Sudan University of Science and Technology

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كلية الدراسات العليا

Physicochemical and Sensory Properties of Fermented Milk (Mish) Produced In River Nile State

الخواص الفيزيوكيميائية والحسية للبن المتخمر(المش) المنتج في ولاية نهر النيل

Thesis submitted in Partial Fulfillment of the Requirements for the Degree of Master of Science (M Sc.) Animal Production in Tropics

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الآيـه:

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(ومـا أوتيتم من العلم الا قليلا)

صدق الله العظيم

سورة الإسراء الآية (85)

Dedication

To my dear mother,

beloved husband,

sons & daughter and

brothers & sister

I dedicate this research with my sincere love

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First and last, I'm thankful to Allah for giving me the power and health to accomplish this study.

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Table of content

S. No.	Item	Page
	الآيه	I
	Dedication	II
	Acknowledgment	III
	Table of contents	IV
	List of Tables	VI
	Abstract	VII
	ملخص البحث	VIII
1	**Chapter one: Introduction**	**1**
2	**Chapter Two: Literature Review**	**3**
2.1	Milk	3
2.2	Importance of milk	3
2.3	Fermentation	4
2.4	Fermented milk	5
2.5	Microbiology of fermented milk	6
2.6	Types of fermented dairy products	7
2.6.1	Yoghurt	7
2.6.2	Mish	8
2.6.2.1	Factors influencing Mish manufacture	9
2.6.2.1.1	Raw milk composition	9
2.6.2.1.2	Starter Cultures	9

2.6.2.1.3	Fermentation Process	10
2.6.2.1.4	Processing methods	11
2.6.2.1.5	Spices	12
2.6.2.2	Chemical composition of Mish	12
2.6.2.3	Sensory Characteristics of Mish	13
2.7	Quality and safety of fermented milk	13
2.8	The Shelf-life of fermented milk	14
3	**Chapter three: MATERIAL AND METHODS**	**15**
3.1	Samples collection	15
3.2	Chemical analysis	15
3.2.1	Fat content	15
3.2.2	Protein content	15
3.2.3	Total Solids Content	16
3.2.4	Ash content	17
3.2.5	Titratable acidity	17
3.3	Sensory evaluation	18
3.4	Statistical Analysis	18
4	**Chapter Four: Results**	**19**
4.1	Physicochemical composition of Mish samples in River Nile state	19
4.2	Sensory characteristics of Mish samples in river Nile state	21
5	**Chapter Five: Discussion**	**22**

5.1	Discussion	22
5.2	Conclusion	24
5.3	Recommendations	24
	References	25
	Appendices	34

List of tables:

No	Title	Page
Table (1)	Physicochemical composition of the Mish samples in River Nile state	20
Table (2)	Sensory characteristics of Mish Samples in River Nile state	21

Abstract

This study was conducted at Sudan University of Science and Technology during November to Dec. 2019 to evaluate the physicochemical and sensory characteristics of collected Mish samples in River Nile state. Thirty Samples were collected from three manufacturers (two modern, A, B and traditional) Mish made C), ten samples for each producer. These samples were subjected to physicochemical (fat, protein, total solids, ash and acidity), and sensory (color, flavor, taste and texture) evaluations. The data analyzed using SPSS programme with ANOVA. The results showed significant differences (P<0.05) in the physicochemical characteristics among the treatments. The higher, (9.62±0.37%) fat content was for the Mish sample (C) while the lower (3.66±0.45%) one was for the sample(B). The average protein contents were 5.02±0.16 %, 4.98±0.73% and 3.06±0.62% for samples A, B and C respectively. The higher (22.52±0.88 and 22.06±3.11)% total solids were found in the Mish samples A and B while the lower (13.48±1.53%) one was in samples (C). The Mish samples A and B showed higher (2.31±0.61, 2.60±0.97)% ash contents in comparison with the (C) samples (1.42±0.37%). The acidity of traditional Mish samples had higher values (3.58±0.13%) while those of the modern samples were lower (1.80±0.29% and 1.76±0.18%).Sensory evaluation showed significant (P<0.05) variations only in color and texture among the treatments; however the flavor and the taste of the mish samples showed no significant variations among the treatments. It’s concluded that the quality of the Mish samples of the modern manufacturers is slightly better than that of the traditional one.

ملخص البحث

اجريت هذة الدراسة في جامعة السودان للعلوم والتكنلوجيا فى الفترة نوفمبر – ديسمبر 2019 وذلك لتقييم الصفات الفيزوكيميائية لعينات المش لثلاث مصانع (أ : ب : ج) فى ولاية نهر النيل ، حيث تم تجميع ثلاثون عينة من ثلاثة مصانع (مصنعين حديثين ا،ب وتقليدي ج)عشرة عينة من كل مصنع لدراسه الخواص الفيزوكيميائية (الدهن،البروتين،مجموع المواد الصلبة،الرماد والحموضة) والتقيم الحسي (اللون،النكهة،الطعم والقوام) . تم تحليل البيانات باستخدام برنامج ال SPSS مع ANOVA. اظهرت النتائج وجود فروقات معنوية ($P<0.05$) فى الخواص الفيزيائية الكيميائية بين عينات المش المختلفة. أعلى نسبة للدهون %(9.62±0.37) كانت لعينات المصنع (ج) بينما اقل نسبة للدهون% (3.66±0.45) كانت للعينات (ب). متوس المحتوى البروتين لكل من العينات (أ،ب،ج) كانت كالأ تى:%(3.06±0.62 ,5.02±0.16,4.98±0.73)على التوالى . إن اعلى جوامد كلية%(11.3± 22.52±0.88,22.06) كانت للعينتان (أ، ب) بينما اقلها %(13.48±1.53) كانت للعينة (ج). إن عينات المش (أ ، ب) احتوت على اعلى%(2.31± 0.61,2.60±0.97) نسبة من الرماد مقارنة مع العينة (ج) %(1.42±0.37) إن حموضة عينة المش التقليدي كانت لها اعلى قيم حموضة%(3.58 ±0.13) بينما العينات الحديثة كانت حموضتها منخفضة %(1.80± 0.29)و (1.76±0.18)%

أظهرت نتائج التقيم الحسى وجود فروقات معنوية ($P< 0.05$)فقط فى اللون والقوام بين عينات المش المختلفة بينما انه لا توجد فروقات معنوية فى كل من المذاق والنكهة لعينات المش المختلفة . ختاما وجد انه لعينات المش المصنع بطريقة حديثة جودة افضل من تلك التى صنعت بطريقة تقليدية.

CHAPTER ONE

Introduction

Food fermentation has a long history in Africa and relies on indigenous knowledge of the majority of the population. Many food production fermentations occur at the household-scale or at small enterprise scale (Mathara *et al.*, 2004). Sudan has a very tradition in producing a variety of fermented dairy products, more than 50%of milk production is converted into fermented dairy products (Dirar,1993).Fermented milk products are dairy products made from skim, whole or slightly concentrated milk that require specific lactic acid bacteria to develop their characteristics, flavor and texture (Thapa, 2000).

According to Tamime (2006) a wide range of indigenous fermented milk products are traditionally made in rural areas worldwide and most of them rely primarily on spontaneous fermentation due to the presence of indigenous micro flora mainly lactic acid bacteria in the milk, however now a most fermented milks are manufactured under controlled conditions with specific starter culture. Fermented milks have been produced by traditionally methods for many centuries and there are several hundred such products recorded around the world, and they are produced as a result of microbial souring of milk, usually from cow milk, but also milk of other species, e.g. Sheep, goats and buffalo (Fernandes, 2008). Osman (2007) explained, fermented milk products are processed from, whole, standardized or skim milk, after fermentation using selective microorganisms, that convert the milk sugar (lactose) into lactic acid, developing the acidity, coagulate casein and the fluid milk is changed into a semi- solid product, e.g. yoghurt, Mish and others.

The nature of fermented products is different from one region to another. This is depending on the local indigenous microflora, which in turn reflect the climatic conditions of the area (Savadogo *et al*., 2004). Naturally acidified milk may have been one of the first milk products and it is known by many names (Spreer, 1998).

According to Kurman *et al*. (1992) around 400 generic names are applied to traditional and industrial fermented milk products, many of these products are known locally by different names. Many people throughout Africa enjoy soured milk products. In these products, the lactic acid bacteria perform an essential role in preserving a highly nutritious food product (Beukes *et al*., 2001). Elmardi (1988) noticed that Mish is one of the most fermented products almost known in all regions of the Sudan with different names and the intensity of spicing may differ from region to another and even from family to another within the same district, it depends on spices availability and the taste of the people. Therefore, Mish is the one of the dairy products sales in the River Nile state, different processors produced different products their quality is not well documented this research is to carry out the evaluation of the quality of Mish samples in the state.

Objective of the study:

To study physicochemical and sensory characteristics of Mish in River Nile state.

CHAPTER TWO

Literature Review

2.1. Milk:

Milk is defined as the secretion of the mammary glands of mammals, its primary natural function being nutrition of the young. Milk of some animals, especially cows, buffaloes, goats and sheep, is also used for human consumption, either as raw milk or in the form of dairy products (Walstra *et al.*, 1999). Milk has been defined as the normal secretion (excluding colostrum) which can be gained by normal milking method from the lactating mammary gland of the healthy normally fed cows. Milk can be considered as three basic components water, fat, and solid-non-fat (SNF). The organic matter in the non-fatty portion consists mainly of the protein casein, albumin and globulin, lactose and citrates. However, milk from individual cows may show a day-to-day variation. Such fluctuation may be influenced by the mental and physical conditions of the animal.

Excitement, worry or discomfort is liable to have a diverse effect on both the quantity and quality of milk produced (Johnson, 1986).

Chemical composition of cow's milk and other mammals (Apendex1)

2.2. Importance of milk:

Milk is considered as a nearly complete food since it is a good source of protein, fat and major minerals. Also, milk and milk products are main constituents of the daily diet, especially for vulnerable groups such as infant's school age children and old age (Davies *et al.*, 1986 and Gasmalla *et al.*, 2013). Several studies have reported the distribution and occurrence of the essential components in various animal milks (Moore *et al.,* 2005). Milk is one of the most important nutrition food sources besides breast milk for infants and babies. In fact, consumption of dairy products has recently been linked to health benefits that are the direct antitheses of diseases and complexity that related to overweight and obesity. For example, individuals that consume dairy products are more likely to have lower weight (Vollmer *et al.,* 2001) lower blood pressure (Abbott *et al.,* 1996 and Kampman *et al.,* 2000) and decreased risk of stroke, colon cancer (Holt, 1999) and osteoporosis (Mccabe *et al.,* 2004).

2.3. Fermentation:

Fermentation is defined as a process leading to the anaerobic breakdown of carbohydrates and other major compounds such as organic acids, proteins and fats, the fermentable in the broader view that fermentation is an energy yielding oxidation and reduction process (Robinson, 2002). Fermented milk are products prepared from milks, whole, partially or fully skimmed, concentrated or milk substituted from partially of fully skimmed dried milk, either homogenized or non-homogenized, pasteurized or sterilized and fermented by means of specific microorganisms (Kroger *et al.,* 1989).

Milk fermentation process depended on the microbial biological activity to produce a range of metabolites. These metabolites have preservative and antagonistic effects so prevent the spoilage and/or pathogenic food microbes. Fermentation produces aromatic compounds such as diacetyl and acetaldehyde which flavor the foods, as well as vitamins and antioxidants (Ross *et al*., 2002 and Ray and Daeschel, 1992). The nature of fermented products is different from one region to another. Differences depend on the local indigenous microflora and the climatic condition of the area. Thus, traditional fermented milk in cold region contained mesophilic bacteria such as *Lactococcus* and

Leuconostoc spp while thermophilic bacteria which include mostly *Lactobacillus* and *Sterptococcus* prevailed in subtropical or tropical regions (Savadogo *et al*., 2004)

2.4. Fermented milk:

Fermentation has been used to preserve and store milk since the days of the Pharaohs (Wilson 1988). Milk fermentation is generally carried out by the spontaneous enzymatic activities of lactic acid bacteria (LAB) and is known to inhibit the growth of several pathogenic bacteria (e.g. Staphylococcus aureus, coliforms, *Escherichia coli*, *Campylobacter jejuni* and Vibriocholera), mainly due to pH reduction induced by theaction of microorganisms and enzymes (Asogwa *et al.,* 2017). For these reasons, fermentation is considered a successful preserving method, even though some cases of milk contamination by pathogenic bacteria due to the high temperature and humidity characteristics of the African regions, and by the lack of refrigeration, have been reported (Mensah 1997 and Mogessie, 2006). Fermented milk has an important socio-economicrole and is widely practiced in Africa (Asogwa *et al*., 2017), due to the low energy required by the process and to the high nutritional value of fermented dairy products, such as yoghurt and sour milk. The majority of fermented milk types in Africa is obtained from cow's milk, but milk from camel, goat, buffalo, sheep and horse is also commonly used. Production protocols differ across African regions, because they depend on local indigenous microbiota, which in turn reflects the climatic conditions of each area. As a consequence, traditional fermented milk from regions with cold climatic conditions usually contains mesophilic bacteria, such as Lactococcus and *Leuconostoc spp*., whilst that from regions with hot climatic conditions is characterized by thermophilic bacteria, mainly Lactobacillus and Streptococcus (Jans *et al.*, 2017).

In Sudan, the most important fermented milk is rob (also called roub or robe), which is produced in rural areas mainly by households, in order to use the surplus milk produced during the rainy season; about80% of the rainy season milk is fermented into roub, and rob represents about 90% of all fermented milk (Abdelgadir *et al*., 1998). This product is made mainly from cow's milk, but occasionally also from sheep and goat's milk (Mohammed Salih *et al*., 2011). A particular fermented milk is produced in Sudan from camel's milk: gariss, made by a semi-continuous or fed-batch fermentation process involving *Lactobacillus helveticus*, and *L. debrueckii* subsp. *lactis*, together with yeasts such as Candida and Kluyveromyces (Mirghani, 1994).

2.5. Microbiology of fermented milk:

In general, the production of fermented milks is associated with the known traditional micro flora of the raw milk, namely lactic acid bacteria. But, now a-days many bacterial species known as nontraditional micro flora have been incorporated into applications and are used in the manufacture of fermented and other dairy products. Some examples belong to the genera *Lactobacillus*, *Bifidiobacterium* and Entero coccus, which showed health benefits for the consumer (Tamime, 2006). Moreover, certain non – traditional species of lacto bacilli and yeasts are used in fermented milk products to contribute to special flavor and taste in such products (ELnimer, 2007).

According to Murshidi (1998) the shelf- life of mish independent on the high acidity it contains, which inhibits the growth of typhoid, paratyphoid- and coli form bacteria. Furthermore, he added, Tuberculosis and brucella microorganisms may survive in the product for weeks due to their resistance to high acidity. *Escherichia coli, Listeria monocytogenes* and *Yersinia enterocolitica* are three of the most important food borne Bactria pathogens and can lead to food- borne diseases through consumption of contaminated milk and fermented milk products (Morgan *et al.,* 1993 and Mead *et al*., 1999).

2.6. Types of fermented dairy products:

The various sources of fresh milk in Sudan shaped the different traditional dairy products. Dirar (1993) divided the Sudanese fermented dairy products into two major groups: the truly indigenous which include Rob, Gariss, Biruni and Mish and the quasi-indigenous which include Zabadi and Gibna beida. Methods of preparation are different slightly from one part of the country to another. The most important traditional products are Rob (fermented milk product mainly of cow's), Zabadi (local name of yogurt), Gariss (fermented camel's milk product), Gibna Bayda (white cheese), Gibna Mudaffra (White pickled cheese) and Mish (fermented milk product with spices) (Dirar, 1993 and Abdelgadir *et al*., 1998).

More than half the quantity of milk produced in Sudan is processed into some fermented dairy products such as rob, gariss, laban gaduim and Mish. In addition, there are two guasi-indigenous products, namely Jibna beida and Zabadi (Dirar, 1993). Also, Abdelgadir *et al.* (1998) reported that the surplus milk produced is fermented by souring into one or other certain dairy products, some of which are widely spread in the country whereas others are confined to certain geographical niches.

2.6.1. Yoghurt:

Common fermented milk products including yoghurt, a low-fat food, have a wide range of nutrients, including increased concentrations of lactic acid, galactose, free amino acids, and fatty acids due to fermentation (Tamime and Robinson, 1990 and Hattingh and Viljoen, 2001). Fermented milk productin general showed an increase in folic acid content but a slight decrease in vitamin B_{12}, while other B vitamins were affected only slightly (Alm, 1982) in comparison to the raw milk (Sahlin, 1999). Cultured milk, yoghurt, and curd contain microbes producing a certain amount of enzyme β-galactosidase, which help in tackling the problem of lactose intolerance (Sarkar, 2006).

2.6.2. Mish:

Mish is atypical Sudanese sour milk product, obtained by acidifying the raw milk with selective lactic acid bacteria and addition of certain flavoring stuffs e.g. species, left to ripen, packed or consumed. (Osman 2007). Dirar (1993) described mish as that product gained from milk, which first boiled, inoculated by starters after cooling and after souring seeds of black cumin or of fenugreek and perhaps few pods of green or red pepper are added and the product is fermented for two or more days before consumption.

Mish is a fermented milk food almost known to all regions of the Sudan and may be similar products but in different names (El-Mardi, 1988). Mish is made by boiling the milk, and after cooling, is inoculated with a small quantity of soured 'laben-rayeb' or 'mish', followed by the addition of seeds of black cumin, fenugreek and perhaps a few pods of green or red pepper and the product is fermented for two or more days before consumption. In modern dairy industry, it is made from w hole cow's or skim milk by adding starter culture, and after curdling spices such as black cumin, fenugreek, garlic and sometimes hot or green pepper are added, then is packaged and left for 24hours to ripen and develop a curd (Dirar,1993).

Black cumin played a remarkable inhibitory effect on the growth of *Staph aureus*. This may be due to the fact that volatile oil inhibits the growth of some pathogenic bacteria (Abdalla and El-Zubeir, 2006). The intensity of spicing may differ from region to another and from family to family within the same district. Variation depends on spices availability and the taste of the people (El-Mardi, 1988).

2.62.1. Factors influencing Mish manufacture:

The manufacture of Mish is dependent on several factors:

2.6.2.1.1. Raw milk composition:

The composition of Mish is like that of normal raw milk used to produce it. According to (E nimer, 2007) the only difference between both is related to the action of the bacteria, which convert the form of the milk from raw to coagulated, whereby a slight concentration of the components is noticed as a result of heat treatment, which in turn decreases the volume of water and increases the total solids. Murshidi (1998) noticed, the fat content in the final product depends on the fat content of the raw milk used, if it is whole, standardized or fully skimmed. The lactose % in the final product is decreased due to the fermentation process, by which the lactose is converted into lactic acid (ELnimer, 2007). According to (Walstra *et al.*, 1999), the composition of the product may be changed by such process steps as standardization, ultra-filtration, addition of skim milk powder, caseinates, stabilizators and flavorings.

2.6.2.1.2 Starter Cultures:

Blume (2013) defined the starter cultures as selective strains of lactic acid bacteria used in the manufacture of a wide variety of milk products. According to Sharma (2006), starter cultures are selected strains of lactic acid bacteria (LAB), (e.g. *Str. lactis*, *Str- cremoris, Str.thermophilus, Leuconstoc dextranicum, Lactobacillus bulgaricus, lactobacillus acidophilus* and *lactobacillus helveticus*) used singly or in combination of two or more species as starter cultures in the manufacture of several milk products; their function is to produce lactic acid and flavor compounds and bring about the coagulation of milk and desired changes in milk cream. Hugenholtz *et al*. (2002) and Kleerebezem and Hugenholtz, (2003) explained LAB are mainly Gram-positive, anaerobic bacteria, non – sporulating and acid tolerant; Biochemically they include both homofermenters and heterofermenters, where by the former produce primarily lactic acid, while the latter yield also a variety of fermentation by- products, including lactic acid, acetic acid, ethanol, CO_2 and formic acid. According to Tamime (2002), LAB are the main group of microorganisms that has been used successfully for decades for the production of fermented milks, and these organisms belongto the genera Lactococcus, *leuconostoc*, *Pediacoccus*, *Streptococcus* and *Lactobacilli*, classified into cocci and rods, have a growth temperature of (20-30^{o}C) and (37-45^{o}C). Lactic acid is formed by the action of many forms of bacteria upon sugars and there are two forms, called d- lactic acid and lactic acid receptively (Herrington, 2000). All acidified milk products have one characteristic in common, which is the presence of lactic acid (Spreer, 1998).The growth of starter culture bacteria is inhibited by the presence of bacteriophages (viruses),Milk naturally contains antibiotics like lactinin and agglutinin, beside antibiotics, bacteriocins, as noticed by Abdelhamid *et al*. (2001).

2.6.2.1.3. Fermentation process:

Fermentation is a mean of obtaining energy from carbohydrates without the presence of molecular oxygen i.e. in anaerobic conditions; it will proceed wherever the appropriate carbohydrate substance is in contact with microorganisms under favorable conditions of pH and low oxygen and hence is an important adjunct to get the full nutritional value from carbohydrates rich foods (Solomon, 2002). Spreer (1998) defined fermentation is a conversion of a substance by a microorganism, by a vegetative or animal cell or by its enzymes into a product. In food production, the term fermented is applied to the value addition and conversion of raw materials by microorganisms and enzymes into a product ready for consumption. Fermentation is one of the oldest technologies and a process dependent on the biological activity of microorganisms for production of a range of metabolites, which can suppress the growth and survival of undesirable micro flora in foods (Fox,1993). As given by Thapa (2000), controlled fermentation of milk produces acidity and flavor at desirable level, when preparing fermented milk products. The dramatic shift from food production for local communities to large scale food production to the requirements of expanding markets, led to the development of large scale of fermentation processes for commercial production of fermented foods with the most used microorganisms including lactic acid bacteria (LAB) for a variety of dairy products as explained by Klaenhammer and Fitzgerald (1994). Ray and Daeschell (1992) mentioned, fermentation process involve the oxidation of carbohydrates to generate a range of products, which are principally organic acids, alcohol and co2.The production of fermented milk is based on the fermentation process performed by lactic acid bacteria. When considering food fermentation, lactic acid bacteria are primarily responsible for many of the microbial transformation found in the more common fermented food products (Franz *et al.*, 1999).

2.6.2.1.4. Processing methods:

Mish can be processed either by using traditional or industrial methods. The traditional methods are performed in small house holds for self-consumption, while the industrial in milk factories for commercial purposes. The fermentation of the raw milk is common to produce both. But, the difference between both methods is associated with the addition of starters. Starter cultures, which are found naturally in milk, are dominating, when applying traditional methods. When preparing Mish on industrial basis, artificial starters, which are a mixture of one or more pure microbial cultures are added to the raw milk (Academic Teaching Staff, 2010).

2.6.2.1.5 Spices:

The spices used in Mish production contribute to the flavor, taste and have also health- benefiting effects. EL-Hussien (1984) mentioned, black cumin seeds are found to be acceptable without health hazards associated with their consumption. Similarly, garlic was used since ancient times as food, spice or remedy; in the Middle Ages it was used as antibiotic and is registered as a drug in many European countries, (Grinwald,1992). In Asia, fenugreek seeds (Trigonella foenumgrocum) consumed as spices and also are medicines (Patil *et al.*, 1997).

2.6.2.2. Chemical composition of Mish:

El Zubeir *et al*. (2005) reported that the chemical composition of Mish samples was 11.83 ± 2.96 %, 5.09 ± 2.9%, 2.83 ± 0.93%, 2.34 ± 0.98% and 1.24 ± 0.41 for total solid, protein, fat, lactose and acidity respectively. Abdalla and Ahmed (2010) found that the chemical composition of Mish samples collected from the dairy plant in Khartoum state has the following percentages; 6.82± 0.01, 8.38±0.17, 30.93± 0.19, 2.00± 0.07 and 3.96 ± 0.04 % respectively for fat, protein, total solids, ash and acidity. Abdel Gader (2008) found that the fat contents of the Mish samples from modern factory and that from traditional one were 6.98 ± 0.15 and 5.89 ± 0.29 respectively, while the protein contents were 10.26 ± 0.34 % and 7.9 ± 0.37% respectively, the ash content were 1.433 ±

0.16% and 0.828 ± 0.03 % and for the acidity were 2.334 ± 0.01 % and 2.35 ± 0.018 %.

2.6.2.3 Sensory Characteristics of Mish:

Omar *et al.* (2018) found that the sensory characteristics of Mish sample with pomegranate peel had no significant effect on the sensory properties except for the taste (5.60+ 1.34, 5.40+1.57, and 5.40+1.96). Tahaa *et al* (2017) found in Mish sample with thyme and ginger had no significant effect except texture and overall (7.80+1.51,6.10+1.77) (6.90+1.10, 5.93+1.28) respectively.

2.7. Quality and safety of fermented milk:

Milk is fermented by LAB to produce other products varied in their tastes, constitutions and shapes. Dairy products are major source of nutrition and consumed daily throughout the world. In some countries, addition of traditional spices enhances the fermentation process and suppresses the growth of pathogenic organisms (Abdalla and ElZubeir, 2006). Fermentative properties revolutionize the dairy products industry. Its uses as probiotic pave the way of bacteriotherapy era. Its use as natural preservative remains safe for many centuries (Ali, 2011).

Governments are asked to strength their efforts to advance the measurements of food quality and safety (Yagoub *et al*., 2006). Many factors are indigenously attributed to the fermentation processes such as the form of the inocula, type of vessels used and the micro flora from the starter/s or from the surrounding environment (Osuntoki *et al*., 2008).

2.8. The Shelf-life of fermented milk:

Abdalla and El Zubeir (2006) stated that milk product shelf life can be extended, but this is not practiced on a very large scale. The heat treatment of milk improves the keeping quality considerably. Milk fermentations provide a way for long-term preservation, provide the nutritional value, improve the appearance of various products, give the desirable taste, prevent the spoilage and reduce the effort and time required for cooking (Tamime, 2002; Motarjemi, 2002 and Floros *et al*., 2010).Sometimes fermented milks are preserved by the addition of preservatives like hydrogen peroxide, a practice, which is prohibited in many countries (Berg, 1988).

Fermented products generally have a large shelf life than their original substrate and their ultimate spoilage is different in character. The antimicrobial effects offer fermentation are not confined to spoilage organisms alone and can also affect pathogens that might be present. Thus, traditional food fermentation can take potentially hazardous substances as raw materials, such as raw milk and transform them into products with both improved keeping qualities and reduced risk of causing illness (Keller and Jordan, 1990; Mitchell, 2000 and Beukes *et al*., 2001).

CHAPTER THREE

Materials and Methods

3.1. Samples collection:

Thirty samples (10 samples from each) of Mish produced by two modern dairy companies (companies A and B) and traditional mish (C) ready for consumption in River Nile state were collected. The samples were collected randomly in an ice box samples from each manufacturer. All samples were subjected to chemical analysis (fat, protein, ash, total solids acidity) and Sensory evaluation (Flavor, Color, Texture, Taste).

3.2. Chemical analysis

3.2.1. Fat content:

The fat content was determined by Gerber method according to AOAC (2000). Ten milliliters of sulfuric acid (density 1.815 gm/ml at 20 °C) were poured into a clean dry Gerber tube, followed by the addition of 10.9 gram of well mixed Mish sample. One ml of amyl alcohol (density 0.814-0.816 gram at 20 °C) and distillate water (at 20 °C) were added. The contents were then thoroughly mixed till no white particles could be seen. Gerber tubes were centrifuged at 1100 revolution per minute (rpm) for 3 minutes and the tubes were then transferred to a water bath at 65 °C for 3minutes. The fat percent was then read out directly from the fat column.

3.2.2. Protein content:

The protein contents of Mish were determined according to AOAC (2000) using kjeldahl method. Ten ml amounts of Mish samples were weighed then transferred to kjeldahl flasks. Twenty-five ml of concentrated sulfuric acid free nitrogen which had 1.86 density, were added to each milk, whey and cheese followed by two kjeldahl tablets then they were digested on a heater until clean solutions were obtained. The flasks were removed and left to cool. Each digested sample was poured in a 100 ml volumetric flask, diluted to 100 ml with distilled water and allowed to cool. Five ml of each diluted sample was transferred to a distillator followed by 10 ml of 40% NaOH. The distillate of each of the three-sample received in a conical flask of 100 ml capacity containing 25 ml of 2% boric acid and three drops of bromo-cresol green plus methyl red indicator then the distillation continued until the volume in the flak reached 75 ml. The flasks were removed then titrated against 0.1 N HCl until the end points were reached (red colour). The protein contents were then calculated as follows:

$$\text{Nitrogen \%} = \frac{T \times 0.1 \times 20 \times 0.014}{\text{Weight of the sample}} \times 100$$

Protein %= Nitrogen % × 6.38

Where:

T = Titration figure

0.1 N = Normality of HCl

0.014 = The atomic weight of nitrogen/1000

20 = Dilution factor

3.2.3 Total Solids Content:

Total solids content was determined according to AOAC (2000). Five grams of Mish were weighed into clean dried pre-weighed porcelain dishes. The weight of each sample and the dish was recorded. The dishes were put in an air oven at 100^{o}C for three hours, then placed in a desiccator to cool for 30 minutes and weighed. Heating, cooling and weighing were repeated several times until the difference between weighing reached less than 0.5 mg. The total solids content of each of the samples were calculated as follows:

$$\text{Total solids} = \frac{W_1}{W_0} \times 100$$

Where:

W_1= Weight of sample after drying

W_0= Weight of sample before drying

3.2.4 Ash content:

The ash content was determined according to AOAC (2000). Five grams of Mish were weighed into porcelain dishes which were then placed in a muffle furnace at 550^{o}C for 1½ hours, cooled in desiccators and weighed.

The ash percentage was calculated as follows.

$$\text{Ash \%} = \frac{\text{Weight of ash}}{\text{Weight of sample}} \times 100$$

3.2.5 Titratable acidity:

Titratable acidity was determined according to AOAC (2000). Ten grams of Mish were weighed into a clean flask and five drops of phenoniphthalein added and titrated against 0.1 N NaOH. Then the titratable acidity of each sample was calculated as follows:

$$\text{Titratable acidity} = \frac{T}{W}$$

Where:

T= Titration figures

W= Weight of samples

3.3. Sensory evaluation:

The sensory evaluation of the Mish was examined by 10 untrained panelists (Sensory evaluation sheet Appendix 2) judging the flavor, texture, taste and the color of the Mish samples according to Larmond (1987).

3.4. Statistical Analysis:

The statistical analysis was done using SPSS grogramme version 16 for data analysis with One Way ANOVA the LSD was used for mean Separation between the treatments. Alpha level 0.05 was used (SPSS version 16, 2007)**.**

CHAPTER FOUR

Results

4.1. Physicochemical composition of Mish samples in River Nile state:

Data in Table 1 shows the physicochemical characteristics of Mish samples in River Nile state.

The statistical analysis indicated that significant variations were observed in all the physicochemical parameters of the Mish samples. The high (9.62±0.37%) fat contents was in the Mish samples made traditionally (C), while the low (3.66±0.45%) one was in the Mish samples of company (B). However, the protein content was significantly ($P<0.05$) higher (5.02±0.16%) in the Mish samples of company (A) whereas the lowest one (3.06±0.62%) was in those of company (C).

The total solids content was significantly ($P<0.05$) higher (22.52±0.88%) in Mish samples of Company (A) while the lower (13.48±1.53%) one was in those of traditionally made (C). The ash content was found to be significantly ($P<0.05$) different among the different manufacturers. The high (2.60±0.97%) ash content was in the Mish samples of company (B) whereas the low (1.42±0.37%) one was in those of company (C). Titratable acidity of the Mish samples was significantly ($P<0.05$) different among the Mish samples of different companies. The highest (3.58±0.13%) titratable acidity was in the Mish samples traditionally made(C), while the lowest (1.76±0.18%) one was for those of company (B).

Table 1: Physicochemical composition of the Mish samples in River Nile state

Treatments	Chemical composition %				
	Fat	**Protein**	**Ts**	**Ash**	**Acidity**
A	4.07±0.13 [b]	5.02±.16 [a]	22.52±.88 [a]	2.31±.61 [ba]	1.80±.29 [b]
B	3.66±.45 [c]	4.98±.73 [ba]	22.06±3.11 [ba]	2.60±.97 [a]	1.76±.18 [cb]
C	9.62±.37 [a]	3.06±.62 [c]	13.48±1.53 [c]	1.42±.37 [c]	3.58±.13 [a]
Lev. Sig	*	*	*	*	*

Means bearing different superscripts within columns are significantly different ($P<0.05$)

A= Mish samples .

B = Mish samples .

C = Mish samples traditionally.

4.2. Sensory characteristics of Mish samples in river Nile state:

Results in Table 2 demonstrated the sensory characteristics of the Mish samples in River Nile state. Statistical analysis revealed that significant differences ($P<0.05$) were found in the color and texture of the of different Mish samples. However, no significant variations ($P>0.05$) were observed in the flavor and taste of the different Mish Samples. The high (5.57±1.51) flavor scores was for the Mish samples of company (B) while the low (4.14±1.57) one was in traditionally made (C). The best color (7.00±0.00) was for the Mish samples of company (B) and the lower (4.43±1.9) scores were in those of company (A). The highest texture (5.86±1.57) scores was for the Mish samples of company (B) while the lowest (2.71±1.8) one was for those traditionally made (C). The taste of the Mish samples was the same for all tasted samples.

Table 2 Sensory characteristics of Mish Samples in River Nile state

Treatments	Sensory Evaluation scores			
	Flavor	Color	Texture	Taste
A	5.00 ±1.63	4.43±1.90[cb]	5.29±.76[ba]	5.57±1.51
B	5.57±1.51	7.00±.00[a]	5.86±1.57[a]	5.86±1.07
C	4.14±1.57	5. 00±.00[b]	2.71±1.8[c]	5.29±1.38
Lev. Sig	**NS**	*	*	**NS**

Means bearing different superscripts within columns are significantly different ($P<0.05$)

A= Mish samples .

B = Mish samples .

C = Mish samples traditionally made

NS = Non Significant different .

CHAPTER FIVE

DISCUSSION

The results indicated that fat content of the Mish samples produced by the Modern companies is lower than those processed under traditional methods this could be due to fact that the traditional producers used full cream milk in processing the Mish while those of the modern producers used standardized milk fat almost with 3% fat. The fat content in the final product depends on the fat content of the raw milk used (Murshidi, 1998). This result was not in accordance with those reported by El Zubeir *et al. (*2005).

The high protein contents of the Mish samples in Modern companies probably due to the quality of the raw milk used in manufactured of the products (Walstra *et al*., 1999). The result of this study was not in accordance with those found by El Zubeir *et al. (*2005) and Abdalla and Ahmed (2010) who stated that protein of Mish reached (8.38a±0.169, 7.44b±0.169, 7.84b±0.167).

This study reported high total solids contents in Mish samples produced by modern companies might be due to quality of the milk used in processing the products also could be related to the hygienic measures implemented in production of Mish, the results were in consistent with those of Sharma (2006); Franz *et al.* (1999) and Kurman *et al*. (1992). However, the result was not similar to those of Mohamed (2014) who reported the total solids of (23.262± 0.393, 22.900 ±0.451, 23.217 ±0.407 and 23.100 ± 0.543)% for Mish product Produced in Khartoum state ready for sale and consumption produced by 3 different milk factories.

The ash content was high in Mish samples of modern companies may be due to increased salt concentration in those samples of the modern companies. This result was higher than those reported by Abdalla and Ahmed (2010) who found (2.00±0.074 , 1.31±0.074, 1.48±0.074)% for the samples of Mish during storage from three different dairy plants.

The acidity content was high in traditional Mish samples this probably because of high activities of lactic acidity bacteria which hydrolyzed lactose into lactic acid. These results were agreed with those of Abdalla and Ahmed (2010). However, the result was higher than that reported by El Zubeir *et al*. (2005) and Abdel Gader (2008) who found that the titratable acidity of the Mish samples of the modern factory and traditional one was 2.334 ± 0.014 % and 2.352 ± 0.018 % respectively.

The results indicated that no significant variations were observed in the flavor of the different Mish samples this might be due to the fact the panelists mostly preferred the modern Mish flavor, color, texture, and taste than those of traditional Mish. This could be due to the quality of the milk which has an impact on the color of the product and the additives used that may improve the flavor, taste and texture. These results were not consistent with those reported by Sulieman *et al*. (2011) who reported that higher sensory attributes scores of the Mish samples made from the cow milk in the laboratory.

Conclusion:

It could be concluded that Mish from different dairy processors modern and traditional manufacturers showed significant variations in the chemical composition. The higher total solid, ash and protein contents were in samples made by the modern companies while the lower fat content and higher acidity were for those made by traditional one. Generally, the panelists considerably accepted the mish samples made by modern method which gained higher sensory scores in comparison with the traditional one.

Recommendations:

Its recommended that:

- Raw milk used for processing of Mish should be of high quality.
- Consumption of Mish samples produced by modern milk
- Factories should be encouraged to avoid possible health hazards.
- More researches and studies should be carried out on amino acids and vitamins contents and microbial quality of Mish.

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Appendices

Appendix (1): Chemical composition of cow's milk and other mammals.

Species	Composition (%)						
	Water	**Fat**	**Protein**	**TS**	**SNF**	**Lactose**	**Ash**
Human	87.43	3.75	1.63	12.57	8.82	6.89	0.21
Cow	87.20	3.70	3.50	12.80	9.10	9.40	0.70
Buffalo	82.76	7.38	3.60	17.24	9.82	5.48	0.78
Camel	87.61	5.38	2.98	12.39	7.01	3.26	0.70
Ewe	80.71	7.90	5.23	19.29	11.39	4.81	0.90
Goat	87.00	4.25	5.23	13.00	8.75	4.81	0.86
Mare	89.04	1.59	2.69	10.96	9.37	6.14	0.51

(Jenness, *et al.*,1988)

Appendix (2): Sensory evaluation sheet

Samples No. رقم العينة	**Colorاللون**	**Flavor النكهة**	**Texture القوام**	**Taste المذاق**
1-				
2-				
3-				

Keys:

الدرجات	اللون	النكهة	القوام	المذاق
7	مقبول جدا	مكثفة جدا	طرية جدا	مقبول جدا
5	مقبول	مكثفة	طرية	مقبول
3	مقبول بعض	قليلة	قاسية	مقبول بعض

الشئ			الشئ	
غير مقبول	قاسية جدا	غير مقبولة	غير مقبول	1