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Utilization of Peanut in Production of Nutella

إمكانية تصنيع النوتيلا من الفول السوداني

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الآية

قال الله تعالى: (وَإِذ قُلتُم يا موسى لَن نَصبرَ عَلى طَعامٍ واحِدٍ فَادعُ لَنا رَبَّكَ يُخرِج لَنا مِمّا تُنبِتُ الأَرضُ مِن بَقلِها وَقِثّائِها وَفومِها وَعَدَسِها وَبَصَلِها قالَ أَتَستَبدِلونَ الَّذي هُوَ أَدنى بِالَّذي هُوَ خَيرٌ اهبِطوا مِصرًا فَإِنَّ لَكُم ما سَأَلتُم وَضُرِبَت عَلَيهِمُ الذِّلَّةُ وَالمَسكَنَةُ وَباءو بِغَضَبٍ مِنَ اللَّهِ ذلِكَ بِأَنَّهُم كانوا يَكفُرونَ بِآياتِ اللَّهِ وَيَقتُلونَ النَّبِيّينَ بِغَيرِ الحَقِّ ذلِكَ بِما عَصَوا وَكانوا يَعتَدونَ)

سورة البقرة (61)

صدق الله العظيم

Dedication

To our parents

To our sisters and brothers

To our teachers

And to our all friends

With our love

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We are most grateful to Allah assistance, health and patiencethatgave usto complete this work.

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Abstract

The main goals of this research were to increase utilizations peanut and to produce of Nutella from peanut and evaluate the chemical composition, Nutritive and caloric value and general acceptability of the product by the panelists.

The results obtained in this research were indicated that, the peanut Dry matter (94.73%), protein (18.79), fat (49.89), total carbohydrates (29.34), fiber (2.71), ash (1.98) and energy (600.01) K. Cal. on dry basis, whereas peanut Nutella showed that, dry matter (30%), fat (14%), T.A (0.564), T.S.S(65%) and pH (6.19).

Finally, the product was highly accepted by the panelists with respect to its color, taste, flavor, and overall quality.

ملخص الدراسة

الأهداف الأساسية لهذا البحث هي زيادة استخدام الفول السوداني وإنتاج النوتيلا من الفول السوداني وتقييم التركيب الكيميائي، القيمة التغذوية والسعرات الحرارية للفول السوداني والقبول العام للمنتج بواسطة المحكمين.

النتائج المتحصل عليها من هذا البحث تشير إلى أن الفول السوداني يحتوي على وزن جاف(94.73)، بروتين (18.79)، دهن (49.89)، الكاربوهيدرات الكلية (29.34)، الياف(2.71)، رماد(1.98)والطاقة(600.01) كيلو كالوري على أساس الوزن الجاف.

وأخيراً وجد منتج النوتيلا من الفول السوداني قبولاً بدرجة عالية من قبل المحكمين من حيث اللون والنكهة والطعم والقوام والجودة.

CHAPTER ONE

1. INTRODUCTION

The world groundnut (in shell) harvested area in 2007 was 23.4 million hectares with a total production of 34.9 million metric tons (Mt). The total harvested area in 2007increased by 3.7 million ha when compared to 1990, while production increased by 11.7 million Mt. The world's average productivity in 2007 was about 1490 kg/ha. It is cultivated in as many as 90 countries. Groundnut is therefore an oilseed crop on a global scale. Groundnuts are predominantly grown in developing countries (Asia and Africa), where the Crop finds the appropriate climates for optimum production. About 90% of the total world production comes from this region and about 60% of production comes from the semiarid Tropics (**Prasad *et al*., 2010**).

In Africa, groundnut is grown mainly in Nigeria, Sudan, Senegal, Chad, Ghana, Congo, and Niger. In 2007, the total harvested area in Africa was 9.04 million ha with a total production of 8.7 million Mt. The average productivity in this region is 964 kg/ha, which is poor when compared to the US and other developed countries where it is close to 3500kg/ha. Average productivity is 1720 kg/ha in Nigeria, 500 kg/ha in Sudan, and close to 700kg/ha in Senegal. For a long time, groundnut was the main export product of Senegal and The Gambia (**Prasad *et al*., 2010**).

Sudan is one of the major groundnut producing countries. The total area under groundnut production is approximately one million hectares with an average yield of 855 kg/ hectares. The crop is grown under irrigation mainly in Gezira scheme, New Halfa scheme, some Northern region and Kassala. Under rain fed the crop grown in western Sudan in Kordofan and Darfur regions **(Mahgoub *et al*., 2017).**

Peanut seeds are a good source of protein, lipid and fatty acids for human nutrition. Oil, protein, alcohol-soluble sugars, mineral ash and lignin contents of 3 Virginia-type peanut kernels .Peanut are rich in oil, naturally containing from 47to 50 % **(Özcan and seven, 2003).**

Peanuts high nutritional content is attributed to the presence of biologically active compounds such as, to copherols, flavonoids, phytosterols, resveratrol, as well as to their relatively high level of protein and their easy oil digestibility the fat content in peanuts has been largely

studied. In general, peanuts contain 50-55% fat of which approximately 30% is linoleic acid and 45% is oleic acid **(Angulo *et al.*, 2009).**

Nutella is probably one of the most well-known brand names of a sweetened hazelnut cocoa spread. Since its introduction to the market in the second half of the 20th century it has become the source of happiness for countless people. Nutella now days are appreciated all over the world and it can be found in many disparate countries. Nutella has indeed a huge follow-up and plenty of fans all over the world **(Maruo, 2019).**

Objective of the study

General objective

The main objective of this study is to increase utilization of peanut in production of Nutella.

Specific objectives

1. Determination of chemical composition of peanut chiefly the protein.
2. Processing of Nutella from peanut.
3. Determine the chemical and physiochemical analysis and sensory evaluation of the Nutella.

CHAPTER TWO

2. LITERATURE REVIEW

2.1. Peanut

Peanut (*Arachis hypogaea*. L) Or groundnut is an annual herbaceous plant of the *Fabaceae* or Legume family. It is known by many other local names such as earthnuts, ground nuts, goober peas, monkey nuts, pygmy nuts, pig nuts (Eng.) Batungchina (Sul.), and Mani (Span., Tag.) and Huasheng (Chin.). Despite its name and appearance, the peanut is not a nut, but rather a legume (**Murata, 2003**).

2.1.1 Scientific classification of peanut

Ibrahim (2015) classified Peanut as follow:
Kingdom: *Planate*
Family: *Faba cea*
Genus: *Arachis Ls*
Species: *A.hypogaea*

2.1.2 History of peanut

Ibrahim (2015) mentioned that, the domesticated peanut is an amphidiploids or allotetraploid, meaning that it has two sets of chromosomes from two different species, thought to be *A.duranensis* and *A. ipaensis*. This likely combined in the wild to form the tetraploid species *A. monticola*, which gave rise to the domesticated peanut. This domestication might have taken place in Paraguay or Bolivia where the wildest strains grow today. Many per Columbian cultures, such as the Moche, depicted peanuts in their art. Archeologists have dated the oldest specimen to about 7,600 years, found in Peru. Cultivation spread as far as Mesoamerica, where the Spanish conquistadors found the tlalcacahuatl (the plants Nahuatl name, whence Mexican Spanish cacahuate and French cacahuete) being offered for sale in the marketplace of Tenochtitlan (Mexico City). The plant was later spread worldwide by Europeantraders.

2.1.3Origin and Distribution

The cultivated groundnut is an ancient crop of the New World, which originated in South America (southern Bolivia/north west Argentina region) where it was cultivated as early as 1000 B.C(**Murata, 2003**).

The term Arachis is derived from the Greek word "arachos", meaning a weed, and hypogaea, meaning underground chamber, i.e. in botanical terms, a weed with fruits produced below the soil surface. There are two most common names used for this crop i.e. groundnut or peanut. The term groundnut is used in most countries of Asia, Africa, Europe and Australia, while in North and South America it is commonly referred to as peanut. The term groundnut refers to the pods with seeds that mature underground; the connotation of peanut is because this crop belongs to the leguminous family which includes also other crops such as peas and beans. It is a legume crop and not related to other nuts e.g. walnut, hazelnut or cashews**(Prasad *et al.*, 2010**).

In Africa, groundnut is grown mainly in Nigeria, Sudan, Senegal, Chad, Ghana, Congo, and Niger. In 2007, the total harvested area in Africa was9.04 million ha with a total production of 8.7 million Mt. The average productivity in this region is 964 kg/ha, which is poor when compared to the US and other developed countries where it is close to 3500kg/ha. Average productivity is 1720 kg/ha in Nigeria, 500 kg/ha in Sudan, and close to 700 kg/ha in Senegal**(Prasad *et al.*, 2010).**

Sudan proudly boasts 14% of the world total peanut's production and is one of the top five producers worldwide providing much needed foreign exchange. In fact, groundnut cultivated area represents about 35% of total cash crop area. Two varieties of groundnut are grown in Sudan; one is grown in the western part of the county accounting to 60-70% of the total production whilst the other variety grows in Gazeria and East Sudan**(Kumar, 2018)**.

2.1.4 Botanical description

Groundnut seed consists of two cotyledons, stem axis and leaf primordial, hypocotyls and primary root. The function of the hypocotyls is to push the seed to the soil surface during germination, and its length is determined by planting depth. The hypocotyl stops elongating as soon as light strikes the emerging cotyledon. Thus, groundnut emergence is intermediate between the epigeal (hypocotyls elongates and cotyledons emerge above ground) and hypogeal (cotyledons remain below ground) types. The taproot grows very fast, reaching a mean length of 10 – 12 cm within four to five days. Lateral roots appear about three days after germination. Initial plant growth is slow, with more rapid growth being observed between 40 and 100 days after emergence. Groundnut is a self-

pollinating, annual, herbaceous legume growing upright, and has an indeterminate growth habit. Plants develop three major stems; the main stem develops from the terminal bud on the epicotyls while the two lateral stems equal in size to the central stem develop from the cotyledonary auxiliary buds. Groundnut produces a well-developed taproot with many lateral roots .Groundnut plants start flowering about 30 to 40 days after planting. The tip of the ovary bearing from 1–5 ovules.Grows out from between the floral bracts, bearing with it the dried petals, calyx lobes and hypanthia; creating a unique floral structure - the carpophores, commonly known as a peg or gynophores. The peg quickly elongates, and growth is positively geotropic until it penetrates several centimeters (5-10 cm) into the soil when the tip becomes Diageo tropic, and the ovary starts developing into a pod. The pod is an elongated sphere with different reticulation on the surface and /or constriction between the seeds, and contains one to five seeds. Pods reach maximum size after 2 to 3 weeks in the soil, maximum oil content in 6 to 7 weeks, and maximum protein content after 5 to 8 weeks. Considerable variability exists in groundnut morphological traits: seed size, (0.15 to more than 1.3 g seed-1), seed color (white, light rose, rose, red, purple, white blotched with purple red), number of seeds pod-1 (1-5), pod length (11-83 mm) and pod breadth "9-27 mm" (**Murata, 2003**).

2.1.5 Nutritional value of peanuts

Peanut are rich in essential nutrients. In a 100g serving, peanut proviede570 calories and are an excellent source (defined as more than 20% of the Daily value, DV), magnesium (52%DV) and phosphorus (48% DV), and dietary fibre. They also contain about 25g protein ber 100g serving, a higher proportion than in many tree nuts. Also it has many amino acid such as, (tryptophan, theronine and arginine),vitamins (thiamine(B1), riboflavin(B2), niacin(B3), vitamin C and vitamin E) and minerals**(Ibrahim,2015).**

2.1.6Post-Harvest

2.1.6.1 Pod Picking/Stripping/Threshing

Peanut pods are picked by hand. Pods are immediately sun dried to prevent deterioration. Picking is done in such a way that the peduncle) does not go with the pod. The pods are then washed and the inferior, immature ones are separated from the mature and sound peanut pods. The

plant residues are usually either left in the field to decompose or kept and used as animal fodder. During wet season, farmers usually strip or thresh immediately after harvest so that peanut pods can be immediately dried to the desired moisture content and prevent deterioration. For dry season crops, stripping is delayed because farmers windrow the plants in the field to reduce plant and pod moisture content. Stripping can be done manually or with a mechanical peanut stripper (**Murata, 2003**).

2.1.6.2 Drying

Sun drying is the most commonly used drying method which is considered as the cheapest but very dependent on climatic condition. It will take 2-5 days to sundry the harvested peanut crop in the field. In general, drying is done twice within the cycle of postharvest operation: initial drying prior to threshing, and final drying before pod shelling. When peanuts are grown as second crop, windrow drying in the field is sometimes followed by aeration in small shaded huts prior to threshing and final peanut pod drying as practiced in Cagayan Valley. For seed purposes, only sound, mature, clean and well-filled peanut pods must be selected. Sundry selected peanut pods to attain 8 to 10% moisture content. This is achieved by sun drying the windrowed pods for 2-3 days and the newly harvested pods for 4 to 5 days. Spread selected pods uniformly into the drying floor, turning them from time to time. Care should be observed not to damage pods (**Murata, 2003**).

2.1.6.3 Shelling and Sorting

For immediate marketing of peanuts, pods are shelled carefully to avoid scratching, splitting and rupturing of the seed coat, as well as breaking of the cotyledon. Traditionally, farmers shell peanut manually. Hand shelling is the preferred method of obtaining peanut seeds because it protects seeds from being broken. After shelling, manually clean and sort peanuts into whole nut, reject, broken or unshelled. The common practice is to winnow peanut by using circular bamboo tray “bilao” and hand pick the nuts (**Murata, 2003**).

2.1.6.4 Storage

Peanuts seed are stored unshelled to maintaining viability for 6 months. The shells act as a natural protective covering of the seeds against mechanical damage and insect infestation. After the last sun drying, allow the dried peanuts to cool for about 6-12 hrs. Store the dried pods in a tightly closed storage container to prevent entry of air and moisture. Place

storage containers inside a dry and rain protected structure. Before use, open the seed storage container 3- 5 days before planting. In the absence of tight containers, dried peanut seeds are placed in sacks and stored in a well-ventilated room or inside a cold storage. Sundry the seeds for a few hours a day prior to planting as moisture content may have increased in the peanut seeds during storage. For shelled peanuts, farmers or traders usually store them for less than months before marketing or processing as shelled peanuts easily deteriorate(**Murata, 2003**).

Table (2.1): Chemical composition of peanut

Composition	**Raw**	**Roasted**
Moisture content	7.48	1.07
Ash content	1.48	1.41
Crude fiber	2.83	2.41
Crude fat	46.10	40.60
Protein	24.70	18.40
Carbohydrate	17.41	36.11

Source: Ayoola *et al*. (2012)

Table (2.2): Mineral Composition of the peanut on dry weight basis

Mineral	**Raw**	**Roasted**
	Mg/ 100g	
Sodium	0.71	0.57
Potassium	0.47	0.55
Calcium	1.18	1.35
Magnesium	0.18	0.24
Iron	0.40	0.47
Zinc	0.44	0.50
Phosphorus	0.68	0.69

Source: Ayoola *et al*. (2012).

2.1.7 Utilization

2.1.7.1 As food

(1)Peanuts can be eaten raw, used in recipes.(2)confections made from peanuts include salted peanuts,(3) and peanut butter, as well as many other uses (sandwiches, peanut candy bars, peanut butter cookies, and cups).(4) Dry roasted salted peanuts are also marketed in significant quantities.(5) Peanuts are often a major ingredient in mixed nuts because

of their relative cost compared to Brazil nuts, cashews, walnuts, and so on.(6) Although peanut butter has been a tradition on camping trips and the like because of its high protein content and because it resists spoiling for long periods of time, the primary use of peanut butter is in the home. Large quantities are also used in the commercial manufacture of sandwiches, candy, and bakery products. Boiled peanuts are a preparation of raw, unshelled green peanuts boiled in brine and often eaten as a snack

2.1.7.2 As medicine

In folk medicine, groundnut is used for aphrodisiac purposes, inflammation, cholecystosis, nephritis and decoagulant. In China, the oil is taken with milk for gonorrhoea, and used externally for rheumatism, while in Zimbabwe the groundnut is used in folk remedies for plantar warts (**Murata, 2003**).

2.1.7.2.1Niacin

Peanuts are a good source of niacin, and thus contribute to brain health and blood flow.

2.1.7.2.2 Antioxidants

Recent research on peanuts has found antioxidants and other chemicals that may provide health benefits. New research shows peanuts rival the antioxidant content of many fruits. Roasted peanuts rival the antioxidant content of blackberries and strawberries, and are far richer in antioxidants than carrots or beets. Research published in the journal Food Chemistry shows that peanuts contain high concentrations of antioxidant polyphenols, primarily a compound called p-coumaric acid, and that roasting can increase peanuts' p-coumaric acid levels, boosting their overall antioxidant content by as much as 22 %(**Murata, 2003**).

2.1.7.2.3 Resveratrol

Peanuts are a significant source of resveratrol, a chemical associated with but not proven to cause a reduction in risk of cardiovascular disease and cancer. The average amount of resveratrol in one ounce of commonly eaten peanuts (15 whole peanut kernels) is 73 μg.

2.1.7.2.4 Coenzyme Q10

Peanuts are a source of coenzyme Q10, as are oily fish, beef, soybeans and spinach(**Murata, 2003**).

2.1.1 Aflatoxins

Aflatoxin (a type of Mycotoxins) are a group of approximately 20 related fungal metabolites produced in cereals, maize grains, peanuts and animal feeds mainly by the fungi *Aspergillus flavus* and *Aspergillus parasitica*. The other aflatoxin producing species include *A.bombycis*, *A. ochraceoroseus, A. pseudotamari, A.tamarii*, *Emericella astellata* and *Emericellavenezuelensis*, which are scarce in nature and occasionally found in agriculture compared to *A.flavus* and *A.parasitica*. Identification of aflatoxin was linked to a groundnut meal contaminated with *A.flavus*leading to mysterious disease "Turkey X disease" that killed more than 1,00,000 Turkey poultry birds in England in 1960's. The toxic principles were named as aflatoxins (*A.flavus* toxins) Aflatoxin B1 is identified as the most powerful and lethal naturally occurring liver carcinogen.The atmospheric conditions conducive for aflatoxin productionare high moisture during harvest, dry weather near crop maturity and inadequate drying and storage of crops. Post harvesting conditions such as transport, storage (excess heat and moisture, pest related damage, long periods of storage) and food processing influence the production of aflatoxins. Aflatoxins are toxic to human and animal health. They cause liver and kidney damage, cause immunosuppressive, carcinogenic and mutagenic effects**(Kumar, 2018)**.

2.1.1.1Types of aflatoxins

Aflatoxin consists of a group of 20 fungal metabolites. Out of them only B1, B2, G1, G2, M1 and M2 are usually found in foods, where "B" and "G" referring to the blue and green fluorescent colors produced on thin layer chromatography plates under UV light, while the subscript numbers 1 and 2 indicate major and minor compounds, respectively. M1, M2 is the metabolites of B1, B2 found in human and animal milk. Aflatoxin B1 & B2 are produced by *A.flavus* and *A.parasiticus*. Aflatoxin G1 & G2 areproduced by *A.parasiticus***(Kumar, 2018)**.

2.1.1.2Methods for detection and quantification of Aflatoxins

2.1.1.2.1 Chromatography

Chromatography is one of the most popular methods to analyze mycotoxins such as aflatoxins. The most common techniques of chromatography are Gas chromatography (GC), liquid chromatography (LC), High performance liquid chromatography (HPLC) and Thin layer

chromatography (TLC). From these methods, LC and HPLC are the most used. In many cases, they are followed by fluorescence detections stage**.** Gas Chromatography "GC"**(Kumar, 2018).**

2.1.1.2.1.1 High performance liquid chromatography (HPLC)

Principle: Obtain representative sample and grind or equivalent so that 95%willpass through 20-mesh sieve (sieve opening 0.84mm), mixing the subsample portion. Weight 10 of ground in clean jar and seal tightly. Add 20 ml of 70% methanol or 20 ml of 50% ethanol and seal jar. The sample shakes for 1 min, then filter and collected the filtrate (the pH must be 6-8).

Procedure: Remove microwell sealer, and place t he appropriate number ofmicrowells in a microwell holder.re-seal those un used microwell, usinga single channel pipette, at 50µl of assay diluent to each microwell dissolve the coating conjugate in microwell by pipetting the content up and down 5 time at 50µl of sample extracts. Mixing the content in each well by pipetting it up and down 3 times. Put one test strip into one well, allow the test strip to develop color for 5 min interpret test results immediately.

Result: Negativesampleresult less than 10 ppb (2 lines are visible on strip). Positive sample results greater than 10ppb or equal to 10 ppb (1 line is visible). Invalid results if there is no line in strip should be retest.

I. Electrochemical techniques.
II. Electrokinetics.
III. Fluorescence.
IV. Ultra violet absorption.
V. Spectrometry.
VI. Biosensors.

2.1.1.3 Detoxification Aflatoxins in Foods

Aflatoxins are colourless to pale yellow crystals, exhibiting fluorescence under UV light. They are slightly soluble in water (10-20µg/ml) and freely soluble in moderately polar solvents such as chloroform, menthol and dimethyl sulfoxide. They are unstable in UV light in presence of oxygen, unstable in extreme p H (<3 or >10). The lactone ring opens under alkaline conditions and the aflatoxins are destroyed, but this reaction isreversible on acidification. Ammoniation results in the opening

of lactone ring at high temperature, causes decarboxylation of aflatoxins and this reaction is irreversible**(Kumar, 2018).**

2.1.1.3.1Physical method

Physical processes involve the separation ofthecontaminated fractions, removal or inactivation of aflatoxins by physical means,such as heat, cooking, radiation and roasting. Aflatoxins can be separated from the feed bycleaning. Cleaning is a multistep process which removes thedust, husks and products colonized by moulds by mechanicalsorting and washing. Separation of discoloured seeds/kernels also minimizes the aflatoxin contamination. Aflatoxins have low solubility in water. Hence washing may not remove theaflatoxins from the feeds.Heating is another method of destroying aflatoxins. Aflatoxinshave high decomposition temperatures ranging from 237 °C- 306 °C. Various heat treatments such as boiling, roasting,baking and steaming provide a viable mechanism for reducing the AFs concentration in foodstuffs.Ionizing radiation such a gamma radiation had little effect when used directly in detoxifying the aflatoxins. It indirectly decontaminates the aflatoxins by radiolysis of water, which generates free radicals. Microorganisms inactivation depends on the dosage of gamma radiation, at low dosage (0.1 MRad) was reported to stimulate aflatoxin production in bread and other foods, where as gamma radiation at 0.3-0.4 MRad dosage, suppressed mould growth as well as aflatoxin production. Adsorption is another method of aflatoxin reduction. It involves the binding of toxin compound to the adsorbent compoundduring digestion in gastro intestinal tract **(Kumar, 2018).**

2.1.1.3.2 Chemical method

The effective chemical agents that degrade aflatoxins include:

I. Chlorinating agents such as sodium hypochlorite, chlorine dioxide, and gaseous chlorine.
II. Oxidizing agents such as hydrogen peroxide, ozone, and sodium bisulphate and The hydrolytic agents' acids and alkalis. These chemicals either oxidize the double bond of the terminal furan ring or hydrolyze and oxidize the lactones ring of AFB1**(Kumar,2018).**

2.1.1.3.3 Biological method

Many bacteria, yeast and fungi are able to degrade aflatoxins in solutions. Flavobacterium(aurantiacum) NRRL B-184,that could irreversibly

remove aflatoxin B1 from aqueous solution has been reported. Thebacteria has completely detoxified the toxin contaminated milk, oil, peanut butter, peanuts and corn, where as it partially detoxified the contaminated soybean.Reported that the bacterium F.aurantiacum successfully removed the aflatoxin M1 from naturally contaminated milk. 9.9µg/ml of aflatoxin was completely removed at a cell concentration of 7.0 x1010cells/ml. At 30°C after 4hours of inc aflatoxicol and other compounds include Corynebacterium rubrum, Aspergillus niger, Trichoderma viride, Mucor ambiguus, Dactylium denroides, Mucor griseo cyanus, Absidia repens, Helm inthosporium sativum, Mucor alternans, Rhizopus arrhizus, Rhizopus oryzae, Rhizopusstolonifer, and the protozoan Tetrahymena pyriformis.

Moulds that are producing aflatoxins are also thought to degrade them by mould mycelia through the action of an enzyme peroxidase. Peroxidase catalyzes the decomposition of hydroperoxides, generating free radicals, which react with aflatoxins. Some peroxidises such as myeloperoxidase, produce hypochlorite and singlet oxygen in the presence of hydrogen peroxide and chloride ion. Aflatoxins areeffectively destroyed by hypochlorite**(Kumar, 2018).**

2.2 Chocolate

Chocolates are semisolid suspensions of fine solid particles from sugar and cocoa (and milk, depending on type), making about 70% in total, in a continuous fat phase.

As near as historians can tell, Aztec and Mayan people living in Central and South America were using chocolate almost 2,000 years ago. These people enjoyed bychocolate drink. But if you try this drink today, you'd find that it tastes much different from the chocolate drinks you enjoy. In fact, it was a very bitter-tasting drink kind of like coffee. Christopher Columbus brought some cacao beans back from the New World to show to the king and queen of Spain. But Europeans did not know what to do with the beans, so they mostly ignored them **(Charles, 2004).**

2.2.1 Utilisation as medicine

Cocoa and dark chocolate have the highest flavanol content of all foods, which have many benefits such as:

2.2.1.1 Reducing cardiovascular disease

Dietary flavanols show promising potential for reducing cardiovascular disease risk via improvement in vascular function, a health area which has been most extensively researched during the last few years**(Paoletti *et al.*, 2012).**

2.2.1.2 Blood pressure (BP) lowering

The four meta-analyses that have been carried out over the recent years have progressively included an increasing number of studies and all come to the same conclusion that regular intake of cocoa or chocolate significantly lowers blood pressure. The most recent meta-analysis showed a considerable and clinically meaningful effect of cocoa flavanols on BP reduction with -3.16 mmHg for systolic BP and -2.02 mmHg for diastolic BP**(Prasad *et al.*, 2010**).

2.2.1.3Cancerprotective

Oxidative damage is likely to play a major role at various steps of carcinogenesis. Therefore, the antioxidant ability of flavonoids might contribute to the cancer-preventive effects that epidemiological studies have found to be associated with high consumption of fruits and vegets. Support for such a theory comes from the observations that phenolic compounds inhibit DNA oxidative damage**(Borchers *et al.*, 2000).**

2.2.2 Chocolate and Mood

Caffeine is very beneficial for the human health and safe up to a particular limit (300 milligrams or less per day). Itincreases the secretion of important neurotransmitter serotonin. It stimulates the central nervous system and flow of blood in brain. This alkaloid decreases fatigue, lifts the spirit and enhances alertness of mind and mood, respiration and cardiovascular function.Chocolate; it gives instant pleasure, it is considered one of the favourite foods consumed during "comfort eating"**(Munjal*etal*.,2019).**

2.2.3 Chocolate quality

The International Organization for Standardization defines quality as 'the totality of featuresand characteristics of a product that bear on its ability to satisfy stated or implied needs'. Quality may be judged as good or bad depending on the level of adherence to specifications or standards for the products with regards to raw material input and finished productsand how well it matches consumer preferences**(Afoakwa, 2010).**

2.2.3.1 Rheological measurements of chocolate quality

Chocolate behaves as a non-Newtonian liquid exhibiting non-ideal plastic behaviour, where shear-thinning occurs once a yield value has been overcome. This is caused by the three dimensional structure of the material collapsing and asymmetric particles, which align inthe stream lines as the shear rate increases, causing a decrease in viscosity until it becomes independent of shear rate at high shear rates. The Herschel–Bulkley model and the Cassonmodel are both used as popular models to fit non-ideal pla3+stic behaviour Chocolate quality is often determined byrheological measurements and sensory evaluation for solidor more viscous food products. now recommendsthe measurement of stress and viscosity at shear rates between 2 and 50 s−1 in 7 minutes usingboth up and down curves in shear rate, this being preceded by a pre-shear at 5 s−1 lasting for5 minutes**(Afoakwa, 2010).**

2.2.3.2 Sensory evaluation of chocolate quality

Chocolate quality may also be defined byconsumer tasting which evaluates the eating qualityin terms of characteristics such as appearance, taste, mouth feel, flavour and aftertaste. Thismay be done either subjectively or objectively. Subjective opinions may be based on likes anddislikes. Objective measures are scoring systems, which are independent of likes or dislikes and need to be determined by a trained panel. Objective measures can also be obtained byinstrumental analysis, such as shear measurements, rheology or textural studies**.**Sensory analysis can be of two kinds, analytical and affective. Analytical involves theevaluation for differences or similarities between products and quality or quantity of sensory attributes of products. It is based on an analytical tool and usually carried out by a trainedpanel of 10–20 assessors. The panel is used to provide objective evaluation, and shouldnot be used to evaluate preference. The affective analysis targets preference or acceptanceevaluation or getting opinions, to a product. It uses a large number of panellists, which shouldbe representative of the target population. To study the global% of a food product,descriptive analytical methods in association with scaling may be used**(Afoakwa, 2010).**

2.2.4 Cocoa

Cocoa trees (*Theobroma cacao L*) grow in a limited geographical zone approximately10 degrees to the north and south of the equator, in particular Central America, West Indians lands, South America and Africa**(Paoletti *et al.*, 2012).** The tree that gives us chocolate is the cacaotree. Chocolate comes from beans that are found in large pods on the tree. Cacao trees grow near the equator, where it is hot and wet. The trees have lots of smallwhite or yellow flowers that bloom during theyear. Some of the flowers change into pods,but most do not. The pods are shaped like little footballs.The pods are green when they first form, but they change to a golden or reddish color as they get ripe**(Charles, 2004).**

Table(2:3): Chemical composition of cocoa

Parameters	**Values**
Fat	50–57
Protein	17.5–22
Starch	16
Fibre	23–29
Ash	4–6

Source:Borchers *et al*.,(2000).

Table(2:4): Mineral composition of cocoa powder

Mineral	**Amount (mg/100g)**
Calcium	169.45
Copper	4.61
Iron	13.86
Magnesium	593.64
Manganese	4.73
Phosphorus	795.27
Potassium	2,058.20
Sodium	8.99
Zinc	7.93

Source:**Borchers *et al*., (2000)**.

2.2.4.1Cocoa processing and technology

The processing was classified by **Afoakwa** (**2010**)as flowed**:**

I. Bean selection and quality criteria

II. Cleaning, breaking and winnowing.
III. Sterilisation.
IV. Alkalisation.
V. Roasting.
VI. Nib grinding and liquor treatment.
VII. Liquor pressing.
VIII. Cake grinding (kibbling)

2.2.5 Nutella

It took a long time for chocolate to become popular outside the regions of Central and South America where cacao trees come from. Over the years, people added things such as sugar and milk to the long and complicated process of making chocolate from cacao beans. Today, people around the world eat millions of kilograms of chocolate, making it the world's most popular sweet**(Charles, 2004).**

2.2.5.1 History

Ferrero introduced Nutella on the market in 1963.First the original form of Nutella was first created in the 1940 by Mr. PietroFerrero, a pastry maker and founder of the Ferrero Company. At the time cocoa was in short supply due to rationing during the Second World War,which meant cocoa beans were not readily available. Pietro Ferrero has mixed toasted hazelnuts with cocoa, cocoa butter and oils to create 'PastaGianduja'.His recipe is made from ingredients available in this region of northern Italy nuts, milk, sugar and just enough cocoa. He obtained a paste that shapes "in pain" wrapped in a sheet of tin. Inspired by a classic Piedmont traditional pastry, this product will be called "Giandujot "But it was not until 1949 that the recipe is completed. For a hot summer, says the legend, the Giandujot began to melt like snow in the sun. Seeing this,Pietro Ferrero immediately understood the great advantages of this consistency creamier. He adapted the recipe for the creamy chocolate spreadthat we know today, and called at the time Supercrema.Eventually in 1964 in recognition of the international appeal of the uniquehazelnut taste, the product was re-named Nutella.

2.2.5.2 Nutella ingredients

According to the product label, the main ingredients of Nutella arepalm oil by hazelnut, cocoa solids and skimmed milk. Nutella is marketed as "hazelnut cream" in many countries.

2.2.5.3 Nutella Manufacturing Processes

Nutella is described as a chocolate and hazelnut spread, although it is mostly made of sugar and palm oil. The process of making this spread begins with the extraction of cocoa powder from the cocoa bean that contains approximately 50 percent of cocoa butter (roasted). The cocoa powder is then mixed with the hazelnuts along with sugar, vanillin and skim milk in a large tank, until it becomes a paste-like spread, then added palm oil to help retain the solid phase of the Nutellaat room temperature. Whey powder is then added to the mix to act as a binder for the paste it is an additive to prevent coagulation of product. Lecithin added to help emulsify the paste and to enhance the sweetness of the Nutella.

Table (2.5): Nutritional value of Nutella

Parameter	**Quantity per 100(g)**
Protein	7.3
Sugars	54.4
Total fat	30.3
Saturated fat	10.0
Total carbohydrates	54.7
Sodium(mg)	33
Energy (KJ)	2175

CHAPTER THREE

3. MATERIALS AND METHODS

3.1 Materials

The Peanut used in this study was obtained from Samil Factory and was kept in polyethylene bags at room temperature, and other materials were purchased from Omdurman market, Khartoum.

3.2Methods

3.2.1Chemical methods

3.2.1.1Moisture content

The moisture content was determined according to the standard method of the AssociationofOfficialAnalytical Chemists **(AOAC, 1990).**

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: Asampleof2±0.001gwasweighedintoapre-driedand tarred dish. Then, the sample was placed into an oven (No.03-822, FN400, and Turkey) at105°C until a constant weight was obtained. After drying, the covered sample was transferred to desiccators and cooled to room temperature be for were weighting. Triplicate results were obtained for each sample and the mean value was reported to two decimal points according to the following formula:

Calculation:

$$\textbf{Moisture content}\ (\%) = \frac{(Ws - Wd) * 100\%}{\text{Sample weight (g)}} \qquad \text{[eq.1]}$$

Where:

Ws= weight of sample before drying

Wd= weight of sample after drying.

3.2.1.2Crudeproteincontent

The protein content was determined in the different samples by Micro Kjeldahl method using acopper sulphate – sodium sulphate catalyst according to the official method of the **AOAC (1990).**

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 again stastandard solution of HC1 (0.1N).The protein content is calculated by multiply in the total N% by 6.25g as a conversion factor for protein.

Procedure:

A sample of two grams(2±0.001g) was accurately weighed And transferred together with,4±0.001gNaSo4 of Kjeldahl catalysts(No.0665, Scharlauchemie,Spain) and 25m1of concentrated sulphuric acid (No.0548111,HDWIC,India) was added into aKjeldahld igestion flask. Afterthat, the flask was placed into a Kjeldahld igestion unit (No.4071477, typeKI26, Gerhardt, Germany) for about 2 hours until acolorless digest was obtained and the flask was left to cool room temperature. The distillation 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 bromo creasol green and methyl redasanin di cator until a brown reddish color was observed.

Calculation:

$$\textbf{Crude Protein (\%)} = \frac{(\text{ml HCl sample} - \text{ml HCl blank}) * N * 14.00 * F * 100\%}{\text{Sample weight (gm)} * 1000} \quad \text{[eq.2]}$$

Where:

N: normality of HCl (0.1N).

F: protein conversion factor=6.25

3.2.1.3Fatcontent

Fat content was determined according to the official method of the **AOAC (1990).**

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

Procedure:

A sample of 5±0.00lg was weighed into an extraction them blend covered with cotton that previously extracted with hexane (No.9-16-24/25-29 51, LOB a Cheme, India). Then, the sample and a pre-dried and weighed extraction flask containing about100ml hexanes were attached to the extraction unit (Electro-thermal, England) and the Extraction process was conducted for 6hrs. Attend 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 putinanovenat 105°C for 3hrs, cooled to room temperature in desiccators, reweighed and the dried extract was registered as fat content according to the following formula:

Calculation:

$$\textbf{Fat content (\%)} = \frac{(W2-W1) * 100\%}{W3} \qquad \text{[eq.3]}$$

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%).

[eq.4]

3.2.1.5. Crude fiber content

The crude fiber was determined according to the official method of the **AOAC (1990).**

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±0.001g of a defatted sample was placed into a conical flask containing 200 m1of H2SO4 (0.26N). 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 (0.23N) solution for 30 minutes under reflux condenser and the precipitate was filtered, rinsed with hot distilled water, 20 m1ethyl alcohol (96%) and 20 ml di ethyl ether. finally, the crucible was driedat105°C(overnight) to a constant weight, cooled, weighed, ashedin a Muffle furnace (No.20.301870, Carbolite, England) at600°C until a constant weight was obtained and the difference in weight was considered as crude fiber.

Calculation:

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

[eq.5]

Where:

W1= weight of sample be for ignitions (gm).

W2= weight of sample after ignition (gm).

3.2.1.6. Available carbohydrates

Available carbohydrates were calculated by difference according to the follow in equation:

Available carbohydrates (%) = Total carbohydrates%–Crude fiber%.

[eq.6]

3.2.1.7. Ash content

The ash content was determined according to the method described by the **AOAC (1990).**

Principle: The inorganic materials which are vary in gin concentration and compositions are customary determined as a residue after being ignite data specified heat degree.

Procedure:

A sample of 5±0.001g was weighed into a pre-heated, cooled, weighed and tarred porcelain crucible and placed into a Muffle furnace (No.20.301870, Caroline, England) at 600° C until a white gray ash was obtained. The crucible was transferred to desiccators, allowed to cool room temperature and weighed. After that, the ash content was calculated as a percentage based on the initial weight of the sample.

Calculation:

$$\text{Ash (\%)} = \frac{[(\text{W of crucible Ash})-(\text{W to empty crucible})] * 100\%}{\text{Sample weight (g)}}$$

[eq.7]

3.2.1.8Foodenergyvalue

The energy value of peanut Nutella was calculated based.

Protein =3.87K.cal/g

Fat =8.37K.cal/g

Carbohydrate=4.12K.cal/g

K.cal=4.184Kj

3.2.2 Physcio-chemical methods

3.2.2.1 Hydrogen ion concentration

The PH is defined as the logarithm of reciprocal of hydrogen ion concentration in (gm.\liter). The PH of different samples was measured following the method **AOAC (1997).**

Principle: The pH of a sample is measure potentio-meterically with a pH-meter after standardization of the meter electeodes with buffer solution and the reading is taken when the equilibrium potential across the electrodes is achieved.

Procedure: After standardization of the pH-meter (pH-meter model pHs-2F) electrodes with two buffer solutions (p of pH4.01-6.89).The electrodes of pH meter were rinsed with distilled water, immersed in the sample solution (28ºC) and left to stand until stable reading was achieved. All the reading was expressed as pH then earest decimal point (0.01) pH units.

3.2.2.2 Total soluble solids (TSS %)

AOAC (1997) described the total soluble solids of Peanut Nutella by using a hand refract-meter and were expressed as (%) sucrose degree brix

3.2.2.3 Titerable of acidity

The total acidity was conveniently determined according to the method described by **AOAC (1997).** Take 10 gm. of the sample, diluted with 100ml distilled water and then filtered by using filter paper No

Of prepare sample was titrated against 0.1 N Sodium hydroxide and using phenolphthalein as an indicator, total acidity (mg\100mg) expressed as oleic acid.

$$\textbf{T.A} = \frac{\text{Titer ml} * \text{Normality of NaOH} * \text{equivalent wt.} * 100}{\text{Wt. of sample} * 1000} \quad \{\text{eq.8}\}$$

3.2.2 Statistic an analysis method

The results obtained in this study were subjected to Statistical Analysis System (SAS) by using Excel 2007.

3.2.3 Peanut Nutella processing

The processing used in this study for production Nutella is described in fig (1). In this method the peanut roasted at(185ºC), grinded and weight(20g), then mixing materials, sugar(100g), water(80g), whole milk powder(40g), cocoa(30g), glucose(20g), butter(10g), vanilla(1g), salt (0.5g) lecithin(0.5g). After that filled in a glass bottle and wormed in water bath (50ºC) for (2-30min), then cooling to (27-30ºC),addition of lecithin and vanilla, and stored at room temperature.

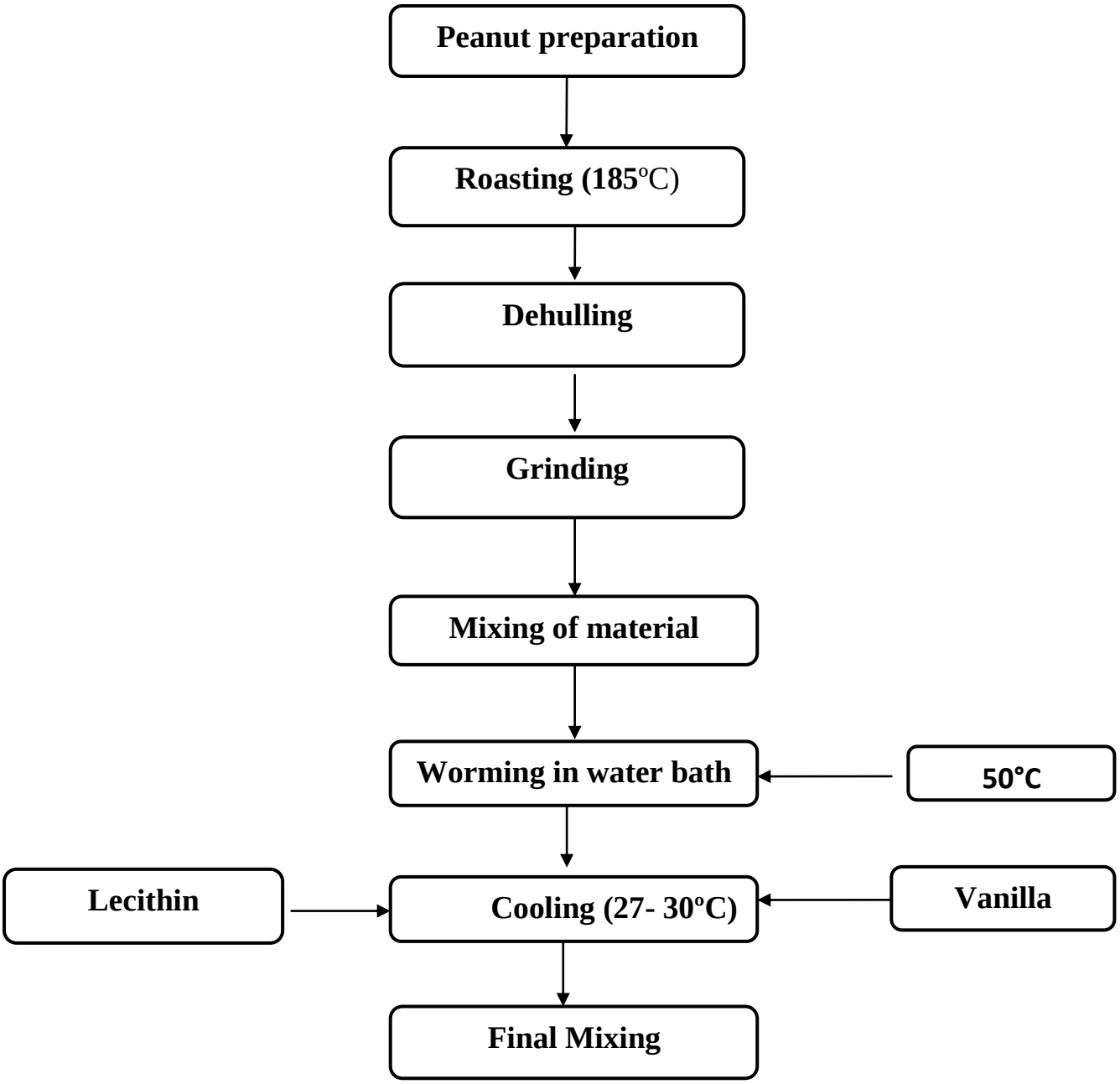

Figure (1): Flow processing diagram for production of Peanut Nutella

CHAPTER FOUR

4. RESULTS AND DISCUSSION

Table (4.1) shows Chemical composition of Peanut on wet and dry basis. Protein, Ash and crude fiber which were agreed, and Carbohydrate, moisture and fat which were disagreed with those reported by **Ayoola*etal*.,(2012)**.

Table (4.2) shows recipe formulation of processed Nutella, the weight of the Peanut butter(20g), sugar(100g), milk powder(40g), cocoa(30g), glucose(80g), butter(20g), lethcien(10g), salt(0.5g), vanilla(0.5g). And the formulas (%) were found 6.62, 33.11, 13.25, 9.93, 26.49, 6.62, 3.31, 0.17, 0.17, 0.33, and 100 %, respectively.

Table (4.3)shows chemical and physic-chemical characteristics of Peanut Nutella, from the results moisture, fat, T.A as % oleic acid, total soluble solids (T.T.S. %) and hydrogen ions concentration (PH) were found to be 30%, 14%, 0.564 %, 65% and 6.19 %, respectively.

Table (4.5) shows Sensory evaluation of processed Nutella, the color, taste, flavor, appearance, texture and overall acceptability, the product was very acceptable by the panelist.

Table (4.1): Chemical composition and energy value of peanut

Parameter	Values (%, n = 2±SD)	
	On wet basis	On dry basis
Moisture & Dry Matter	05.27±0.09	94.73±0.16
Protein	17.80±0.28	18.79±0.24
Fat	47.26±0.87	49.89±0.07
Total carbohydrates	27.79±0.06	29.34±0.09
Crude Fiber	02.57±0.04	2.71±0.11
Available carbohydrates	25.22±0.17	26.63±0.12
Ash	01.88±0.03	1.98±0.05
Energy / 100g		600.01K Cal 2510.45 K J

SD= standard deviation.

n= Number of independent determinations.

Table (4.2): Recipe formulation of Peanut Nutella

Ingredients	Weight (g)	Formula (%)
Peanut butter	20	6.62
Sugar	100	33.11
Milk powder	40	13.25
Cocoa	30	9.93
Water	80	26.49
Glucose	20	6.62
Butter	10	3.31
Lethcien	0.5	0.17
Salt	0.5	0.17
Vanilla	1	0.33
Total	302	100

Table (4.3): Chemical and physio-chemical characteristics of Peanut Nutella

Parameters	Values
Moisture%	30.00
Fat%	14.00
Titrable acidity	0.564
T.S.S%	65
PH	6.19

Table (4.4) Sensory evaluation of Peanut Nutella

Sense / Rank		Unacceptable	Acceptable	good	very good	Excellent	Total	Mean± SD	Evaluation
Appearance	N	0	1	6	8	5	20	3.85 ±0.87	**V. Good**
	%	0%	5%	30%	40%	25%	100%		
Color	N	0	0	6	9	4	20	3.85 ±0.74	**V. Good**
	%	0%	0%	30%	45%	20%	100%		
Texture	N	0	2	6	9	3	20	3.65 ±0.87	**V. Good**
	%	0%	10%	30%	45%	15%	100%		
Taste	N	0	4	2	9	5	20	3.75 ±1.06	**V. Good**
	%	0%	20%	10%	45%	25%	100%		
Flavor	N	0	3	5	4	8	20	3.85 ±1.13	**V. Good**
	%	0%	15%	25%	20%	40%	100%		
Overall quality	N	0	0	5	9	6	20	4.05 ±0.75	**V. Good**
	%	0%	0%	25%	45%	30%	100%		

1 = Unacceptable
2 = Acceptable
3 = Good
4 = very good
5 = Excellent

CHAPTER FIVE

5. CONCLUSION AND RECOMMENDTIONS

5.1 Conclusion

From the results obtained in this study, it can be concluded that, the Nutella can be manufactured from peanut. The peanut Nutella was high nutritional value especially in proteins, fat and energy value. The processed product appears high acceptable by the panelists.

5.2 Recommendations

1. We recommend utilize the peanut in production of Nutella because it's available locally and cheap.
2. Also we can recommend that, consumed the peanut Nutella by the Mal-nutrition persons.
3. Additional studies are definitely needed to ensure safety, storage conditions, self-life and economic feasibility for the product.

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