Chapter one

1. Introduction

Meat is defined as the whole or part of the carcass of cattle, camel, goat, sheep, buffalo, poultry, rabbit, hare and deer slaughtered. (*Williams, 2007*)

Meat as a high energy food is considered to be the food of choice due largely to its nutritive value. Meat is an excellent protein and energy source for daily diets and after digestion provides with most of essential amino acid. (*Chang et al, 1991*) In most countries, meat consumption increases as economic development improves. (*Fuller, 1996*)

Beef is an excellent source of complete protein and minerals such as zinc, selenium, phosphorus, iron and B vitamins. Red meat is the most significant dietary source of creatine and like any other meat (pork, fish, veal, lamp …etc), is a source of creatine. Creatine is converted to creatinine during cooking. (*Wilson, 1981*)

Fishes are good source of protein commonly consumed as an alternative source of protein due to the higher price of meat and other source of animal protein. Fish meat has lower cholesterol content when compared with other meat and thus often recommended for especially among the adult. (*Omolara et al, 2008*)

The Objective of this study are:

- Lack of research in the field of burger.
- To evaluate a comparative characteristics of fish burger and beef burger.
- To introduce the fish burger as food choice.
- To study the production cost of fish burger versus beef burger

Chapter Two

2. Literature Review

2.1: Fish meat:

2.1.1: Nutritional composition of fish meat:

Fish is an important and malnutrition which considered major reason of infant mortality in the developing world. It could be good source in endemic goiter caused by lack of dietary iron and iodine. (*Somia, 2009*)

Each 100 grams of white fish contains less than 1% of fat, 18% of protein and an energy value of 50-80kcal. Oily fish contains 8-15% fat and so has a higher energy value (80-160kal/100g). When processed, preserved and cooked properly, fish retains most of its high nutrient contents, which can be lost during poor handling and storage. (*Somia, 2009*)

As shown in table (1) fish protein is almost equal to that of beef, poultry and higher than eggs and milk. (*FAO, 1989*)

Table (1): The average amount of protein and calories for fish and other animals or animal product per 100:

Source	Amount of protein (g)	Amount of calories
Fish	18	120
Poultry	19	100
Beef	20	310
Eggs	13	160

Milk	4	60

2.1.2: The nature of fishing in Sudan:

Fishermen are considered in most of developing countries as one of the most neglected and poorest within society, having traditionally inherited fishing methods that are not adapted to modern fishing ones, gears, handling and presentation. Actually, the some conditions are in Sudan and thus there is a huge gap between the world modern fisheries and traditional fisheries in the country. (*Somia, 2009*)

2.1.3: Fish meat consumption in Sudan:

The consumption per capita of fish in Sudan is about 2kg/ year and it is considered very low when compared to the international level, as about 13kg/ year. (*FAO, 2006*) Estimated the per capita consumption of fish in Sudan as national average close to 1kg/ year. (*FAO, 1995*) In urban areas consumption was estimated to be as 2kg/ year, while for rural population it was 0.5kg/ year, compared with other countries; it was 7.5kg/ year in Austria, 12.6kg/ year in Germany, 16.3kg/ year in Norway and in African the average was about 7kg/ year. (*Somia, 2009*)

2.1.4: Chemical composition of fish:

Generally fish contains very little carbohydrate, while the moisture content is very high. In most fish species the moisture content is 60 - 80%, protein 15-26% and 2 - 13% for fat. (*Omolara et al, 2008*)

Table (2): The chemical composition of fish meat. (*Raju et al, 2003*)

Components	Percentage %
Moisture	78.09
Protein	18.40
Fat	1.46
Ash	1.50

2.1.5: Fish burger:

Fish burger is a product in which fish flesh is mixed with additive, stuffed into suitable casing. The development of the technology of fish burger has mainly come from table (3). (*Raju et al, 2003*)

Table (3)

Components	Percentage %
Moisture	68.64
Protein	16.76
Fat	5.64
Ash	2.67

2.2: Beef meat:

2.2.1: Nutritional composition of beef meat:

Meat can be part of balanced diet contributing valuable nutrients that are beneficial to health. Meat and meat products contain important levels of protein,

vitamins, minerals and micronutrients with are essential for growth and development. Further processing of meat offers the opportunity to add value, reduce prices, improve food safety and extend the shelf-life. This can result increased household in-come and improved nutrition, while the per caput consumption of meat in some industrialized countries is high, per caput consumption below 10kg in developing countries must be considered insufficient and often leads to under-nourishment and malnutrition. (*FAO ,1995*).

2.2.2: Chemical composition of beef meat:

Meat is by the codex Alimentarius as all parts of an animal that are intended for, or have been judged as safe and suitable for, human composition. Meat is composed of water, protein and amino acids, minerals, fats and fatty acid, vitamins and other bioactive not components, and small quantities of carbohydrates. (*Ali et al, 2011*)

Table (4)

Product	Water	Protein	Fat	Ash	Kg
Meat	54.7	16.5	2.8	0.8	1351

From the nutritional point of view, meat importance is derived from its high quality protein, containing all essential amino acids and its highly bio available minerals and vitamins. Meat is rich in vitamin B_{12} and iron which are not readily available in vegetarian diets. (*FAO, 2006*)

2.2.3: Beef meat burger:

Reported, the chemical composition of fresh beef burger is shown in table (5). (*Ali et al,2011*)

Table (5)

COM PONENTS	PERCENTAGE%
Moisture	70.10±.28
Protein	18.29±.9
Fat	3.64±.38
Ash	3.11±.09
PH	6.73±.01

Also reported, the chemical composition of fresh beef burger is shown in table (6). (*Lee et al,1997*).

Table (6)

ITEM	Composition(g)
Moisture	48±.05
Protein	10±.05
Fat	7±.15
Ash	1.70±.01

2.3: Quality of meat:

Meat quality includes tenderness, palatability, aroma, flavour, colour and juiciness. Species, sex, breed, age, and post-mortem handling are known to influence these factors. It is also possible that diet or some component of diet may exert some effects on the factors mentioned above. (*Dike man, 1990; Koohmaraie, 1992; Glitsch 2000; Kerry et. al 2002; Egena et al, 2008*)

The effect of temperature of comminuting on stability and eating found that increasing temperature of comminuting lead to increase cooking loss , softening in texture and darkening in colour and subjective assessment indicated that least comminuting temperature of the250C of the burger were acceptable and in temperature above300c off flavor developed. (*Sally brown et al, 1984*)

2.3.1: Colour:

Colour is an important criterion of row or cooked meat products. It reflects the proper composition of the products, in particulary relation of meat to other compounds, freshness of the raw materials, texture, taste and proper condition of storage. (*Klak et al.,2001; Alberti et al,2002*)

The presence of muscle pigments, myoglobin are the main limiting factor of the meat colour. Discolouration can be related to the amount of these pigments in the meat (*Adegoke et al, 2005*). Colour loss in the burger is caused partly by oxidation of the meat pigment myoglobin to metmyoglobin. (*Wilson, 1981*)

2.3.2: Tenderness and juiciness:

Tenderness and juiciness are closely related, the more tender meat, the more juicy. Juiciness varies inversely with cooking loss. (*Lawrie, 1991 ; Judge et al.,*

2001). Reported that, age, breed and diet influence tenderness, juiciness and flavour. (*Mcmillan , 2005*).

2.3.3: Flavour and aroma:

Meat aroma develops from the interactions of the non-volatile precursors, including free amino acid, peptides, reducing sugars, vitamins, nucleotides and unsaturated fatty acids, during cooking. (*Mottram, 2002*)

2.4: Physicochemical properties:

2.4.1: Cooking loss%:

Is the ability of meat to hold its own or added water during cooking. The water lost during the cooking meat expressed as%. (*Ahmed, 2012*) Cooking loss in beef burger was 33%. The loss in burger after cooking may be affected by several factors such as water-holding capacity, moisture and fat retention and the type of ingredient used in their formulation. (*Nueul et al, 2010*)

2.4.2: Water holding capacity (WHC):

It is the ability of meat to hold its own or added water during the application of any force. (*Hamm, 1986*) Fat reduction decreased emulsion stability and water holding capacity and resulted in higher cooking losses. (*Meitem et al, 2003*). Reported the water holding capacity of burger was ranged from 0.38-0.51. (*Qiao et al, 2001*).

Chapter Three

3. Material and Method

3.1: location of the study :

The study was conducted at laboratory of meat science and technology, college of animal production science and technology. Sudan University of science and technology

3.2: Material Used in Process:

3.2.1: Meat Sources:

3:2.1.1: Beef meat:

Beef meat used in this study was Purchased from Graduates incubator (4kg) and kept in the deep freezer (-18° - +2°c) for 24 hours.

3:2.1.2: Fish meat:

The fish meat used in this study was purchased from AlMawrda fish market (4kg) and kept in deep freezer (-18° - +2°c) for 24 hours.

3.2.2: Spices:

The spices were bought from supermarket in AlWaly Street, it consist powder of: Ginger, Cinnamon, Nutmeg, Salt, Garlic.

3.2.3: The casing:

It was bought from AlWaly Street market.

3.2.3: The filler:

The croutons were bought from AlWaly Street market.

3.2.5: The binder:

The starch was bought from AlWaly Street

Table represented the ingredients of beef and fish burger

Table(7): Ingredients of beef/fish burger

Material	Amount(g)	Percentage
Meat (Fish/Beef)	1000	79.1%
Croutons	100	7.91%
Starch	100	7.91%
Cinnamon	3	0.23%
Garlic	3	0.23%
Nutmeg	3	0.23%
Common salt	9	0.71%
Ginger	3	0.23%
Onion	4	0.3%
Ice-water	40	3.15%
.Total	1265	100

3.3: Tools used for manufacturing:

1. Mincer.
2. Burger stuffer.
3. Cutters (knife).
4. Sensitive balance.
5. Cooker.
6. Refrigerator.

3.4: Preparation of burger:

The meat was minced by electric mincer (3.5cm plate) and croutons (bread crumbs) and garlic added during the mincing, then added arise (starch). Then the spices were added and mixed with ice water to give cohesive dough, then put in burger stuffer and packed in to the casing , and packed in plastic bag, then chilled and stored in a deep freezer (-18°c).

3.5: Preparation of sample:

All the samples ware packed, chilled and storage at (-18° - +2°c) in deep freezer for analysis.

3.6: Cooking loss%:

Cooking loss percentage was determined according to (*Honikel, 1998*) method, by weighing differences in burger samples before and after cooking.

3.7: statistical analyze:

Used SPSS program version 16 for analysis data by Independent -Sample T-Test.(*SPSS, 2007*)

Chapter Four

4. Results

4.1: Chemical Composition:

Results In table (8) showed significance differences (P≤0.05) in protein and either extract between fish burger and beef burger. Where there were no significant differences (P≤0.05) in moisture, Dm, Ash, and Nfe.

Table No. (8): Chemical composition between fish and beef burger

Type / Parameters	Beef Burger	Fish Burger	Sig.
Moisture	70±10.98	72±5.23	N.S
DM.	30±10.98	28±5.23	N.S
Ash	2.17±.49	2.37±.67	N.S
CP	21.12±.81	32.17±2.18	**
EE	3.87±.86	8.47±.79	**
NFE	42. 83±11.34	28.98±7.29	N.S

N : 4

** : *significant at (P<0.01).*

N.S : *No significant* $(P \leq 0.05)$

Sig. : *Significance*

4.2: Sensory evaluation:

Result In table (9) showed no significance differences (P≤0.05) sensory evaluation between fish burger and beef burger.

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Table No. (9): : Sensory evaluation fish and beef burger

Type / Parameters	Beef burger	Fish burger	Sig.
Color	6.33±.65	6.33±.77	N.S
Odor	6.08±1.08	6.33±.49	N.S
Taste	6.58±.79	6.58±.90	N.S
Texture	6.08±.79	5.91±.90	N.S
Appearance	6.41±79	6.41±.90	N.S

N : *4*

N.S : *No significant difference* $(P \leq 0.05)$

Sig. : *Significance*

Chapter Five

5. Discussion

Result in table(1) refracted no significant (P≤0.05) differences in moisture, dry matter, ash and nitrogen free extract among beef and fish burger, while there were significance (P≤0.05) differences in crude protein and either extract, fish burger refracted high content of it's than beef meat, this is might be due to high protein content in fish meat this results agree with Raju et al (2003) and Ali et al (2012). Fish burger also recorded high either extract content than beef burger and this might be due to high either extract in fish meat this results disagree with Raju et al (2003) and Ali et al (2012).

Result in table (2) showed no significance (P≤0.05)) differences in (colour, odour, taste, texture and appearance) are not significance between beef and fish burger that results agree with those of wafa(2012).

The result recorded significant (P≤0.05) differences in economic cost among fish burger and beef burger, while fish burger represented lower economic cost than beef burger this results agree with Wafa(2012).

Chapter Six

6. Conclusion and Recommendations

6.1: Conclusions:

The present study verified that:

- The fish burger were higher in crude protein and either extract than beef burger in chemical composition.
- Fish burger were lower in economic cost than to beef burger.
- Result showed no significant ($P \leq 0.05$) differences in (colour, texture, flavour, juiciness, odour and appearance) among fish and beef burger.

6.2: Recommendations:

We strongly recommend continuation of further studies in this topic to cover the followings:

- To study the contamination level of fish burger compared to other meat types for it governs the shelf life of the product.
- To verify that the fish burger can replace the beef and poultry burger especially, regarding the cost per kg.
- To study the possibility of using the fish and beef burger as a functional food at convalescence for it is easy digestion coupled with low cholesterol.

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