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**Sudan University of Science and Technology**

**College of Agricultural Studies**



**Department of Food Science and Technology**

**Burger Production for Vegetarians with addition of  
Mushroom and Soy bean**

**إنتاج بيرغر للنباتيين بإضافة المشروم وفول الصويا**

A Dissertation Submitted to Sudan University of Science And Technology in  
partial fulfillment for the degree of B.Sc. in food Science and Technology.

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# DEDICATION

To

*Our fathers and mothers*

*Our brothers and sisters*

*And to all friends*

## ACKNOWLEDGEMENTS

With all due humbleness and gratitude we render ultimate thanks and special praise to Allah (Almightly) who gave us health, power and patience to accomplish and conduct this research.

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## Abstract

The aim of this study was a trial to prepare burger for vegetarians using mushroom (*Agaricus bisporus*), soybean and assess the effect of added mushroom on physicochemical and organoleptic characteristics of produced burger. physicochemical composition and sensory evaluation of mushroom burger of 75% mushroom, 60% mushroom and 15%soybean , 15% mushroom and 60%soybean to replace meat in burger, compared to normal burger (control)were carried out. The result obtained revealed that the physicochemical composition of significant difference ( $p \leq 0,05$ ) between the control burger and the burger of 75 % mushroom, 60% mushroom and 15%soybean and 15% mushroom and 60%soybean. The high result in moisture, ash and carbohydrate was found to be 73.00%, 2.27% and 21.03, respectively and low in fat (0.18) and PH (0.36) which was in 75% mushroom. The high result in protein was found in15% mushroom and 60%soybean (21.81).The sensory evaluation revealed that there was no significant difference ( $p \leq 0,05$ ) in color and tenderness except for flavour, taste and total acceptability burger for vegetarian was in 75% mushroom, 60%mushroom and 15% soybean and 15% mushroom and 60%soybean, the high flavour and tenderness was found in 60%mushroom and 15% soybean (B)and 15% mushroom and 60%soybean(C). According to this study mushroom and soy bean are recommended in making burger for vegetarians.



## الملخص

كان الهدف من هذه الدراسة إعداد بيرقر للنباتيين باستخدام المشروم (الأجاريكس) وفول الصويا وتقييم تأثير الفطر المضاف على الخصائص الفيزيوكيميائية والحسية للبيرقر المنتج . أجري التحليل الفيزيوكيميائي والتقييم الحسي لبيرقر المشروم 75% ، 60 % و 15 % المستبدلة من اللحم في البيرقر بالمقارنة مع بيرقر اللحم العادي (الشاهد) . أظهرت النتائج أن التحليل الفيزيوكيميائي وجود إختلافات معنوية ( $p \leq 0.05$ ) ، بين الشاهد و البيرقر الذي يحتوي 75% مشروم، 60% مشروم 15% و فول الصويا (B) و 15% مشروم و 60% فول الصويا (C). وكانت أعلى نتيجة في المحتوى الرطوبي ، الرماد والكربوهيدرات لتكون 73.00 % ، 2.27 % و 21.03 ، على التوالي وانخفاض في الدهون 0.18 و pH 0.36 في 75% مشروم . تم العثور على أعلى نتيجة في البروتين في 15 % مشروم و 60 % فول الصويا 21.81 ، أظهر التقييم الحسي عدم وجود إختلافات معنوية ( $P \geq 0.05$ ) في اللون والطراوة بإستثناء النكهة والطعم والقبول العام في 75 % مشروم ، 60 % مشروم 15 % فول الصويا و 15 % مشروم 60 % فول الصويا ووجد أفضل نتيجته في الطعم والطراوة في 60 % مشروم و 15 % فول الصويا (B) 15 % مشروم و 60 % فول الصويا (C). وفقا" لهذه الدراسة ينصح بإستخدام المشروم والصويا لإعداد بيرقر خاص للنباتيين.

# CHAPTER ONE

## INTRODUCTION

Meat is defined as those animal tissues, which are suitable for use as food. All processed or manufactured product, which might be prepared from tissues, are included in this definition. The processed meat products are define as those in which properties of fresh meat have been modified by use of one or more procedures, such as grinding or chopping addition of seasoning, alteration of color or heat treatment (Adam, 2013). Since meat contains an abundance of proteins with high biological value, meat is categorized as a protein food group in dietary food guides. In other words, in terms of nutrition, meat excellent diet source of essential amino acids. Meat also plays an important role in supplying our diet with minerals and vitamins, such as iron, zinc, selenium, and B vitamins. However, consumers often associate meat and meat products with a negative health image. This regrettable image of meat is mainly due to its content of fat, saturated fatty acids, and cholesterol, and their association with chronic diseases, such as cardiovascular diseases, some types of cancer, , and obesity. Also, intake of sodium chloride from meat products has been linked to hypertension. The public has become increasingly concerned about health and nutrition matters in recent years, and this has sparked the commercialization of natural foods consumed as dietary supplements. With the demand for nutritious and healthy food products, the researches have to focus their creation towards utilization of plant sources such as soybean, chick pea and mushroom in preparing meat like product with high nutritional value and quality and at in the same time with low price (Sharief, 2018). Soybean which is an excellent, inexpensive source of protein and iron. Soybeans can be eaten in their

whole form and also used to make a number of vegetarian substitutions for meat, dairy, and eggs (Clifford and Kozil, 2012).

Mushrooms have been broadly used as food or food ingredients in various his fungus is cultivated on a decayed organic material and produce edible portion on the surface of the substrate. Mushrooms are considered to be healthy because they are low in calories, sodium, fat and cholesterol level. Therefore, they form an important constituent of a diet for a population suffering from atherosclerosis. It also contains appreciable amount of dietary fiber and B-glucan, vitamin B groups, D and other useful nutrients. Mushrooms have become attractive as functional foods and a source of physiologically beneficial substances. Mushrooms can be considered a functional food (medical food or nutritional food) in this way. Such functional or medical foods should not claim to cure disease, but there are an increasing number of scientific studies that strongly support some functional foods such as mushrooms as having a role in disease prevention and in some cases of bringing about a suppression or remission of a diseased state. Mushrooms have been known for their nutritional and culinary values as well as viewed as tonics and used as medicines by humans for ages. In modern terms, they can be considered as functional foods which can provide health benefits beyond the traditional nutrients they contain. Edible mushrooms, due to their commercial and environmental importance, have lately attracted the attention of the researchers. Although the nutritional and medical value of the mushroom is high, the Sudanese consumer wouldn't prefer consumption of mushroom in its natural form. This study is concerned with using mushroom in the burger processing and hence the objectives of this study were as follows: (Sharief 2018).

**General objective**

To produce burger for vegetarians using mushroom and soybean.

**Specific objective**

1. To formulate burger product for vegetarians.
2. To determine the nutritive value of the product.
3. To evaluate product from sensory point of view.

# CHAPTER TWO

## LITRETURE-REVIEW

### 2-1 Mushroom

#### 2-1-1 Definition of mushroom

A mushroom is fleshly fungi spore-bearing fruiting bodies of typically produced above ground on soil or on their food sources fruiting body of fungi.

#### 2-1-2 Mushroom history:

Mycophagy the act of consuming mushrooms dates to ancient times. mushroom have s nearly always been around, with a very long and interesting history(cheung2008). Hippocrates first mentioned mushrooms when he wrote about their medicinal value in 400 B.C. Mushrooms have been found in fossilized wood that is estimated to be 300 million years old, and almost certainly prehistoric man used mushrooms collected in the wild as food. Recently, the importance of the role of mushrooms in history was evidenced by the fact that the desert truffle, *Terfezia arnenari*, was described in the Bible as "bread from heaven" and also "manna of the Israelites". Edible mushroom species have been found in association with 13,000 year old ruins in Chile, but the first reliable evidence of mushroom consumption dates to several hundred years BC in China. The Chinese value mushrooms for medicinal properties as well as for food. Ancient Romans and Greeks ate mushrooms particularly the upper class. The Roman Caesars would have a food taster taste the mushroom before the Caesar to make sure they were safe (Gordan, 2006).

Mushrooms are also easily preserved, and historically have provided additional nutrition over winter many cultures around the world have either used or continue to use psilocybin mushrooms for spiritual purposes as well as medicinal mushrooms in folk medicine. Mushrooms were used a lot as they were easily preserved thus making it a perfect food source for cold winter days. Fossils of edible mushroom species were found the 13,000 year old ruins in Chile, but the reliable evidence of Mycophagy can be dated back to several 100 years BC in China. The Chinese used mushrooms for medicinal properties as well as for food. Romans and Greeks also consumed mushrooms. Close to 4600 years ago, the Egyptian pharaohs liked it so much that they even tried to restrict the consumption to the upper class by making it a royal food. Later on the Roman casers used to have a food taster to taste the mushrooms right before the Caesar consumed it to ensure that they were not poisonous. Around the 18th century the French were considered to be a leader in formal mushroom cultivation. Louis XIV was supposed to be the first mushroom grower and the mushrooms were cultivated in special caves near Paris set aside for this purpose. The mushrooms were taken to England from France by the gardeners of England who found that was a very easy crop to grow that saved space, time, money and labor mushroom cultivation became quite popular in England especially with new experiments being conducted on the spawn and the amount of publicity mushroom cultivation got in journals and magazines. In the late 19th century or 1800s, mushroom cultivation reached the United States. But since the spawns crossed Atlantic were spoiled by the time they reached US' mushroom cultivation wasn't a success initially (Sharief, 2018).

### 2-1-3 Classification of mushroom

Kingdom: fungi (muceteae)

Class: Basidiomycetes

Order: Agaricales

Family: Agaricaceae

There are several types of mushrooms .However; it is found that there are those that are edible and none debones.

**The edible ones which include ( Alnage,2005):**

Scientific name	E.N	A.N
<i>Agaricus bisporus</i>	Button	مشروم الأزرار (الأجاريكس)
<i>Pleurotus ostreatus</i>	Oyster	مشروم المحارى
<i>Lentinus edodes</i>	Shittake	مشروم الشيتاك
<i>Volvariella volvacea</i>	Straw	المشروم الصيني
<i>Canoderma lucidum</i>	Varnish skin	الرايش الأحمر
Termitomyces		

### 2-1-4 Poisonous mushroom:

Because there is no known test by which to tell if a mushroom is edible or not, a mushroom should never be eaten unless it has been accurately identified and the edibility of the species is known (Chang and Miles, 2004).

Even though poisonous mushrooms represent less than 1% of the world's known mushrooms, we cannot ignore the existence of the relatively few dangerous and sometimes fatal species. Mushrooms must

be identified by a competent mycological authority. Therefore, if one is not absolutely sure whether a given mushroom is edible or otherwise, it should not be tested, and the unidentified mushroom should be left alone (Chang and Miles,2004).

The toxins contained in various species are very different in chemical composition, and thus the effects are very of poisoning differ considerably according to the species involved. In any case, suspected mushroom poisoning should never be regarded lightly and medical assistance should be sought at once. The following summary of mushroom poisoning is taken from the account by shepherd and Totter dell (Chang and Miles, 2004).

#### **2-1-5 Mushrooms structure**

A mushroom or a fruit body has three main parts above the substratum, the cap, the gills and the stipe. The cap forms the upper protective layer of the mushroom while the stipe or the stem lifts the spore-producing region above the substratum to enable release of the spores. The gills radiate out on the underside of the cap. The gills are lined with reproductive cells called basidia from which spore are producing (Ibrahim, 2017).

#### **2-1-6 Mushrooms as a source of food:**

Man has been hunting for the wild mushrooms since antiquity, Thousands of years ago, fructifications of higher fungi have been used as a source of food; due to their chemical composition which is attractive from the nutrition point of view. During the early days of civilization, mushrooms were consumed mainly for their palatability and unique flavors. Present use of mushrooms is totally different from traditional because, lot of research has been done on the chemical composition of



mushrooms, which revealed that mushrooms can be used as a diet to combat diseases(Wani, 2010).

The oriental use of mushrooms is older than the European, the mushrooms like *Agaricus campestris*, *Morchella esculenta*, *Helvella crispa*, *Hydnum coralloides*, *Hypoxylon vernicosum* and *Polyporus mylittae* were used much earlier in India. 100 to 200 g of mushrooms (dry weight) is required to maintain an optimal nutritional balance in a man weighing 70 kg, the nutritive value of *pleurotusflabellatus* as 0.974% ash, 1.084% crude fiber, 0.105% fat, 90.95% moisture, 0.14% non-protein nitrogen and 2.75% protein; the food value of mushrooms lies between meat and vegetables. The mushrooms in general contain 90% water and 10% dry matter. More so, the protein content varies between 27 and 48%. Carbohydrates are less than 60% and lipids are between 2 to 8%. that an average mushroom is about 16.5% dry matters out of Which 7.4% is crude fiber, 14.6% is crude protein and 4.48% is fat and oil. the edible mushrooms were highly nutritional and compared favorably with meat, egg and milk food Sources. Of several thousand mushroom species known worldwide only around 2000 are considered edible, of which about 20 are cultivated commercially with only 4 to 5 under industrial production. There is also a significant difference in the nutrient contents of pileus verses stalks(Wani, 2010) .

Mushroom has been a food supplement in various and they are cultivated and eaten for their edibility and delicacy. They fall between that best vegetables and animal protein source mushroom are considered ash source of proteins, vitamins, fats, carbohydrates, amino acids and minerals. Mushrooms are good sources of vitamins like riboflavin, biotin and thiamine(Wani, 2010).

## **Benefits from Mushrooms:**

### **a) Nutritional Value:**

#### **Carbohydrates**

The carbohydrate content of mushrooms represents the bulk of fruiting bodies accounting for 50 to 65% on dry Weight basis. Free sugars amounts to about 11%. *Coprinus atramentarius* contain 24% of carbohydrate on dry weight basis. The mannitol, also called as Mushroom sugar constitutes about 80% of the total free sugars, hence it is dominant, and a fresh mushroom contains 0.9% mannitol, 0.28% reducing sugar, 0.59% glycogen and 0.91% hemicellulose. Carbohydrates of *Agaricus bisporus* were Raffinose, sucrose, glucose, fructose and xylose are dominant in it. Water soluble polysaccharides of mushrooms are antitumor (Wani, 2010).

#### **Protein:**

Is an important constituent of dry matter of mushrooms, the digestibility of mushroom protein to be as high as 72 to 83%. Protein content of mushrooms depends on the Composition of the substratum, size of pileus, harvest time and species of mushrooms. The protein in *A. bisporus* mycelium ranged from 32 to 42% on the Dry weight basis. 46.5% protein on dry weight basis in *A. bisporus*, 30.16, 28.16, 34.7 and 29.16% protein in dried mycelium of *A. campestris*, *Agaricus arvensis*, *M. esculenta* and *Morchella deliciosa* respectively, 14 to 27% crude protein on dry weight basis in *A. bisporus*, *Lentinus subnudus*, *Calocybe indica* and *Volvariella volvacea*. On Dry matter basis, the protein content of mushrooms varies between 19/100 and 39/100 g In terms of the amount of crude protein, mushrooms rank below animal meats but well above most other foods including milk. On a dry weight

basis, mushrooms normally contain 19 to 35% Proteins as compared to 7.3% in rice, 12.7% in wheat, 38.1% in soybean and 9.4% in corn(Wani, 2010).

Mushrooms are very useful for vegetarian because they contain some Essential amino acids which are found in animal proteins. The digestibility of *Pleurotus* mushrooms proteins is as that of plants (90%) whereas that of meat is 99%. the decrease in the protein content of mushroom on storage. The protein conversion efficiency of edible mushrooms per unit of land and per unit time is far more superior compared to animal sources of protein. Mushrooms in general have higher protein content than most other vegetables and most of the wild plants. 14.71 to 17.37% and 15.20 to 18.87% protein in the fruiting bodies of *Lactarius deliciosus* and *Lactarius sanguifusus* respectively. Mushrooms contain all the essential amino Acids required by an adult, the total nitrogen content of dry mushrooms is contributed by protein amino acids and also revealed that crude Protein is 79% compared with 100% for an ideal protein(Wani, 2010).

### **2-1-7-1-3 Fats**

In mushrooms, the fat content is very low as compared to carbohydrates and proteins. The fats present in mushroom fruiting bodies are dominated by unsaturated fatty acids. the fat content of some mushrooms as 2.04% in *Suillus granulatus*, 3.66% in *Suillus luteus* and 2.32% in *A. campestris*, mushrooms are rich in linolenic acid which is an essential fatty acid. Total fat content in *A.bisporus* was reported to be 1.66 to 2.2/100 g on dry weight basis. a fat content of 11.52% in the *Amanita ceasarea* fruiting bodies on dry weight basis. In 100 g fresh matter of *A. bisporus* (Lange) Sing and *Pleurotus ostreatus* (Jacq: Fr.)

Kumm , the content of fatty compounds were found to be 0.3 and 0.4 g respectively but on dry weight basis, it is 2 and 1.8 g respectively. Mushrooms are considered good source of fats and minerals(Wani, 2010).

#### **2-1-7-1-4 Vitamins:**

Mushrooms are one of the best sources of vitamins especially Vitamin B. wild mushrooms contain much higher amounts of vitamin D than dark cultivated *A. bisporus*. Mushrooms also contain vitamin C in small amounts ,which are poor in vitamins A, D, and E(Wani, 2010).

#### **2-1-7-1-5 Mineral constituents:**

The fruiting bodies of mushrooms are characterized by a high level of well assimilated mineral elements. Major mineral constituents in mushrooms are K, P, Na, Ca, Mg and elements like Cu, Zn ,Fe, Mo, Cd form minor constituents. K, P, Na and Mg constitute about 56 to 70% of the total ash content of the mushrooms; while potassium alone forms 45% of the total ash. About content of potassium and sodium in *A. bisporous* was 300 and 28.ppm respectively .*A. bisporus* ash analysis showed high amount of K, P, Cu and Fe, *M. esculenta* contains Ca (0.5776 mg), P (3.313 mg), Fe (1.213 mg) and (3.831 mg), *A. bisporus* contains Ca (0.04g), Mg (0.16), P (0.75 g), Fe (7.8 g), Cu (9.4 mg), Mn (0.833mg) and Zn (8.6 mg) per kilogram fresh weight. Mushrooms have been found to accumulate Heavy metals like cadmium, lead, arsenic, copper, nickel, silver, chromium and mercury. The mineral proportions vary according to the species, age and the Diameter of the fruiting body. It also depends upon the type of the substratum. The mineral Content of wild edible mushrooms has been found higher than cultivated ones (Wani, 2010).

### **2-1-7-1-6 Antioxidant activity:**

Antioxidants are chemical compounds that protect cells from the damage caused by unstable molecules known as free radicals; Free radicals are powerful oxidants and those chemical entities that contain unpaired electrons.

They are capable of randomly damaging all components of the body, viz. lipids, proteins, DNA, sugars and are involved in mutations and cancers. The nascent oxygen is trapped by enzymes like superoxide dismutase, catalase and glutathione peroxidase. Over production of free radicals creates oxidative stress. The antioxidants are an important defense of the body against free radicals and mushrooms which are rich sources of these antioxidants. Waxy cap mushroom extracts (*Hygrocybe coccinea*) are inhibitory to sarcoma. Immunoceticals isolated from more than 30 mushroom species have shown anticancer actins in animals. Antioxidant property of compounds is correlated with their phenol compounds. mushroom extracts possess DNA protecting properties *G. lucidum* extracts can trap number of free radical. Antioxidant properties of several ear mushrooms. Many species of mushrooms have been found to be highly potent immune enhancers, potentiating animal and human immunity against cancer. Tyrosinase from *A. bisporus* is antioxidant; triterpenoides are the main chemical compounds and camptothecin is responsible for antioxidant properties in *G. lucidum* (Wani, 2010).

### **2-1-7 -2 Medicinal Values**

#### **2-1-7 -2-1 Heart and coronary diseases**

Lower fungi have yielded important medicines like penicillin and other antibiotics from penicillium (a common contaminant in mushroom cultivation). Mushrooms contain substances which lower the cholesterol

level in serum and liver which makes it good for those suffering from heart diseases.

### **2-1-7 -2-2 Cancer**

Many mushrooms contain substances, which suppress the growth rate of tumors.

### **2-1-7 -2-3 Diabetes**

Research in animals indicates that mushrooms like *pleorotus ostreatus* (Oyster), cord caps, saneness, *lentinula edodes* and *grifola frondosa* have a positive effect on diabetes.

Protection against free radicals and infection:

Free radicals can damage body cells and induce cancers. Free radicals are the result of specific transformation process. Many bio active compounds protect the body against these radicals. These substances are often called anti oxidants and are present in many mushrooms. In other words, the body immunity is boosted. This will be a relief to those suffering from HIV/AIDS

### **2-2 Meat definition**

Meat is defined as those animal tissues, which are suitable for use as food.

All processed or manufactured product, which might be prepared from tissues, are included in this definition. The processed meat products are define as those in which properties of fresh meat have been modified by use of one or more procedures, such as grinding or chopping addition of seasoning, alteration of color or heat treatment(Adam,2013).

## **2-2-1 Nutritional value and Chemical composition**

### **2-2-1-1 Nutritional value**

The composition of meat cannot be describe simply in term of the different component and their percentages, since meat includes the entire carcass along muscles fatty tissues, bones, tendons, edible organs, and glands. Variation in composition results in differences in nutritive value. This is further complication is by the fact that variation in composition is noticed between and within species (Person and Gillett, 1999). Nutritionally meat is very good source essential amino acids to a lesser extents of certain minerals. Although vitamins and essential fatty acids are also present, meat also provides calories from protein, fat and limited quantities of carbohydrates (Adam,2013).

Meat is generally a good source of all minerals expect calcium. Calcium of meat is present in the bone and teeth (Adam, 2013).

Recent research has demonstrated meat only a rich source of dietary iron but it enhance iron absorption from other source particularly in the liver than in muscular tissue. Percentage of some minerals in processed meat products is higher than fresh meat because of added salt and seasoning. Vitamins occur in the form of water soluble B vitamins along with some vitamin A (Lipid soluble) and vitamin C (Water soluble ascorbic acid). The level of vitamin in meat is reduced by cooking, the amount depend on temperature employed. Meat is generally an excellent source of the soluble B complex group but is very boor source of water soluble vitamin C, except when ascorbic acid has been added to processed meat products. it is also a very poor source of the fat- soluble vitamins A, D, E and K that are found primary in the body fat and variety meat i.e. Liver, kidney, heart etc. Carbohydrates constitutes less than one

percent of weight of meat, most of which present as glycogen and lactic acid, thus the liver is a good source of Carbohydrates. On nutritional basis alone, meat is vital to diet. It is one of the few foods which provide complete protein. As well as being a rich source of such essential iron, Niacin and vitamin B12 (National live stock and meat board, 1983). Meat is the most important single item in the diet, primarily because of its palatability and high nutritive value (Adam, 2013).

#### **2-2-1-2 Chemical composition**

The chemical and biochemical content of muscle are affected by intrinsic factors. The most important intrinsic factors are species, sex, age and anatomical location of muscle. The extrinsic factors are nutrition, fatigue, fear, pre-slaughters manipulation and environmental conditions before slaughter. Generally the composition of meat is 75% water, 18% protein, 3, 5 soluble non protein substances and 3% fat (Adam, 2013).

#### **2-2-2 Reasons for making meat products**

A major purpose for converting meat into meat products must be to modify or upgrade the less noble cuts of meat, together with any edible trimmings of fat and connective tissue removed from the more noble cuts, and to make the flavour and texture more acceptable to consumers than they would be if treated only by the simple cooking and serving methods which are appropriate for the noble cuts.

The technical problems which must be dealt with in improving the acceptability of such meat are:

- To remove bones
- To make the connective tissues less objectionable
- To present the available fat in more acceptable form



To leave flavour and nutritive value unimpaired or even improved. An alternative purpose may be to preserve the meat. Here the question of the 'nobility' of the meat may not be so important. For bacon and ham manufacture, for instance, the pigs may be specially selected for properties relevant to the quality of the final product, such as back fat thickness or low tendency to PSE; meat without these desirable properties may be diverted to other products or even to the butchery trade. Preservation may of course be undertaken in addition to the upgrading described above, e.g. the canning of luncheon meat. Economic factors may distort these purposes in special cases, for example, a sausage factory might be run at full capacity to satisfy an existing market, even at the cost of using more noble meat as raw material. Such distortions are likely to be temporary (Sharief, 2018).

### **2-2-3 Processed meat products**

Those are products in which properties of fresh meat have been modified using one or more procedures such as alteration of colour, grinding or chopping, addition of seasoning or heat treatment. The original purpose of meat processing was preservation by inhibiting microbial decomposition as well as processing that result in flavorful and nutritious products. Increased price for lean meat has also altered processing practices and has encouraged the incorporation of increased percentage of less expensive fat.

The processed products should be uniform in colour, texture, and fat distribution and suitable to conveniently and cut into protein size with the minimum of waste to consumer. Also reduced cooked loss improved tenderness and texture and increased shelf life are some of most important characteristics of processed meat comminuted products are

those made from raw meat material that has been reduced into small meat pieces, chips, or flaks. Some comminuted products can be classified as sausage and other are not. Two main advantages are gained from all comminuted products, i.e. improved uniformity of product to more uniform particle size, distribution of ingredients and increased in tenderness, as meat is subdivided into smaller particles. Equipment commonly used for comminuting includes the meat grinder, bowls chopper, emulsions mill and flaking machines (Adam,2013).

Many commercial products being as ground meat, chucks' flaks, slices or fillets that are formed into roast, steak, patties or nuggets. These often are marketed as burger steaks, and many even are being breaded and precooked. the original for meat processing was preventing spoilage; preservation also results in flavorful and nutritious products. Meat processing has additional aspects of providing both convenience and variety (Adam,2013).

Processed meat means a meat product containing no less than 300g/kg meat, where either singly or in combination with other ingredients or additive, has undergone a method of processing other than deboning, slicing, dicing, mincing or freezing or includes manufactured meat and cured and /or dried meat flesh in whole cuts or pieces (Adam, 2013).

Meat was processed as early as prehistoric times, probably drying in the sun and later by smoking over wood. Today, meat is processed with salt, color fixing ingredients, and seasonings in order to impart desired palatability traits to intact and comminuted meat products. Intact meat product includes bacon, corned beef, smoked and pork hock. Comminuted meat products include all types items (Adam,2013).

## **2-2-4 Burger**

The word is derived from hamburger, a large beef sausage which is cut into slices before cooking but the term is now applied more commonly to product of similar Organoleptic properties made as flat slices. It was common practice in Germany to name food products especially sausage, after the town where they are manufactured. In UK the same products are referred to as beef burger possibly due to the misapprehension that burgers are named according to their meat constituent. Such as bacon burger, lamb burger and hamburger, or according to basic ingredient for example cheese burger, microwave burger which is usually intended to be fully cooked in microwave oven (Abd Al-bagi, 2017).

The basic ingredient of burger is lean meat of suitable quality due to its role in water holding and determining the organoleptic properties of burger. Good quality frozen meat is best used since it has superior water binding properties.

Fat is added as separate ingredient it plays the same role as lean meat in determining the organoleptic properties (Abd Al-bagi, 2017).

Burger normally contains some amount of extender like powder milk dried for binder or reduces cooking loss of the product (Rust 1976). Bread crumbs contribute to the mouth feel and texture of burger and absorb any free moisture present. Bread crumb is made from wheat dough which is backed and ground to specified particle size (Abd Al-bagi, 2017).

## **2-3 Legumes**

Leguminaceae is one of the largest and most important family of flowering plants constituting 650 to 750 genera, 18,000 to 19,000 species of herbs, climbers, shrubs and trees. This family broadly defined by the podded fruits (legumes). It is divided into four sub families as caesalpinoideae (2,800 species), mimosoideae (2,900), papilionoideae (14,000) and swartzioideae (80). Legumes are useful as human and animal food and soil-improving components of agricultural and agro forestry. The commonly used legumes include alfalfa, chick peas, clovers, cow peas, kidney, lentils, mung beans, peanuts, peas, pigeon peas, soy beans, and vetches (Ahmed and Hassan, 2014).

### **2-3-1 Nutritional aspects of legumes**

Legumes are the richest source of nutrients (protein, starch, minerals and vitamins) and important health protective compounds (phenolics, inositol phosphates and oligo-saccharides). Legume proteins are composed of several thousand specific proteins. About 70 to 80% of the crude protein in legumes seeds is storage protein. Legume seeds accumulate amount of proteins during their development. The main protein fractions are albumin and globulin. The albumin fraction has a well-balance amino acid profiles and is relatively rich in sulfur containing amino acid (methionine and cysteine), whereas, the globulin fraction differ in their amino acid composition, molecular weight of protein sub units and physico-chemical properties. Proteins are present in pea and beans up to 20% and up to 40 % in soybean and lupin. The protein is rich in lysine, and is therefore complementary to cereals in lysine balance [3,4]. Legumes contain 390 – 510 g/kg starch content as an important energy source. This legume starch is characterized by high amylopectin

content. The oil content of legumes (except soy and lupin) is about 1 – 2% which is mainly composed of poly unsaturated fatty acids. The great nutritional values of legume seeds not only allow them to use as meat replacers but also provide component of rational nourishment and food for vegetarians. The isolated proteins, starch and fibers from legume seeds have good physico-chemical and health protecting properties (Ahmed and Hassan, 2014 ).

### **2-3-2 Soybean**

The origin of soybean cultivation is china .china was the world's largest soybean producer and exporter during the first half of the20 century. In the 1950s soybean production developed rapidly in the USA and the USA is now the largest soybean producing country in the world.

In the 1970s soybean production developed in Brazil, and this country is now the second largest soybean-producing country. Since then, soybean production developed rapidly in Argentina, now the third major soybean producing country.

These soybean-producing countries use machines in commercial production and the commodity rate of soybean is high.

The cultivated area of soybean in china in 2007 was8.90 million ha, the total production was 13.80 million t and the yield per unit area was 1550Kg ha<sup>-1</sup>.

The main reasons for this are that the scale of soybean cultivated by farmers is small and, therefore, advanced cultural practices have not been adopted.

Along with economic developments and improvements in peoples living standards, the demand for soybean in china is increasing rapidly and the domestic production of soybean cannot meet these demands.

The Chinese people are accustomed to eating soybean. Traditional soybean products such as bean curd (tofu), miso, soy sauce, natto, meat and cheese alternative, dried rolls of bean milk cream, soy sauce and soybean milk so on are favored foods to Chinese people.

Most of the commercially imported soybean contains transgenic and is used for extracting oil. The refined oil is used are edible oil; soybean cake as used as feed. This provides a rich base for the selection and breeding of soybean varieties and for making a great contribution to soybean production and breeding in the world.

Soy bean is classified as legumes. But also as oil crop. It has a high nutritional value and contains appreciate amount of proteins which belong to the nutritionally integrated proteins contains the essential amino acids. Its seeds contain 35%-50% high quality protein and 14%-24% oil (Glabees. *et al* 2012).

## **2-4 Vegetarian**

Vegetarian are defined as individuals who do not eat any meat, poultry or fish.

Vegetarian diets do not contain meat, poultry or fish; vegan diets further exclude dairy products and eggs. Vegetarian and vegan diets can vary widely, but the empirical evidence largely relates to the nutritional content and health effects of the average diet of well-educated vegetarians living in Western countries, together with some information on vegetarians in non western countries. In general, vegetarian diets provide

relatively large amounts of cereals, pulses, nuts, fruits and vegetables. In terms of nutrients, vegetarian diets are usually rich in carbohydrates, n-6 fatty acids, dietary fibre, carotenoids, folic acid, vitamin C, vitamin E and Mg, and relatively low in protein, saturated fat, long-chain n-3 fatty acids, retinol, vitamin B12 and Zn; vegans may have particularly low intakes of vitamin B12 and low intakes of Ca. Cross sectional studies of vegetarians and vegans have shown that on average they have a relatively low BMI and a low plasma cholesterol concentration; recent studies have also shown higher plasma homocysteine concentrations than in non-vegetarians. Cohort studies of vegetarians have shown a moderate reduction in mortality from IHD but little difference in other major causes of death or all-cause mortality in comparison with health-conscious non-vegetarians from the same population. Studies of cancer have not shown clear differences in cancer rates between vegetarians and non-vegetarians. More data are needed, particularly on the health of vegans and on the possible impacts on health of low intakes of long-chain n-3 fatty acids and vitamin B12. Overall, the data suggest that the health of Western vegetarians is good and similar to that of comparable non-vegetarians (Key *et al.* 2006).

A large number of individuals around the world follow vegetarian diets, but in most countries vegetarians comprise only a small proportion of the population. India is a notable exception because a substantial proportion of the population, perhaps approximately 35%, follows a traditional vegetarian diet and has done so for many generations (International Vegetarian Union, 2005; Refsum *et al.* 2001). The numbers of vegetarians in Western countries are unknown, with estimates based on rather small samples; for example, in a survey of 2251 individuals throughout the UK (Henderson *et al.* 2002) 5% reported being vegetarian

or vegan. While the number of vegetarians may be increasing in some of the most affluent countries, there is an opposite picture for other countries around the world, in that meat consumption is increasing greatly in many countries that until recently had a low intake of meat. Per capita meat consumption (kg/year) is predicted to increase from 24.2 in 1964–6 to 45.3 in 2030, with a very large increase in East Asia from only 8.7 in 1964–6 to 58.5 in 2030 (World Health Organization, 2003). Steinfeld (2004) has estimated that world total meat production (106 tones/year) increased from about 92 in 1967–9 to 218 in 1997–9 and will increase further to 376 in 2030, a fourfold increase in 60 years. Understanding of the health effects of vegetarian and vegan diets is quite good but many uncertainties remain. The purpose of the present brief overview is to summarize current knowledge on the health effects of vegetarian and vegan diets with an emphasis on recent findings and results from large studies, including the work of the authors' group on the European Prospective Investigation of Cancer and Nutrition (EPIC)-Oxford cohort. Most of the discussion is related to vegetarians in affluent Western countries; the health of vegetarians and individuals with a very low meat intake in poorer countries is a very important topic and there is some information available, but proper consideration of this topic is outside the scope of the present brief overview (Key *et al.* 2006).

#### **2-4-1 Types of Vegetarian Diets**

Vegetarians have different dietary practices, but most can be categorized into one of the following groups:

##### **Vegans**

Eat only plant foods; including fruits, vegetables, legumes (dried beans, peas, and lentils) grains, seeds and nuts.



**Raw vegans**

Eat only plant foods; including vegetables, fruit, nuts and seeds, legumes(dried beans, peas, and lentils), and sprouted grains The amount of uncooked food varies from 75% to 100%.

**Lacto vegetarians**

Eat plant foods as well as dairy products, such as milk and cheese.

**Lacto-ovo vegetarians**

Eat plant foods, dairy products and eggs most vegetarians in the U.S. Fit into this category (Clifford and Kozil, 2012).

# CHAPTER THREE

## MATERIALS AND METHODS

### **3-1 Materials:**

Canned mushroom, meat and spices( Cinnamon, Garlic, Onion, Coriander, Chinese kebab, Black pepper ) were obtained from Al-Ehsan supermarket –Khartoum north.

Soybean was collected from Al-wagba factory for meat processing, Khartoum, Sudan.

### **3-2 Methods:**

#### **3-2-1 Raw materials preparation**

##### **3-2-1-1 Meat preparation**

Meats were stored at -3°C overnight and then sliced and ground using a meat grinder.

##### **3-2-1-2 Mushroom preparation**

Canned mushroom was sieved and partially dried and then stored at -3 °C overnight, sliced and ground using a meat grinder.

##### **3-2-1-3 Soybean preparation**

Soybean was soaked in water equal their weight two times and leaved for two hours to absorb all the added water and then weight for treatment 60% mushroom 15% soybean(B) 112.5g and 60% soybean 15% mushroom (C) 450g.

### **3-2-1- 4 Salt**

A purified and free of impurities table salt( NaCl) 1.2% was add to the mixture for each treatment.

### **3-2-1-5 Spices preparation:**

Spices were cleaned from foreign materials and then ground for further use.

### **3-2-2 Burger formulation**

The experiment designed to produce burger with the following specifications:

Meat 75%, Water 10%, Flour10%, Salt 1.2%, Spices 3.3%.

The mushroom% was calculated from the proportion of meat in formulation of the 100% meat burger.

Formula75% meat

Components	%	Weight in grams
Meat required	75	562.5
Water required	10	75
Flour required	10	75
Salt required	1.2	9
Spices required	3.3	24.75

Formula 60% mushroom 15% soybean

Components	%	Weight in grams
Mushroom required	60	562.5
Soybean required	15	112.5
Water required	10	75
Flour required	10	75
Salt required	1.2	9
Spices required	3.3	24.75

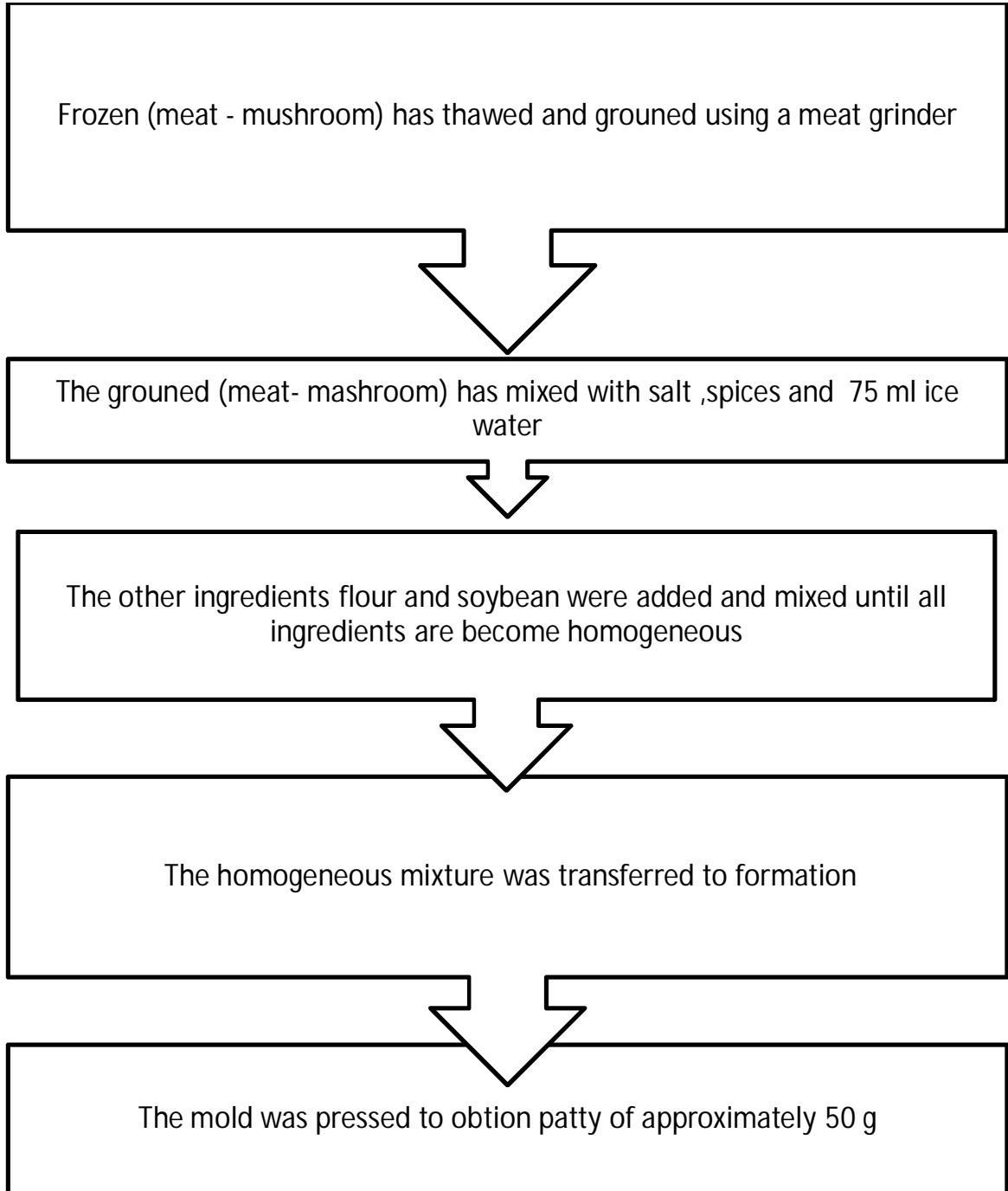
Formula 15% mushroom 60% soybean

Components	%	Weight in grams
Mushroom required	15	112.5
Soybean required	60	562.5
Water required	10	75
Flour required	10	75
Salt required	1.2	9
Spices required	3.3	24.75

Formula 75% mushroom:

Components	%	Weight in grams
Mushroom required	75	562.5
Water required	10	75
Flour required	10	75
Salt required	1.2	9
Spices required	3.3	24.75

### 3-2-3 production of burger



The burgers were placed in between plastic liner and in plastic tray and stored in freezer at  $-18\text{ C}^{\circ}$ .

### **3-3 Physicochemical analysis**

#### **3- 3- 1 Moisture determination**

Moisture content was determined according to the AOAC (1990) as follows: Two grams of each sample were weighed in clean dry and pre-weighed crucible and then placed in oven at 105C° and left overnight, the crucible was transferred to desiccators and allowed to cool and then weighed. Further placement in the oven was carried out until constant weight was obtained, Moisture content was calculated using the following formula:

$$MC\% = \frac{(W_2 - W_1) - (W_3 - W_1)}{W_2 - W_1} \times 100$$

Where:

Mc: Moisture content.

W<sub>1</sub>: Weight of crucible.

W<sub>2</sub>: Weight of crucible with the sample.

W<sub>3</sub>: Weight after drying.

#### **3- 3-2 Crude fiber**

Crude fiber was determined according to AOAC (1990), two grams of defatted sample were treated successively with boiling solution of H<sub>2</sub>SO<sub>4</sub> and KOH (0.26 N and 0.23N, respectively). The residue was then separated by filtration, washed and transferred into a crucible then placed into an oven adjusted to 105C for 18-24 hours. The crucible then with the sample was weighed and ashed in a muffle furnace at 500C and weighed. The crude fiber was calculated using the following equation:

$$CF (\%) = \frac{W_1 - W_2}{W_s} \times 100$$

Where

CF  $\equiv$  Crude fiber.

$W_1$   $\equiv$  Weight of crucible with sample before ashing.

$W_2$  = Weight of crucible with sample after ashing.

$W_s$  = Weight of sample.

### **3- 3- 3Fat content**

Fat was determined according to the method of AOAC (1990) using soxlet apparatus follow.

An empty clean and dry exhaustion flask was weighed. About 2 gram of sample was weighed and placed in a clean extraction thimble and covered with cotton wool. The thimble was placed in an extractor. Extraction was carried out for 8 hours with petroleum ether. The heat was regulated to obtain at least 15 siphoning per hour. The residual ether was dried by evaporation. The flask was placed in an oven at 105 C till it dried completely and then cooled in a desiccators and weighed. The fat content was calculated using the following equation:

$$FC (\%) : \frac{W_2 - W_1}{W_s} \times 100$$

Where

CF= Fat content

$W_1$ =weight extraction flask

$W_2$ = weight extraction flask with fat.

$W_s$ = weight of sample

### **2.2.1.2 Ash content:**

Ash content of the sample was determined according to the method AOAC (1990) as follows: Two grams of sample were placed in a clean dry pre-weighed crucible, and then the crucible with its content ignited in a muffle furnace at about 550°C for 3 hours or more until light gray ash was obtained. The crucible was removed from the furnace to a desiccator to cool and then weighed. The crucible was re-ignited in the furnace and allowed to cool until a constant weight was obtained. Ash content was calculated using the following equation:

$$AC\% = \frac{W_2 - W_1}{W_3} \times 100$$

Where:

$W_1$ : weight of empty crucible

$W_2$ : weight of crucible with ash

$W_3$ : weight of sample

### **3- 3- 4 Crude protein**

Crude protein of the sample was determined by using the micro-kjeldahl method according to AOAC(1990) as follows

Digestion: 1

0.2 gram of sample was weighed and placed in small digestion flask (50 ml). About 0.4 gram catalyst mixture (96% anhydrous sodium sulphate and 3.5% copper sulphate) was added. 3.5 ml of approximately 98% of  $H_2SO_4$  was added. The contents of the flask were then heated on an electrical heater for 2 hours till the color changed to blue-green. The tubes were then removed from digester and allowed to cool.



Distillation: 2

The digested sample was transferred to the distillation unit and 20 ml of NaOH( 40% ) were added. The ammonia was received in 100 conical flask containing 10 ml of 2% boric acid plus 3-4 drops of methyl red indicator. The distillation was continued until the volume reached 50 ml s

3. Titration:

The content of the flask were titrated against 0.02 N HCL. The titration reading was recorded. The crude protein was calculated using the follow

$$\text{CP: } \frac{(T - B) \times N \times 14 \times 100 \times 6.25}{W_s \times 1000}$$

Where

CP= crude protein

T= Titration reading

B= Blank titration reading

N= normality of HCL

Ws= sample weight

1000 to convert to mg

### **3- 3- 5 The pH-value**

The pH-value of sample was measured by- Digital pH meter

**Requirement-** Digital pH meter, distilled water, beaker, electrolyte solution.

## Procedure

1. Blend 15 gm meat with 30mL distilled water at 27-30C°
2. Note the pH with a glass electrode pH meter.

### 3-3-6 Determination of acidity

#### Reagents

1. Standard Sodium Hydroxide solution 0.1 N.
2. Phenolphthalein indicator solution - Dissolve 1 gm phenolphthalein in 100 ml of 95% alcohol.

#### Procedure:

Take 10 gram of sample completed the sample to 100 ml of distil water, then take 10 ml of the prepared sample and titrate against standard Sodium hydroxide solution using phenolphthalein as indicator till a faint pink colour persists for 15 seconds.

#### Calculation:

$$A = \frac{TF \times 0.09 \times 10 \times 0.1}{10 \times 100}$$

Where:

A: acidity

TF: titration figure

### 3-2-7 Sensory evaluation

Cooked burgers were cut into pieces of uniform size and served worm to sixteen judges of student of, College of Agriculture Studies, Sudan University for Since and Technology, semi- trained according to

procedure of ranking scores . sample were coded and presented in randomized order.

The judges evaluated the attributes of color, flavor, taste, tenderness and over all acceptability by the mean of scale (1 unacceptable - 5 excellent).

### **3-2-8 Statistical analysis**

One way ANOVA was performed to examine significant difference between samples of replicated measurements. Probability level of less than 0.05 was considered significant ( $p < 0.05$ ). All data were analyzed using MINITAB version 17 statistical software.

# CHAPTER FOUR

## RESULTS AND DISCUSSION

### 4-1 physicochemical composition

#### 4-1-1 protein

The protein contents( % ) of burgers of different percent of mushroom( 75% meat, 60% mushroom 15%soybean , 15% mushroom 60%soybean, , 75% mushroom) as shown in table 1 are significantly different( 18.565, 20.525,21.805 and 3.52 respectively) . The 15% mushroom 60%soybean burger has the highest protein content due to soybean with mushroom in raw material. The protein of meat burger was lower than the reported by Dalil (2017) and Yousif(2008).

#### 4-1-2 Moisture

The moisture contents of burgers from different percent of mushroom( 75% meat, 60% mushroom 15%soybean , 15% mushroom 60%soybean, , 75% mushroom) as shown in table 1 are significantly different(63.89, 68.04, 65.91 and 73, respectively). With more percent of mushroom the moisture increases because mushroom has high moisture content. The moisture content of meat burger was high than the reported by Dalil (2017) and lower than the reported by Yousif (2008).

#### 4-1-3 Crude fiber

The crude fiber of burgers from different percent of mushroom( 75% meat, 60% mushroom 15%soybean , 15% mushroom 60%soybean, , 75% mushroom) as shows in table1 are( 1.42,3.58, 4.33 and 1.09 respectively) . Fiber was of high amount in15% mushroom 60%soybean.

The fiber content of meat burger was high than the reported by Dalil (2017).

#### **4-1-4 Crude fat**

The fat contents of burgers from different percent of mushroom ( 75% meat, 60% mushroom 15%soybean , 15% mushroom 60%soybean, 75% mushroom) as shown in table 1 are( 4.51, 3.40,4.10 and 0.185 respectively) , which shown high fat contents was in 75% meat burger and low in 75% mushroom. The fat contents of meat burger is lowest than the reported by Dalil (2017) and highest than the reported by Yousif (2008).

#### **4-1-5 Ash**

The ash of burgers from different percent of mushroom(75% meat, 60% mushroom 15%soybean, 15% mushroom 60%soybean, 75% mushroom)as shows in table1 are (2.15, 2.25,2.12 and 2.27 respectively), which shown the high ash contents was in 75% mushroom . The ash of meat burgers is high than the reported by Dalil (2017) and Yousif(2008).

#### **4-1-6 Carbohydrate (CHO)**

The CHO of burgers from different percent of mushroom( 75% meat, 60% mushroom 15%soybean , 15% mushroom 60%soybean, , 75% mushroom)as shows in table 1 are(10.96, 5.79, 9.07 and 22.03 respectively) the CHO of meat burger is highest than the reported by Dalil (2017) and Yousif(2008).

**Table 1: Physicochemical composition (%) of different types of burger:**

Sample	Moisture Content	Crude protein	Crude fat	Crude fiber	Ash	CHO	PH	Acidity
A	63.89 <sup>d</sup> ±0.24	18.565 <sup>b</sup> ±0.728	4.510 <sup>a</sup> ±0.184	1.4200 <sup>c</sup> ±0.0566	2.1500 <sup>a</sup> ±0.0990	10.955 <sup>b</sup> ±0.672	5.945 <sup>b</sup> ±0.00707	0.8400 <sup>a</sup> ±0.0283
B	68.040 <sup>b</sup> ±0.056	20.525 <sup>ab</sup> ±0.643	3.400 <sup>b</sup> ±0.269	3.5850 <sup>b</sup> ±0.0636	2.2500 <sup>a</sup> ±0.0424	5.785 <sup>b</sup> ±0.389	6.295 <sup>a</sup> ±0.00707	0.6400 <sup>b</sup> ±0.0141
C	65.910 <sup>c</sup> ±0.410	21.805 <sup>a</sup> ±0.361	4.10 <sup>ab</sup> ±0.1131	4.325 <sup>a</sup> ±0.148	2.1150 <sup>a</sup> ±0.0212	9.07 <sup>b</sup> ±4.10	5.4250 <sup>d</sup> ±0.0354	0.5200 <sup>c</sup> ±0.0141
D	73.000 <sup>a</sup> ±0.424	3.52 <sup>c</sup> ±0.0283	0.185 <sup>c</sup> ±0.00707	1.085 <sup>c</sup> ±0.007	2.27 <sup>b</sup> ±0.283	21.025 <sup>a</sup> ±0.672	5.5750 <sup>c</sup> ±0.0354	0.36500 <sup>d</sup> ±0.00707

Mean ± SD values bearing same superscripts for each quality attribute are not significantly difference ( $p \leq 0.05$ ).

A ≡ 75% meat burger

B ≡ 15%soyabean60% mushroom burger

C ≡ 60%mushroom15%soya bean burger

D ≡ 75%mushroom burger

## **4-2 Sensory evaluation**

As shown in table 2 sensory evaluations revealed that there was no significant difference ( $P \geq 0.05$ ) in color and tenderness and significant difference ( $P \leq 0.05$ ) in the Flavour, Taste and overall acceptability with 75% meat (A), there was no significant difference between 75% mushroom, 60% mushroom 15% soybean and 15% mushroom 60% soybean in Flavour, Taste and overall acceptability.

**Table 2: Sensory evaluations of burger:**

<b>Sample</b>	<b>Color</b>	<b>Flavour</b>	<b>Taste</b>	<b>Tenderness</b>	<b>Overall acceptability</b>
A	3.813 <sup>a</sup> ±1.223	4.125 <sup>a</sup> ±0.957	4.563 <sup>a</sup> ±0.512	3.750 <sup>a</sup> ±1.183	4.250 <sup>a</sup> ±0.577
B	3.313 <sup>a</sup> ±1.078	3.025 <sup>ab</sup> ±1.125	2.938 <sup>b</sup> ±1.340	2.969 <sup>a</sup> ±1.297	3.250 <sup>b</sup> ±1.000
C	3.188 <sup>a</sup> ±1.167	2.938 <sup>b</sup> ±1.436	2.875 <sup>b</sup> ±1.310	3.031 <sup>a</sup> ±1.008	3.000 <sup>b</sup> ±1.155
D	3.344 <sup>a</sup> ±0.944	2.969 <sup>b</sup> ±0.785	3.156 <sup>b</sup> ±0.961	3.000 <sup>a</sup> ±1.265	2.906 <sup>b</sup> ±1.099

Mean ± SD values bearing same superscripts for each quality attribute are not significantly difference ( $p \leq 0.05$ ).

A ≡ 75% meat burger

B ≡ 15% soyabean 60% mushroom burger

C ≡ 60% mushroom 15% soya bean burger

D ≡ 75% mushroom burger



# CHAPTER FIVE

## CONCLUSIONS AND RECOMMENDATIONS

### 5-1 Conclusion

From this study one can conclude that:

1. The chemical composition of different types of burger showed a high significant difference ( $p \geq 0.05$ ).
2. The sensory evaluation showed no significant difference ( $p \leq 0.05$ ) in colour and tenderness except flavour, taste and overall acceptability.
3. Generally, burger of 60% mushroom and 15% soybean (B) and 15% mushroom and 60% soybean (C) found to be the best.

### 5-2 Recommendations

1. Introduction of mushroom in Sudanese food culture (dietary habits).
2. The production of mushroom products stimulates the cultivation of mushrooms, which play an important role in the management of organic waste on farms and raising the economic level.
3. Further studies are recommended using other varieties of mushroom.

## REFERENCES

- Abdu- Latif ,M.M.** (2018).physicochemical comparative study between meat burger From Camel and Cow Meat and their Blends, Sudan University of Sciences and Technology, college of Graduate Studies, Khartoum, Sudan.
- Ahmed S. and Hassan, M.M.**(2014). Legumes, Journal of Pharmaceutical Sciences,1(2):34-38.
- Ahmed, S. and Hassan, M.M.** (2014). Legumes, Journal of Pharmaceutical Sciences,1(2):34-38.
- Alnage, M.A.**(2005). Basic principles of general agronomy, Arabic House library, Cairo. ( in Arabic).
- Chang,s. and Miles, P.G .** (2004). Mushrooms : Cultivation, Nutritional Value, medicinal Effect, and EnvironmentalImpact.CBC Press, USA.
- Cheung, Peter C.K.** (2008). Mushrooms as functional foods, Hoboken, New jersey.
- Clifford, J. and Kozil,** (2012).vegetarian diets, food and nutrition series health,9(324):9-17.
- Dalil, A. D.**(2017).Effect of Partial Replacement of Meat by Pigeon pea (*cajanus cajan l.* ) on the Nutritional and Sensory Characteristics of Burger B.Sc, SUST, college of Agricultural studies, Department Food Science and Technology , Khartoum, sudan.
- Food safety and standards authority of India ministry of health and family welfare government of India.**(2016). Manual of methods

of analysis of foods meat and meat products and fish and fish products , India.

**Glabees, A.M; Osman, R.M and Yaseen, A. G.**(2012).Comparison Study Between Extracted Soybean Milk and Cow, SUST, college of Agricultural studies,Department Food Science and Technology , Khartoum, sudan.

**Ibrahim , I . I.** (2017).Chemical Composition and Nutritional Value of Some Types M.SC. of Graduate Studies ,Khartoum, Sudan.

**Ibrahim, I.I.**(2017). Chemical Compostion and Nutritional Value of some Types of Wild Mushrooms in Blue Nile State M.Sc.SUST, Sudan.

**Jordan, P.** (2006). Field Guide to Edible Mushroom of Britain and Europe. New Holland Publishers.P.10. ISBN978-1-84537-419-8.

**Key,T.J.; Appleby, P.N. and Rosell, M.S.** (2006).Health effect of vegetarian and vegan diets, proceedings of the nutrition society,794(65):35-41.

**Mustafa, M.A.**(2010). Vegetables, Bustan almarfaa library, University of Alexandria, Egypt. (in Arabic).

**Ramadhan, K; Huda, N. and Ahmad, R.** (2011).Physicochemical Chemical Characteristics and sensory Properties of Selected Malaysian Commercial Chicken Burger, International Food Research, Journal,18(4):1349-1357.

**Wani, B.A, Bodha, R.H. and Wani, A.H.** (2010). Nutritional and medicinal importance of mushrooms, University of Kashmir, Department of Botany, Srinagar, India.

## APPENDICES



**Appendix 1. Manual burger patty press**



**Appendix 2. Meat grinder**



**Appendix 3. Sample (A)**



**Appendix 4. Sample (B)**



**Appendix 5. Sample (C)**



**Appendix 6. Sample (D)**