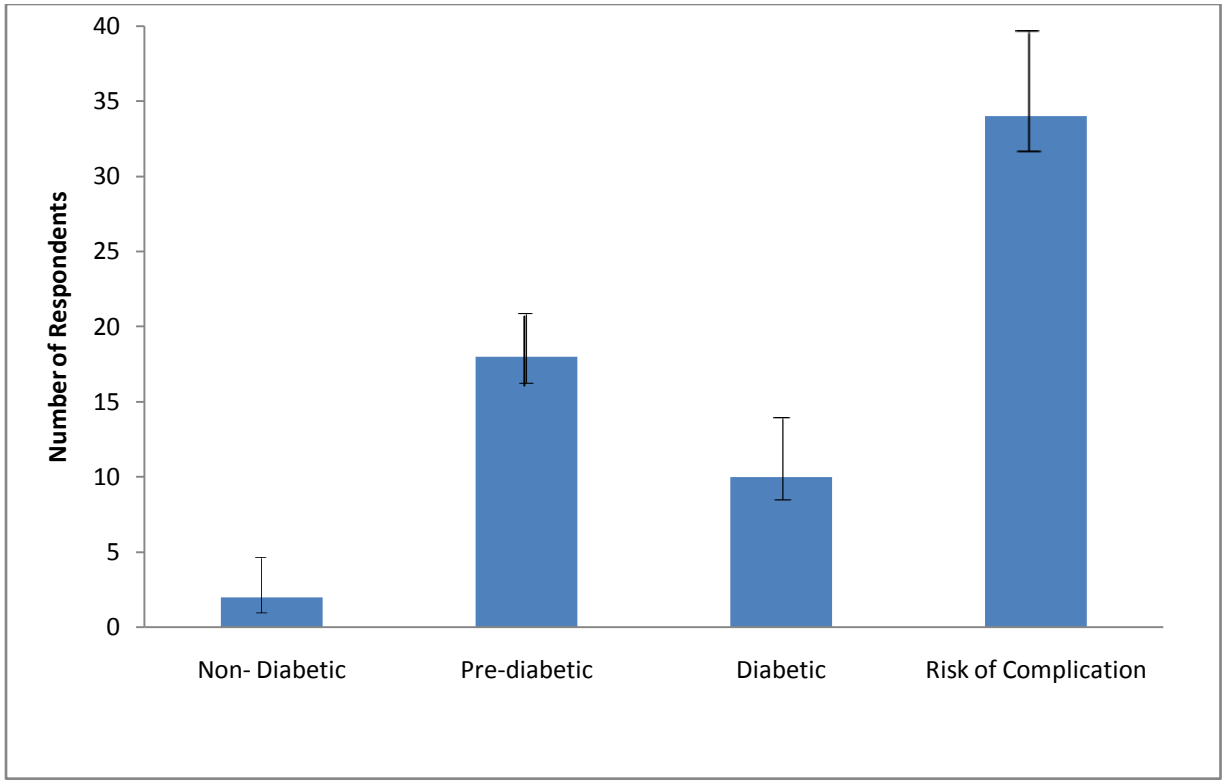


Figure 4:6 Distribution of Patients Based on GlycatedHaemoglobin (HbAic) Target

CHAPTER FIVE

5.1 Discussion

Result of this study indicated that the number of female (105) diabetic patients are more than their male (45) counterpart. Majority of these women are housewives who stay at home, eat several times, take more sweets, do not exercise which could lead to an increase in their blood sugar level and eventually diabetes.

The number of respondents above age 57years are greater than those between age 40 -57years because diabetes affect people mostly as they are aging due to some factors. The number of respondents who practices Islamic religion (127) were greater than those who practice Christianity (23) because of religious sentiment that made the Muslims to settle in these environment where the hospital is located at Tudun-wada Kaduna. The respondents have different occupations because people with different professions emerge in working places and hospitals but most of them are petty traders. From this research finding 86 respondents have some knowledge of diabetes and 64 respondents have no knowledge until when they were tested and diagnosed. Knowledge is an essential component of diabetes W.H.O (2012). Therefore people need to have knowledge of diabetes to be able to prevent and control as diabetes leads to morbidity and mortality. The practice in this hospital was that diabetic patients were tested for fasting blood sugar level, patients paid for medical care/drugs and this is a poor setting, therefore diabetic patients need help and support,from the community and government i.e. employment, free insulin injection for adjustment and glucometer for monitoring as American does (American Diabetes Association USA (2014).

Proximate composition of the bread shows that composite bread had higher protein (4.33%), fat (6.50%), fiber (6.00%). These result when compared with wholewheat and white bread shows a

significant ($P<0.05$) decrease in is nutrients, these is decrease might be due to the processing techniques employed such as dehulling and milling. These process reduce nutrients content of white bread e.g. protein (2.88%) fat (5.50%) and fiber (0.50%).

In table 4.4 the result obtained during sensory evaluation for consumer acceptability study using 9point hedonic scale revealed that the respondents like composite bread because of aromatic flavor of banana. When compared to whole wheat bread which people like moderately. But the respondents, like white bread because it is sweeter as it contains higher amount of sugar (22%) than whole wheat (18%) and composite (2%).

Effect of consumption of composite bread and whole wheat on two hours postprandial blood glucose test of type 2 diabetic patients indicated a reduction in the blood glucose level of diabetic patient, while there was an increase in blood glucose level of diabetic patients who consumed white bread.

Effect in blood glucose level of healthy subject that consumed white bread, wholewheat and composite bread showed a decrease in blood glucose level on 2hours postprandial test. White bread had glycemic index of 100, whole wheat had glycemic index of 61 and composite bread had lower glycemic index of 59 which release glucose into the blood stream at low sustainable rate and had proven benefit for health.

In this study diabetic patients exhibit lower insuligenic indices suggesting poor pancreatic beta cell functions so diabetic patients are advised to eat more protein foods and do more exercise to boost more insulin secretion.

According to dietitians of Canada (2013) glycatedhaemoglobin (HbAic) showed overall picture of an average blood sugar level of diabetic patients over a period of 8-12weeks. HbAic targets are 4-5% non diabetic, 5-6% prediabetic, 6-7% diabetesand above 7% indicated uncontrolled diabetes and the patients are at higher risk of developing complications. In this research findings figure 8 showed distribution of diabetic patients based on HbAic which indicated that 34patients were at risk of developing complications, l0 patients are diabetic, 18 patient are prediabetic and two patients are not diabetic. Therefore those diabetic patients who are at risk of complications (i.e. HbAic>7%) should control their diabetes with serious medical care and have good dietary management.

CHAPTER SIX

6.0 CONCLUSION AND RECOMMENDATIONS

6.1 Conclusion

In conclusion the results of this work shows that nutritional value of local foods such as composite bread can be improved through enrichment with soyabean, banana and orange and the should be encouraged. Based on these findings composite bread had significant effect in modulating regulating and controlling blood glucose level and its liberal use prevents diabetes.

The processing of composite bread was done taking into account hygienic quality. In conclusion the sensory evaluation of the product composite bread is acceptable and in terms of economic cost, it is cheaper.

6.2 Recommendations

i. Based on this work diabetic patients should eat composite whole wheat bread which helps to reduce blood sugar level.

ii. Diabetic patients should eat food rich in fiber, low in animal fat, low in sugar coupled with exercise. `

iii. All food should be eaten in moderation

iv. Government should enlighten the public through mass media, posters/leaf lets etc on the dangers posed by diabetes, how to prevent and manage when it occurs.

v. Further study needs to be carried out on the microbiological analysis of the composite bread to ensure safety.

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APPENDIX I

MINISTRY OF HEALTH, KADUNA STATE

All Communication to be addressed to:
THE HON. COMMISSIONER
Quoting Reference and Date
Telephone: 234-248048
Website: ttp://www/moh.kd.gov.ng.
Email: info@moh.kd.gov.ng.

Independence Way,
P.M/;B 2014
Kaduna.
Kaduna State, Nigeria.

MOH/ADM/744/VOL.1

17th October, 2014

MEDICAL DIRECTOR
YUSUF DANSOHO MEMORIAL
HOSPITAL KADUNA
T/WADA KADUNA.

PERMISSION TO CONDUCT RESEARCH

I have been directed to convey the Ministry approval to HARUNA AISHATU, an M.Sc Student of the DEPARTMENT OF BIOCHEMISTRY AHMADU BELLO UNIVERSITY ZARIA, KADUNA to conduct a research on the Topic: PRODUCTION AND EVALUATION OF COMPOSITE BREAD FOR THE MANAGEMENT OF TYPE II DIABETIC PATIENTS IN YUSUF DANTSOHO MEMORIAL HOSPITAL TUDUN-WADA, KADUNA SOUTH LOCAL GOVERNMENT KADUNA STATE, NIGERIA.

It is expected that necessary assistance be accorded him/her in the process of the research, please.

However, it is mandatory for the researcher to submit a copy of his research finding(s) to the office of the Honourable Commissioner, Ministry of Health, as soon as it is concluded.

Accept the assurances of the Honourable commissioner's highest regards.

F.A. KURAH (MRS)
SECRETARY, ETHICAL COMMITTEE

APPENDIX II

QUESTIONNAIRE

FOR

PRODUCTION AND EVALUATION OF COMPOSITE BREAD FOR MANAGEMENT OF TYPE II DIABETIC PATIENTS IN YUSUF DANTSOHO MEMORIAL HOSPITAL, KADUNA

INTRODUCTION/CONSENT: I'AM MRS HARUNA AISHATU AN MSC NUTRITION student from Ahmadu Bello University Zaria. I am conducting a research on Production and Evaluation of Composite Bread for Management of Type II Diabetic Patients in Yusuf Dantsoho Memorial Hospital, Kadunaand I would like to ask you some questions. I would be glad if you could kindly give me your co-operation and honest response. The information obtained from this survey will be strictly confidential.

Q.I.D Questionnaire Number Interview EER Date	Details

APPENDIX III

QUESTIONNAIRE

FOR

PRODUCTION AND EVALUATION OF COMPOSITE BREAD FOR MANAGEMENT OF TYPE II DIABETIC PATIENTS IN YUSUF DANTSOHO MEMORIAL HOSPITAL, KADUNA

SECTION ONE: RESPONDENT PROFILE (FILL IN THE GAP)

Name of Respondent: ……

Sex: Male [ ] Female [ ]

Age: (a) 40-47 [ ] (b) 58 -57 [ ] (c) 57 and above [ ]

EDUCATION STATUS

(a) Primary [ ] (b) Secondary [ ] (c) Tertiary [ ]

(d) Islamiyya [ ] (e) Others [ ]

RESPONDENT RELIGION

(a) Christianity [ ] (b) Islam [ ] (c) Others [ ]

OCCUPATION OF THE RESPONDENTS

(a) Civil servant [ ] (b) Traders [ ] (c) House wife [ ]

(d) Others [ ]

APPENDIX V

DEPARTMENT OF BIOCHEMISTRY AHMADU BELLO UNIVERSITY, ZARIA

Questionnaire for 9-point Hedonic Scale

Product: Composite Bread, Whole Wheat Bread and White Bread

Name _____ Date _____

Instruction: Please, taste each sample and indicate how much you like or dislike each one and tick as appropriate

		Sample A					Sample B					Sample C				
Score	Scale	Taste	Texture	Color	Aroma	Overall acceptability	Taste	Texture	Color	Aroma	Overall acceptability	Taste	Texture	Color	Aroma	Overall acceptability
9	Like extremely															
8	Like very much															
7	Like moderately															
6	Like slightly															
5	Neither like nor dislike															
4	Dislike slightly															
3	Dislike moderately															
2	Dislike very much															
1	Dislike extremely															

Comments ----------
