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Sudan University of Science and Technology

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Production of Bran Biscuit for Diabetics

إنتاج بسكويت لمرضي السكري

By

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Supervised

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الآيـــة

قال الله تعالى

(مَّثَلُ الَّذِينَ يُنفِقُونَ أَمْوَالَهُمْ فِي سَبِيلِ اللَّهِ كَمَثَلِ حَبَّةٍ أَنبَتَتْ سَبْعَ سَنَابِلَ فِي

□كُلِّ سُنبُلَةٍ مِّائَةُ حَبَّةٍ ۗ وَاللَّهُ يُضَاعِفُ لِمَن يَشَاءُ ۗ وَاللَّهُ وَاسِعٌ عَلِيمٌ)

صدق الله العظيم□

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سورة البقرة الآية (261)

DEDICATION

We Would Like to Dedicate this Modest Research

To our parents" with love".

To our Brothers and sisters,

To our supervisor ustz: Eihab Hatem

To our extended Families

To our Teachers, coworkers and Friends

With Great regard & respect.

Khalda & Nasma

ACKNOWLEDGEMENT

First of all, we would like to express our Prayers and thanks to our great ALMIGHTY ALLAH gave us health, power and patience to complete and conductor our study. This is a real blessing from Him and thanks to Him in the way that suits His supreme greatness. Blessing and peace from Allah to be upon our prophet Mohammed and all his Family and companions.

We wish to express deepest Grateful and sincere appreciations to our supervisor ustz: Eihab Hatem who was too patient with us during this study; Also We would like to express our gratitude to him for his systematic guidance, advice, constructive criticisms and continuous supervision until the completion of the study.

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Merciful,,,

Abstract

The main goals of this research were to study chemical composition of flour and bran Biscuit to determine their nutritive and caloric value and to evaluate the general acceptability of bran Biscuit, chemical composition of flour was showed that, 87.61% Dry matter, 14.78% Protein, 1.24% Fat, 0.91%Fiber, 1.58%ash, 82.47%Total carbohydrates, 81.56%Available carbohydrate and Energy1688.68K. calories.

The produced biscuits were made from 75% wheat flour and 25% wheat bran, as honey was used as an alternative to sucrose. The chemical composition of showed that the Bran Biscuit contain high concentrations of Total carbohydrates 82.07, Available carbohydrate 80.03 and energy 401.21K cal.

On the other hand, the results obtained through the sensory evaluation of the biscuit confirmed the quality of the product was well acceptable by the panelist according to its color, texture, taste, flavor, crushiness and overall quality.

The product is high nutritional value, as it has many health effects, especially for diabetics, such as lowering cholesterol, for these reasons it can be used for other categories than diabetics, such as using it as a nutritional diet to lose weight, as it contains bran.

ملخص الدراسة

تتمثل الأهداف الرئيسية لهذا البحث في دراسة التركيب الكيميائي للدقيق وبسكويت النخالة لتحديد قيمتهما التغذوية والسعرات الحرارية وتقييم مدي قبول البسكويت بواسطة المتذوقين، وقد أظهر التركيب الكيميائي للدقيق أن 87.61٪ مادة جافة ، 14.78٪ بروتين ، 1.24٪ دهون ، 0.91٪ ألياف ، 1.58٪ رماد ، 82.47٪ كربوهيدرات كلية ، 81.56٪ كربوهيدرات متاحة والطاقة 1688.68 كيلو كالوري.

البسكويت المنتج تم تصنيعه من 75٪ دقيق قمح و 25٪ نخالة قمح حيث تم استخدام العسل كبديل للسكروز. أظهر التركيب الكيميائي أن بسكويت النخالة يحتوي على تراكيز عالية من الكربوهيدرات الكلية 82.07 ، الكربوهيدرات المتاحة 80.03 والطاقة 401.21 كيلو كالوري.

من ناحية أخرى ، أكدت النتائج التي تم الحصول عليها من خلال التقييم الحسي للبسكويت أن جودة المنتج كانت مقبولة من قبل المتذوقين بناءاً علي اللون، الملمس، المذاق، النكه، الطعم والجودة الكلية. المنتج ذو قيمة غذائية عالية ، لما له من آثار صحية جيدة خاصة لمرضى السكر ، مثل خفض نسبة الكوليسترول ، ولهذه الأسباب يمكن استخدامه لفئات أخرى غير مرضى السكر ، مثل استخدامه كحمية غذائية لإنقاص الوزن ، نظراً لاحتوائه على النخالة.

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CHAPTER ONE

1 INTRODUCTION

1.1Wheat

Wheat (*Triticum aestivum*) is the most extensively grown cereal crop in the world, covering about 237 million hectares annually, accounting for a total of 420 million tons It is grown all over the world for its highly nutritious and useful grain, as one of the top three most produced crops, along with corn and rice ,It is used in the production of bread, biscuits, feeds, confectionary, amongst many, utilization, wheat contributes more protein and calories to the diet than any other crop and world trade in wheat far exceeds the contributions of other grains put together. **(oyewoie, 2016).**

1.2 Biscuits

Biscuits constitute major component of human snacks in most part of the world. It is an unleavened crisp, sweet pastry made from wheat flour, shortening (hydrogenated fat) & sugar, and is usually made light by the addition of baking powder (a mixture of sodium carbonate, sodium bi-phosphate & cereal flour). Wheat flour constitutes the basic ingredient for biscuit production because of its gluten proteins, which are not present in flour of other cereals. Gluten protein forms elastic dough during baking and gives high organoleptic quality to the finished product **(Ahmad, 2014**).

Biscuits are a truly worldwide food and a long shelf life, are eaten straight from the pack and are nutritious and available in many forms, both sweet and savory, Biscuits have many functional forms, enriched with calcium, iron and vitamins and formulated for infants, children and the elderly and for those with special needs such as gluten-free foods. Biscuits broadly fall into four categories, distinguished by their recipes and process: crackers; hard sweet and semisweet biscuits; short-dough biscuits; and cookies, including filled cookies. Each category and each product type require a particular mixing, forming and baking process. In general, the biscuit making process has the following main steps. Mixing and fermentation or dough standing time is usually a batch process. The forming, baking, oil spraying and cooling are continuous operations with a high degree of automation. It will be seen that biscuit production equipment must meet a wide range of process requirements to produce the structure, texture, volume, appearance, color, and moisture content required by each product. The abilities to mix and form the doughs and to control heat transfer, baking temperature profile, time and humidity are critical factors in producing good-quality products.

1.3 Aims of the study

1.3.1 main objective

The main goal of this study to produce the biscuits for diabetes by using bees honey and bran.

1.3.2 specific objectives

1.Analysis of the raw material and determination of its chemical properties

2.Manufacturing of biscuits containing sugary components with higher nutritional value and less harmful, such as honey.

3. Producing biscuits containing wheat bran to take advantage of the nutrients found in the bran, such as phosphorous, magnesium, iron and potassium, as well as its maximum benefit in strengthening the immune system.

4. Analysis of the bran biscuit and knowledge of its chemical properties

5. To evaluate the chemical, physiochemical and organoleptic characteristics of the end product.

CHAPTER TWO

2. LITRETURE REVIEW

2.1 Wheat

Wheat is the dominant crop in temperate countries being used for human food and livestock feed. Its success depends partly on its adaptability and high yield potential but also on the gluten protein fraction which confers the viscoelastic properties that allow dough to be processed into bread, pasta, noodles, and other food products. Wheat also contributes essential amino acids, minerals, and vitamins, beneficial phytochemicals and dietary fiber components to the human diet, these also are particularly enriched in whole-grain products. However, wheat products are also known or suggested to be responsible for a number of adverse reactions in humans, including intolerances (notably coeliac disease) and allergies (respiratory and food). Current and future concerns include sustaining wheat production and quality with reduced inputs of agrochemicals and developing and human nutrition lines with enhanced quality for specific end-uses, notably for biofuels (**Shewry, 2009).**

2.1.1 Type of wheat

Durum: Very hard, translucent, light colored grain used to make semolina flour for pasta.

Hard Red Spring: Hard, brownish, high protein wheat used for bread and hard baked goods. Bread Flour and high gluten flours are commonly made from hard red spring wheat.

Hard Red Winter: Hard, brownish, mellow high protein wheat used for bread, hard baked goods and as an adjunct in other flours to increase protein in pastry flour for pie crusts. Some brands of unbleached all-purpose flours are commonly made from hard red winter wheat alone.

Soft Red Winter: Soft, low protein wheat used for cakes, pie crusts, biscuits, and muffins. Cake flour, pastry flour, and some self-rising flours with baking powder and salt added for example, are made from soft red winter wheat.

Hard White: Hard, light colored, opaque, chalky, medium protein wheat planted in dry, temperate areas. Used for bread and brewing.

Soft White: Soft, light colored, very low protein wheat grown in temperate moist areas **(oyewoie, 2016).**

2.1.2 World wheat production

Wheat is the universal cereal of the Old-World agriculture and the world's foremost consumed crop plant followed by rice and maize , It is the most widely adapted crop, growing in diverse environments spanning from sea level to regions as high as 4570 m.a.s.l, it grows from the Arctic Circle to the equator, but most suitably at the latitude range of 30° and 60°N and 27° and 40°S **,** a crop of wheat is harvested somewhere in the world during every month of the year (**Briggle and Curtis, 1987)**. Cultivated wheat is classified into two major types: (1) the hexaploidy bread wheat and (2) the tetraploid durum wheat. Currently, at the global level, bread wheat accounts for 95% of all the wheat produced. Based on growth habit, wheat is classified into spring wheat and facultative/winter wheat, covering about 65 and 35% of the total global wheat production area, respectively, the flour of bread wheat is used to make French bread, Arabic bread, Chapatti, biscuits, pastry products, and the production of commercial starch and gluten. Durum wheat is specifically grown for the production of semolina for use in pasta and macaroni products. In North Africa, durum wheat is preferred for the preparation of couscous and bulgur. It is also widely used to prepare a special bread made by mixing bread and durum flours. Wheat has played a fundamental role in human civilization and improved food security at the global and regional levels. It provides about 19% of the calories and 21% of protein needs of daily human requirements at the global level (Braun et al., 2010). It is a staple food for 40% of the world's population mainly in Europe, North America, and the western and northern parts of Asia. The demand for wheat is growing fast in new wheat growing regions of the world such as eastern and southern Africa (5.8%), West and Central Africa (4.7%), and South Asia and the Pacific (4.3%). Demand is also growing in the traditional wheat growing regions of Central Asia (5.6%), Australia (2.2%), and North Africa (2.2%), Many of the developing countries that depend on wheat as a staple crop are not self-sufficient in wheat production, and accordingly, wheat is their single most important imported commodity **(Tadesse *et al.,* 2015).**

2.1.3 Milling of wheat

Wheat is an important agricultural commodity and a primary food ingredient worldwide and contains considerable beneficial nutritional components.

wheat-based food ingredients rich in natural antioxidants can ideally serve as the basis for development of functional foods designed to improve the health of millions of consumers.

Milling is the process used to grind wheat into flour. The milling process of wheat produces large amount of wheat bran and germ as a byproduct. During milling, the endosperm is broken down into fine particles (white flour) bran and germ are removed, Wheat germ, being a byproduct of the flour milling industry, is reported to be one of the most potential and excellent sources of much-needed vitamins, minerals, dietary fiber, calories, proteins, and some functional micro-compositions at a relative low cost In general from wheat milling industries release a byproduct of (25-40) % wheat grain contains significant level of natural antioxidants, mostly concentrated at the outer part**.(Kanojia *et al.*, 2018).**

Milling Step

Cleaning: The first milling steps involve equipment that separates wheat from seeds and other grains, eliminates foreign materials such as metal, sticks, stones and straw; and scours each kernel of wheat. It can take as many as six steps described as followed:

1. Magnetic Separator: The wheat first passes thru magnet that removes iron and metal particles

2. Separator: Vibrating screens remove bits of wood and straw and almost anything bigger or smaller than wheat

3. Aspirator: Air currents act as a kind of vacuum to remove dust and lighter impurities

4. De-Stoner: Using gravity, the machine separates the heavy material from the light to remove stones that may be the same size as wheat kernels

5. Cockle Cylinder: Wheat passes through a separator that identifies the size of the kernels even more closely. It rejects anything longer, shorter, rounder, more angular or in any way a different shape

6. Scourer: The scourer removes outer husks, crease dirt and polish the outer surface with an intense scouring action. Currents of air pull all the loosened material away.

Conditioning/Tempering: Wheat is conditioned for milling. Moisture is added in certain amounts to toughen the bran and mellow the inner endosperm. This help the parts of the kernel to be separated easily and cleanly, Tempered wheat is stored in bins from 8-24 hours, depending on the type of wheat - soft, medium or hard.

Scanner: Wheat is scanned & discolored kernel are separated.

Grinding (**Milling**): Milling process is a gradual reduction of the wheat kernels to produce particles of endosperm which are then graded & separated from the bran by sieves & purifiers Each size returns to corresponding rollers & the same process is repeated until the desired flour is obtained The rolls are paired & rotate inward against each other, moving at different speeds, just one pass through the corrugated "first break" rolls begins the separation of bran, endosperm and germ.

Sifting: The broken particles of wheat are introduced into huge, rotating, box-like sifters where they are shaken through a series of bolting cloths or screens to segregate the larger from the smaller particles Up to 6 different sizes of particles may come from a single sifter, including some flour with each sifting. Larger particles are shaken off from the top, or "scalped," leaving the finer flour to sift to the bottom These fractions are sent to other roll passages and particles of endosperm are graded by size and carried to separate purifiers

Purifiers: In a purifier, a controlled flow of air lifts off bran particles while at the same time a bolting cloth separates and grades coarser fractions by size and quality

Reduction of particle size of semolina into fine flour by passing it through a pair of smooth rolls.

Final Product: The process is repeated over and over again, sifters to purifiers to reducing rolls, until the maximum amount of flour is separated, consisting of close to 75 percent of the wheat **(Hashmi, 2011).**

2.1.4 Wheat flour

Flour is the product obtained by grinding wheat kernels or “berries.” The kernel consists of three distinct parts: bran, the outer covering of the grain; germ, the embryo contained inside the kernel; and endosperm, the part of the kernel that makes white flour. During milling, the three parts are separated and recombined accordingly to achieve different types of flours. This has no effect on nutrient and or vitamin value. The only loss is a minute amount of vitamin E. Ground grain was one of civilized man’s first foods. Ancient methods of grinding can be traced to the Far East, Egypt and Rome. As early as 6,700 B.C., man ground grains with rocks. Water mills did not appear until 85 B.C. in Asia Minor. Windmills appeared between 1180 and 1190

A.D. in Syria, France and England. Storage Flour should be stored in airtight containers in a cool, dry place (less than 60 percent humidity). All purpose, bread and cake flour will keep for 6 months to a year at 70°F and 2 years at 40°F; store away from foods with strong odors. Whole-wheat flour should be refrigerated or frozen, if possible. Before using refrigerated or frozen flour, allow it to warm to room temperature and inspect for rancidity and taste **(Kamel et al ,1993)**

2.1.4.1 Type of Flour

White flour is the finely ground endosperm of the wheat kernel, the flour types were classified to follows:

1. All-purpose flour is white flour milled from hard wheats or a blend of hard and soft wheats. It gives the best results for many kinds of products, including some yeast breads, quick breads, cakes, cookies, pastries and noodles. All-purpose flour is usually enriched and may be bleached or unbleached. Bleaching will affect nutrient value. Different brands will vary in performance. Protein varies from 8 to 11 percent.

2. Bread flour is white flour that is a blend of hard, high-protein wheats and has greater gluten strength and protein content than all and in some cases conditioned with ascorbic acid, bread flour is milled primarily for commercial bakers, but is available at most grocery stores. Protein varies from 12 to 14 percent.

3. Cake flour is fine soft wheats with low protein content. It is used to make cakes, cookies, crackers, quick breads and some types of pastry. Cake flour has a greater percentage of starch and less protein, which keeps cakes and pastries tender and delicate Protein varies from 7 to 9 percent.

4. Self-rising flour, also referred to as phosphate flour, is a convenience product made by adding salt and leavening to all-purpose flour. It is commonly used in biscuits and quick breads, but is not recommended for yeast breads. One cup of self-rising flour contains 1½ teaspoons baking powder and ½ teaspoon salt Self-rising can be substituted for all-purpose flour by reducing salt and baking powder according to these proportions.

5. Pastry flour has properties intermediate between those of all purpose and cake flours. It is usually milled from soft wheat for pastry-making, but can be used for cookies, cakes, crackers and similar products. It differs from hard wheat flour in that it has a finer texture and lighter consistency. Protein varies from 8 to 9 percent.

2.1.4.2 Nutritional Value

Wheat flour is an excellent source of complex carbohydrates. Other than gluten flour, all types of wheat flour derive at least 80 percent of their calories from carbohydrates. Depending on the flour type, the percent of calories from protein ranges from 9 to 15 percent, except from gluten flour, which has 45 percent protein content.

2.1.4.3 chemical composition of Flour

The quality of wheat flour, which will directly affect the appearance, taste, and texture of flour foods, is a function of many factors including wheat variety, processing technology, and storage conditions. Currently, flour quality is typically evaluated by measuring the chemical compositions (protein, gluten, starch, and damaged starch content), dough rheological properties (viscoelasticity and extensibility), or directly investigating the performance in food making (steaming, boiling, and baking).

The major components of wheat flour are protein (approximately 10%–12%) and starch (70–75%), and the minor components are polysaccharides (2-3%) and lipids (2%). Chemical compositions may affect the flour properties of dough kneading (water absorption rate), gluten network formation, dough properties (hardness, viscosity, elasticity, extensibility, plasticity, water retention, etc.,) and cooking characteristics (shape retention, chewing viscosity, hardness, shrinkage, etc. **(Kamlesh, 2019 and Shrivas 2019).**

Table No. (2.1): Chemical composition of flour

parameters	Values
Moisture	11.99
Ash	0.52
Fiber	0.54
Fat	0.06
Protein	11.85
Carbohydrate	86.04

Source: sharoba *et al.* (2013)

Bran

Wheat bran, a by-product of flour milling is composed of the pericarp and the outermost tissues of the seed, including the aleurone layer. It constitutes almost 10% of the total weight of wheat milled for flour. On moisture free basis, bran contains about 17% protein and 70% carbohydrates, about 80%

of which is cellulose and hemicellulose. Most of the bran protein and other nutrients are contained in the aleurone cells, found that bran is mainly cellulose with very little gluten, so there is not much it can be used for other than being a source of fiber, but it does contain higher vitamin and mineral contents, so flour made with a higher extraction rate tends to be more nutritious. However, bran also contains higher levels of phytic acid, which makes the minerals less available to the body, particularly when used in a non-fermented food product. Stanton and Costello used wheat bran to enhance the nutritional quality of baked products such as cakes, yeast bread and muffins reported that consumption of wheat bran in excess of levels in a typical western diet significantly increased stool output.

reported that the physiological effects of dietary fiber are usually compared with the intakes or contents of total dietary fiber. Many health-related effects such as cholesterol reduction attenuation of blood glucose and insulin and prolonged satiety, are due to the physical properties of a fiber (**Eman *et al.* ,2008).**

2.2 Biscuit

2.2.1 Historical background

experimenting and addition of different ingredients, the biscuit too has developed Baking having been labour intensive in the sixteenth century, cookies and biscuits were mostly baked in home kitchens as a special treat. Sweeteners like sugar being a luxury at the time, most biscuits and cookies were sweetened with honey and baked with minimal ingredients. Between the 17th and 19th centuries and due to colonialism, sugar moved from being a luxury ingredient to becoming a bulk commodity affordable to everyone. This increased the production of the biscuit and also enriched the product. The industrial revolution of the 19th century made way for the mass production of biscuits and cookies. Like any food that evolves with the. Cooks of the ancient civilizations of the Middle East explored ways to uplift the ordinary biscuit in terms of richness and sweetness. These cooks enriched the basic flour paste with ingredients such as eggs, butter, and cream and sweetened them with fruits, honey, and sugar.

2.2.2 Definitions

Biscuit can be defined as a small baked product made principally of flour, sugar and fat **(Manley, 1998).** It is different from other baked products like bread and cakes as biscuit has low moisture content. Its moisture content is usually less than 4% and thus it has long shelf life, perhaps six months or longer **(Mamat and Hill, 2017)**.

Biscuit is a popular food product where it is produced using wheat flour, sugar and fat as its main ingredients.

Biscuits may be regarded as a form of confectionery dried to a very low moisture content. Biscuit is defined as a small thin crisp cake made from unleavened dough. **(Agu *et al.,* 2007).**

2.2.3 Row materials

1. Wheat flour

Flour is the main ingredient used in the manufacturing process and its quality is related to the texture and form of biscuit products, although other types of flour also became widely used in the past few years (rice, corn and spelt), wheat flour still holds priority. The main indicator for determining the quality of the flour used in manufacturing baker's wares is the gluten extraction. Gluten adds elasticity to the biscuit dough, which helps maintain its form in the fermentation process.

2. Sweeteners

Sweeteners are the second basic component used in biscuit manufacturing. They add sweetness, influence the texture and color of the product and at the same time help increasing the shelf life, the combination of sucrose and sugar syrup is included in most biscuit products, whereby sucrose contributes more to the texture during baking, while sugar syrup determines the color of the end product by means of the non-enzymatic browning reaction**.**

3. Fats

The third main component in biscuit manufacturing is fats. They help forming the texture, the taste and flavor properties of the product. The basic function of fats is to enrich the dough, giving the typical crumbly biscuit texture of the finished product. Both animal fats (cows' butter) and vegetable fats (palm oil, peanut butter, etc.) are used in biscuit manufacturing. In the course of kneading the dough the fats are included in the gluten structure to add soft and smooth texture to the ready products.

4. Milk

Milk and milk products contribute to increasing the nutritive value, improvement of color, taste and consistency of the finished products, Milk components facilitate to a large extent the Maillard reaction and are therefore used in small quantities in order to prevent strong browning of the surface. Milk powder finds widest application as raw materials, because it is processed and preserved easier than fresh milk. Milk powder and powdered whey products contribute to the flavor of biscuit creams. The main risk is using milk powder which is related to its inadequate solubility. This results in the formation of lumps in the dough, which get dark brown after baking the biscuits. This problem is usually overcome through dissolving in advance the milk powder in cold water before adding it to other ingredients. It is recommended to buy milk powder with specification which allows no more than 0.1% water insoluble matter.

5. Egg mixture

Egg products used in manufacturing biscuits are usually in liquid or dry form (for example egg mixture and egg powder), due to the fast denaturation of egg proteins. Egg powder, due to the high temperature at which it is obtained, does not have the same foaming qualities as fresh eggs or the well-tempered egg mixture immediately before use, Egg products are a very good medium for the development of micro-organisms, which requires control over the conditions of their processing and storage in the safety management system or the implementation of good manufacturing practices.

6. Water

Water has various functions in biscuit manufacturing: it dissolves the micro- and the macro-components in raw materials, facilitates the formation of gluten and helps control the dough temperature, Water does not influence the nutritive value of the product, but promotes the process of mixing the ingredients, as result of which the products get hard texture and crispy.

7. Salt

Cooking salt is used as additive chiefly to improve the taste and to slow down the speed of fermentation. The most widely used raising agents are sodium bicarbonate and ammonium bicarbonate, which emit gases (CO_2) and ammonia in the course of baking, which adds porous structure to the finished products.

8. Functional materials

Most often they are used as surface-active agents (emulsifiers), whose main function is to increase the capacity for more even distribution of fats on other main ingredients. Preference is given to the use of lecithin, mono- and di-glycerides, esters, polysorbate, etc. The surface-active substances form complex structure with the proteins and the starch, decreasing in this way the deformation of dough during baking consistency **(Ahmade, 2014).**

9. Food additives

Food additives are used in order to increase the shelf life, to facilitate the processing of doughs and to improve the sensory qualities of the finished products. Various colors, acidity regulators, flavors, preservatives and stabilizers are used as food additives**. (Stefanova, 2017).**

10. Baking powder

Baking powder is a dry chemical leavening agent, a mixture of a carbonate or bicarbonate and a weak acid. The base and acid are prevented from reacting prematurely by the inclusion of a buffer such as cornstarch. Baking powder is used to increase the volume and lighten the texture of baked goods. It works by releasing carbon dioxide gas into a batter or dough through an acid-base reaction, causing bubbles in the wet mixture to expand and thus leavening the mixture. The first single-acting baking powder was developed by a Birmingham based food manufacturer Alfred Bird in England in 1843. The first double-acting baking powder was developed by Eben Norton Horsford in the United States of America in the 1860s.

Baking powder is used instead of yeast for end-products where fermentation flavors would be undesirable, where the batter lacks the elastic structure to hold gas bubbles for more than a few minutes, and to speed the production of baked goods. Because carbon dioxide is released at a faster rate through the acid-base reaction than through fermentation, breads made by chemical leavening are called quick breads. The introduction of baking powder was revolutionary in minimizing the time and labor required to make breadstuffs. It led to the creation of new types of cakes, cookies, biscuits, and other baked goods **(Civitello, 2017)**.

According to the definition and standard adopted by the United States Department of Agriculture the Baking powder. The leavening agent produced by the mixing of an acid reacting material and sodium bicarbonate, with or without starch or flour. It yields not less than 12 percent of available carbon dioxide. The acid-reacting materials in baking powder are: Tartaric acid or its acid salts, salts of phosphoric acid and compounds of aluminum **(byl, 1930).**

2.2.4 Manufacturing Process

The process of manufacturing of biscuits mainly involves the following three steps; Mixing, Shaping or forming and Baking.

1. Mixing

Mixing is commonly defined as a process designed to blend different ingredients into a uniform, homogenous mixture. The major ingredients are flour, fat, sugar and others as per the desired final one would like to have. For this step, all ingredients are put together in right proportion for dough formation. These are then fed into mixers where mixing is done and dough is prepared for molding/cutting.

2. Shaping or forming

The forming process is specific for each biscuit, cookie type. There are three processes by which shaping or forming of biscuits is achieved, Sheeting and cutting, Rotary molding, Extrusion.

3. Baking

This is the area where we pass these molded/ formed wet biscuit into baking oven. The biscuits are baked on desired temperatures. Various type of heating.

Cooling

The hot product obtained from baking must be cooled to room temperature prior to packaging for several reasons such as:

Being warm, reduced firmness of the baked product so as to withstand packaging process.

- Packaging material shrinkage due to contact to hot product.
- Hot packed product may continue release some steam causing condensation inside the packaging. Cooling can be achieved either by placing the baked product at ambient conditions or by forced air cooling.

Table No. (2.2) Chemical composition of biscuits

Parameters	Values
Moisture	8.16
Protein	11.21
Fat	0.89
Ash	1.16
Fiber	0.55
Carbohydrates	74.34

Source: Mohammed (2018).

2.3 Diabetes

Diabetes mellitus (DM) also known as simply diabetes, is a group of metabolic diseases in which there are high blood sugar levels over a prolonged period. Diabetes mellitus is a chronic disease, for which there is no known cure except in very specific situations. Management concentrates on keeping blood sugar levels as close to normal ("euglycemia") as possible, without causing hypoglycemia. This can usually be accomplished with diet, exercise, and use of appropriate medications **(Hossam, 2014).**

2.3.1 The relationship between diabetes and food nutrition

The role of diet in controlling diabetes is considered imperative, however, diabetes patients are unaware how they should approach this issue. It is evident from the literature that nutrition intervention plays a very important role in providing diet-related self-management education to diabetes patients. This objective can be achieved through trained dietitians. Addition to these, experts recommended that brown bread or whole wheat bread, pasta, basmati rice, and potatoes should be the main part of meals for type 2 diabetics, only 28.8% of patients knew that dietary fiber is important in maintaining good glycemic control. The study conducted by Savoca and Miller stated that patients' food type and dietary behaviors might be influenced by good knowledge about diabetic diet recommendations. Our study results also showed that type 2diabetics had good knowledge regarding food types (50%) and that this may have appositive influence on dietary practices. **(Sami *et al.*, 2019).**

CHAPTER THREE

3.MATERIALS AND METHODS

3.1 Materials

All the ingredients (bran, wheat flour) required for the biscuit processing were purchased from Seen Mills for Grain and stored at room temperature 20°C.

3.2 Methods

3.2.1 Chemical methods

3.2.1.1 Moisture content

The moisture content was determined according to the standard method of the Association of Official Analytical Chemists **(AOAC, 2003).**

Principle: The moisture content in a weighed sample is removed by heating the sample in an oven (105°C). Then, the difference in weight before and after drying is calculated as a percentage from the initial weight.

Procedure: A sample of 2 ± 0.001 g was weighed into a pre-dried and tarred dish. Then, the sample was placed into an oven (No.03-822, FN 400, Turkey) at 105°C until a constant weight was obtained. After drying, the covered sample was transferred to desiccators and cooled to room temperature before reweighing. Triplicate results were obtained for each sample and the mean value was reported to two decimal points according to the following formula:

Calculation:

$$\text{Moisture content (\%)} = \frac{(Ws - Wd) \times 100\%}{\text{Sample weight (g)}}$$

Where:

Ws = weight of sample before drying

Wd = weight of sample after drying.

3.2.1.2. Crude protein content

The protein content was determined in the different samples by micro-Kjeldahl method using a copper sulphate-sodium sulphate catalyst according to the official method of the **AOAC (2003).**

Principle: The method consists of sample oxidation and conversion of its nitrogen to ammonia, which reacts with the excess amount of sulphuric acid forming ammonium sulphate. After that, the solution is made alkaline and the ammonia is distilled into a standard solution of boric acid (2%) to form the ammonia-boric acid complex which is titrated against a standard solution of HC1 (0.1N). The protein content is calculated by multiplying the total N % by 6.25 as a conversion factor for protein.

Procedure: A sample of two grams (2 ± 0.001 g) was accurately weighed and transferred together with, 4± 0.001g NaSo4 of Kjeldahl catalysts (No. 0665, Scharlauchemie, Spain) and 25m1 of concentrated sulphuric acid (No.0548111, HDWIC, India) was added into a Kjeldahl digestion flask. After that, the flask was placed into a Kjeldahl digestion unit (No.4071477, type KI 26, Gerhardt, Germany) for about 2 hours until a colorless digest was obtained and the flask was left to cool to room temperature. The distillation of ammonia was carried out into 25m1 boric acid (2%) by using 20ml sodium hydroxide solution (45%). Finally, the distillate was titrated with standard solution of HC1 (0.1N) in the presence of 2-3 drops of bromocreasol green and methyl red as an indicator until a brown reddish color was observed.

Calculation:

$$\text{Crude Protein (\%)} = \frac{(\text{ml HCl sample} - \text{ml HCl blank}) \times N \times 14.00 \times F}{\text{Sample weight (gm)} \times 1000} \times 100\%$$

Where;

N: normality of HCl (0.1N).

F: protein conversion factor = 6.25

3.2.1.3. Fat content

Fat content was determined according to the official method of the AOAC (2003).

Principle: The method determines the substances which are soluble in petroleum ether (65-70°C) and extractable under the specific conditions of Soxhlet extraction method. Then, the dried ether extract (fat content) is weighed and reported as a percentage based on the initial weight of the sample.

Procedure: A sample of 5 ± 0.00l g was weighed into an extraction thimble and covered with cotton that previously extracted with hexane (No.9-16-24/25-29-51, LOBA Cheme, India). Then, the sample and a pre-dried and weighed extraction flask containing about 100 ml hexanes were attached to the extraction unit (Electro-thermal, England) and the extraction process was conducted for 6 hrs. At the end of the extraction period, the flask was disconnected from the unit and the solvent was redistilled. Later, the flask with the remaining crude ether extract was put in an oven at 105°C for 3 hrs., cooled to room temperature in a desiccator, reweighed and the dried extract was registered as fat content according to the following formula;

Calculation:

$$\textbf{Fat content}\ (\%) = \frac{(W2 - W1)}{W3} \times 100\%$$

Where;

W1 =Weight of the empty flask.

W2 =Weight of the flask and ether extract.

W3=initial weight of the sample.

3.2.1.4. Total carbohydrates

Total carbohydrates were calculated by difference according to the following equation:

Total carbohydrates (%) =100% - (Moisture + Protein + Fat + Ash).

3.2.1.5 Available carbohydrates

Available carbohydrates were calculated by difference according to the following equation:

Available carbohydrates (%) = Total carbohydrates –crude fiber %

3.2.1.6 Crude fiber content

The crude fiber was determined according to the official method of the AOAC (2003).

Principle: The crude fiber is determined gravimetrically after the sample is being chemically digested in chemical solutions. The weight of the residue after ignition is then corrected for ash content and is considered as a crude fiber.

Procedure: About 2 ± 0.001 g of a defatted sample was placed into a conical flask containing 200 m1 of H_2SO_4 (0.26 N). The flask was then, fitted to a condenser and allowed to boil for 30 minutes. At the end of the digestion period, the flask was removed and the digest was filtered (under vacuum) through a porcelain filter crucible (No.3). After that, the precipitate was repeatedly rinsed with distilled boiled water followed by boiling in 200 ml NaOH (0.23 N) solution for 30 minutes under reflux condenser and the precipitate was filtered, rinsed with hot distilled water, 20m1 ethyl alcohol (96%) and 20 ml diethyl ether. Finally, the crucible was dried at 105°C (overnight) to a constant weight, cooled, weighed, ashed in a Muffle furnace

(No.20. 301870, Carbolite, England) at 600°C until a constant weight was obtained and the difference in weight was considered as crude fiber.

Calculation:

$$\textbf{Crude fiber}\ (\%) = \frac{(W1 - W2)}{\text{Sample weight (gm)}} \times 100\ \%$$

Where:

W1 = weight of sample before ignition (gm).

W2 = weight of sample after ignition (gm).

3.2.1.7 Total sugars (reducing and non-reducing sugars)

The total sugars as well as reducing and non-reducing sugars were determined according to Lane and Eynon titrimetric method as described by the Association of Official Analytical Chemists **(AOAC, 2003).**

Principle: Reducing sugars in pure solution in plant materials after suitable pre-treatment (to remove interference substances) may be estimated by using copper sulphate as oxidizing agent in a standard Fehling's solution.

Sample preparation

(A) Reducing sugars: A sample of 10 ±0.001 g was weighed and transferred to 250 ml volumetric flask. 100 ml of distilled water was carefully added and then neutralized with 1.0 N NaOH to a pH 7.5 – 8.0. Then, about 2 ml of standard lead acetate (NO. 23500, BDH, England) was added and the flask was shake and left to stand for 10 min. After that, 2 ml of sodium oxalate were added to remove the excess amount of lead acetate and the solution was made up to volume (250 ml) with distilled water and filtered.

(B)Total sugars: From the previous clear sample solution, 50ml were taken into a 250 ml conical flask and 5± 0.001 g citric acid and 50 ml distilled water were added slowly. Then, the mixture was gently boiled for 10 min to complete the inversion of sucrose and left to cool at room temperature. After that, the solution was transferred to 250 ml volumetric flask, neutralized with 20% NaOH solution in the presence of few drops of phenolphthalein (No. 6606 J. T Baker, Holland) until the color of the mixture disappeared and the sample was made up to volume before titration.

Procedure: A volume of 10ml from the mixture of Fehling's (A) and (B) solutions was pipetted into 250 ml conical flask. Then, sufficient amount of the clarified sugars solution was added from burette to reduce Fehling's solution in the conical flask. After that, the solution was boiled until a faint blue color is obtained. Then, few drops of methylene blue indicator (S-d-FINE-CHEM LIMITED) were added to Fehling's solution and titrated under boiling with sugars solution until brick-red color of precipitate cuprous oxide was observed. Finally, the titer volume was recorded and the amount of inverted sugars was obtained from Lane and Eynon Table. The total sugars, reducing and non-reducing sugars were calculated by using the following formulas:

Calculation:

$$\textbf{Total sugars}\ (\%) = \frac{\{\text{invert sugar (mg)} \times \text{dilution factor}\} \times 100\%}{\text{Titre} \times \text{sample weight (g)} \times 1000}$$

$$\text{Reducing sugars}\ (\%) = \frac{\{\text{invert sugar (mg)} \times \text{dilution factor}\} \times 100\ \%}{\text{Titre} \times \text{sample weight (g)} \times 1000}$$

Non-reducing sugars (%) = {Total sugars (%) – reducing sugars (%)}

Where:

Titre = (Sample – blank).

3.2.1.8 Ash content

The ash content was determined according to the method described by the AOAC (2003).

Principle: The inorganic materials which are varying in concentration and composition are customary determined as a residue after being ignited at a specified heat degree.

Procedure:

A sample of 5 ± 0.001 g was weighed into a pre-heated, cooled, weighed and tarred porcelain crucible and placed into a Muffle furnace (No.20. 301870, Carbolite, England) at 600 °C until a white gray ash was obtained. The crucible was transferred to a desiccator, allowed to cool to room temperature and weighed. After that, the ash content was calculated as a percentage based on the initial weight of the sample.

Calculation:

Ash (%) = [(Wt of crucible +Ash) - (Wt of empty crucible)] x 100%

3.2.1.9 Food energy value

The energy value of biscuit was calculated based on Atwater factors as indicated by **leung (1968).**

Protein = 3.87 K.cal/g

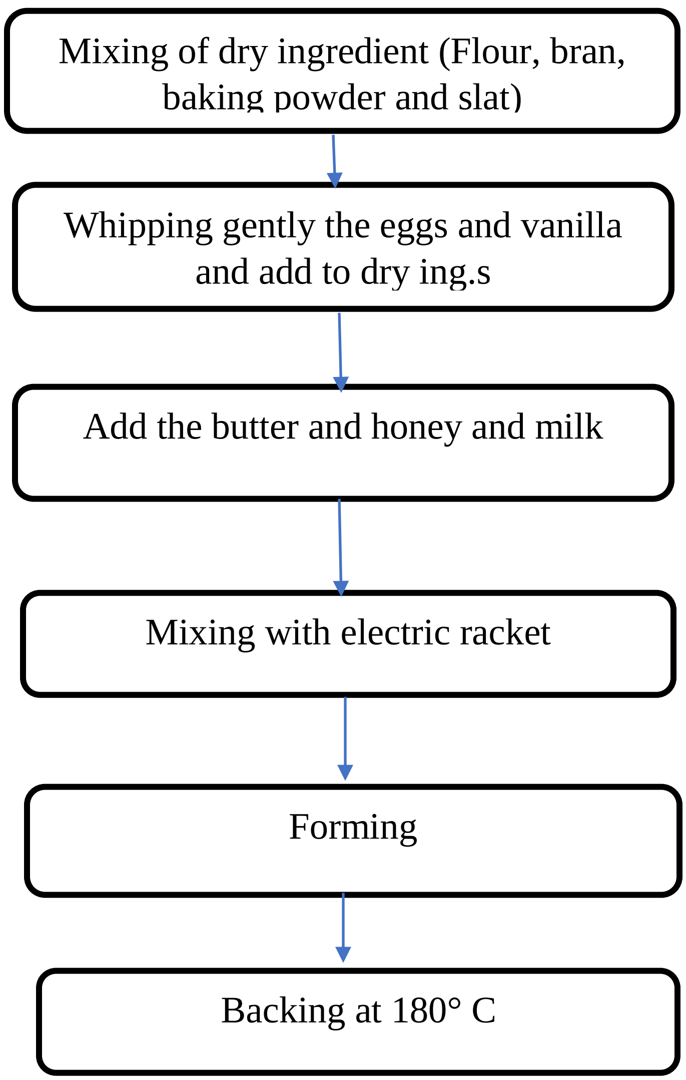
Fat = 8.37 K.cal/g

Carbohydrate = 4.12 K.cal/g

K.cal/g = 4.184 K.J.

3.2.2 processing methods

In bowel add and mixing of 844g of flour and 211g bran , 8.2g baking powder , 4.8g cinnamon, 4.8g cardamon, in another bowel whip 3g of egg and add vanilla to it and whip with an electric racket then add to the previous ingredients and add 200g butter and well mixed, add 572g honey, 100g milk with continues whip until the dough blocks gather, then the dough is cast formed and backed at 180° C.



Flow chart NO. (3.1): processing method of biscuit

3.2.3 Organoleptic evaluation method

The sample of biscuit was evaluated using the hedonic scoring test method, in this method 21 trained panelists from Sudan university of sciences and technology, college of agricultural studies (Some of the Panelist is Diabetes) were asked to evaluate the product with regard to their taste, color, flavor, and overall quality using the following hedonic scale, excellent, very good, good, acceptable, unacceptable

3.2.4 Statistical method

The results obtained in this study were subjected to statistical analysis using the statistical package for social science (SPSS) programe in addition to the Microsoft office excel program in the graphical presentation of the form data in order to extract the results of the research and write recommendations.

CHAPTER FOUR

4 RESULTS AND DISCUSSIONS

4.1Chemical composition of wheat flour

The chemical composition of wheat shown in table (4.1) on wet and dry basis. the dry matter, protein, fat, fiber, ash, Total carbohydrates, Available carbohydrate and Energy were found 87.61, 14.78, 1.24, 0.91, 1.58, 82.47,81.56, 403,60 Kcal respectively on dry basis the results obtained in this study the protein, moisture, fat and ash were agreed, whereas the fiber and carbohydrate were dis-agreed with those reported by **sharoba *et al.* (2013)**

4.2 Biscuit bran processing and recipe

After determining the weight of the raw material of flour 884 g and bran 211 g, then the other ingredients such as baking powder, vanilla, cinnamon, Cardamom, eggs, milk, honey were added in certain proportions and the mixing process was carried out until reaching the appropriate consistency and then the formation process was carried out with molds and then was baked.

4.3 Chemical composition of biscuit

The chemical composition of biscuit was shown in table (4.3) on wet and dry basis. the dry matter, protein, fat, fiber, ash, Total carbohydrates, Available carbohydrate, reducing sugar, non-reducing sugar, total sugar and energy were found to be 91.53, 10.59, 3.64, 2.03, 3.68, 82.07, 80.03, 35.01, 11.37, 46.40 ,104.2 respectively on dry basis, the results obtained in this study, the protein and ash were agreed, whereas the moisture, fat ,fiber and carbohydrate were dis-agreed with those reported by **Mohammed (2018).**

4.4 Organoleptic evaluation of biscuit

All the panelists evaluated the product appear that, the bran Biscuit very acceptable according to its color, taste, flavor, texture, Crunchiness and overall quality. The results obtained were statistically analyzed as indicated in table and graphs (4.4).

Table No. (4.1): Chemical composition of wheat flour

Parameter	Values (%, N=3 ±SD)	
	On wet basis	On dry basis
Moisture or Dry matter	12.39±0.04	87.61± 0.28
Protein	12.95±0.65	14.78± 0.31
Fat	1.09± 0.13	1.24± 0.15
Fiber	0.8± 0.20	0.91± 0.13
Ash	1.39± 0.10	1.58± 0.12
Total carbohydrates	72.26± 0.13	82.47± 0.24
Available carbohydrate	71.46± 0.13	81.56± 0.29
Energy/100g		403.60 K cal 1688.68 K J

Table No. (4.2): Recipes of Bran Biscuits

Ingredients	Formula(g)	Formula (%)
Flour	884	44.47
Bran	211	10.61
Baking powder	8.2	0.41
Cinnamon	4.8	0.24
Cardamom	4.8	0.24
Eggs	3.0	0.15
Butter	200	10.06
Honey	572	28.78
Milk	100	5.03
Total	**1987.8**	**99.99**

Table No. (4.3): Chemical composition and caloric value of bran Biscuit

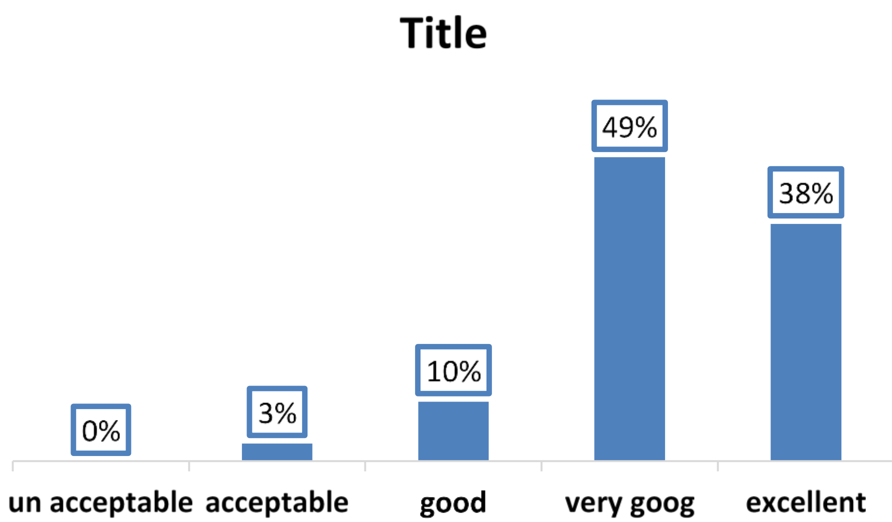
Parameters	Values (%. N=3 ±SD)	
	On wet basis	**On dry basis**
Moisture & Dry matter	8.47± 0.27	91.53± 0.13
Protein	9.7± 0.27	10.59± 0.13
Fat	3.34± 0.16	3.64± 0.09
Fiber	1.86± 0.30	2.03± 0.10
Ash	3.37± 0.15	3.68± 0.17
Total carbohydrates	75.12± 0.14	82.07± 0.09
Available carbohydrate	73.26 ± 0.14	80.03± 0.87
Total sugar	37.17±1.30	46.40±0.61
Reducing sugar	28.05±1.02	35.02±0.95
Non-reducing sugar	9.11±1.18	11.37±0.75
Energy/100g		401.21K cal. 1678.66K J

N= Number of determinations.

SD = Standard deviation.

Table No. (4.4) Sensory evaluation of biscuit

Sense / Rank		Unacceptable	Acceptable	good	very good	Excellent	Total	Mean± SD	Evaluation
Color	N	0	1	1	8	11	21	**3.38±0.80**	**Good**
	%	0%	4.8%	4.8%	38%	52.4%	100%		
Texture	N	0	0	2	12	6	21	**3.20±0.62**	**Good**
	%	0%	0%	9.5%	57%	28.6%	100%		
Crunc-hiness	N	0	1	6	12	2	21	**2.71±0.72**	**Good**
	%	0%	4.8%	28.6%	57%	9.5%	100%		
Taste	N	0	0	1	8	12	21	**3.52±0.60**	**V. Good**
	%	0%	0%	4.8%	38%	57%	100%		
Flavor	N	0	1	0	11	9	21	**3.33±0.73**	**Good**
	%	0%	4.8%	0%	52.4%	43%	100%		
Overall quality	N	0	1	2	10	8	21	**3.25±0.39**	**Good**
	%	0%	4.8%	9.5%	47.6%	38%	100%		



Graph (4.1): The average levels of acceptance of product characteristics in general (organoleptic evaluation of biscuit)

CHAPTER FIVE

5 CONCLUSION AND RECOMMENDATIONS

5.1 Conclusion

From the results obtained in this study it can be concluded that, the bran Biscuit is high nutritional value, as it has many health effects, especially for diabetics, such as lowering cholesterol, and it was also found that biscuits made with bran are acceptable by the panelists.

5.2 Recommendations

1. Other sugar alternatives than fructose can also be used to reduce Disaccharides in biscuits.
2. The product can be used for other categories than diabetics, such as using it as a nutritional diet to lose weight, as it contains bran.
3. Developing the product and increasing the chances of improving it by reducing the percentage of fat and reducing the moisture content to increase the crunchiness.
4. We recommend improving the product by adding nutritional enhancements such as oat instead of bran.
5. Further studies must be conducted on their recipe and its shelf life

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PICTURES APPENDEX

Pict. No. (1) Ingredients of biscuit bran

Pict. No (2) Processed Biscuit