بسم الله الرحمن الرحيم

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A Survey Study on the Imported Cheese Type in Khartoum State

دراسة مسحيه عن أنواع الاجبان المستوردة بولاية الخرطوم

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بسم الله الرحمن الرحيم

قَالَ تَعَالَىٰ:

﴿ وَإِنَّ لَكُمْ فِي ٱلْأَنْعَٰمِ لَعِبْرَةً ۖ نُّسْقِيكُم مِّمَّا فِي بُطُونِهِۦ مِنۢ بَيْنِ فَرْثٍ وَدَمٍ لَّبَنًا خَالِصًا سَآئِغًا لِّلشَّٰرِبِينَ ﴿٦٦﴾ ﴾

النحل: ٦٦

صدق الله العظيم

Dedication

To my parents

To my husband

To my son Mohamed and Abu baker

To My Lovely Family I dedicate this Research

Acknowledgement

I thank God for giving me strength to accomplish this research. and then after thanks my great supervisor in this dissertation ,he always assists me since beginning of this period of supervision even the end , and also supported me and learn me more and more about researching and true method in study field , thank full Prof .Dr. Omer Ibrahim Ahmed Hamid.

List of tables

List of figure

Abstract

The study was carried out during December_ January 2016 to study the types of imported cheese in Khartoum state that include three areas (Khartoum ,Bahry, Omdurman) well-structured questionnaire was formulated about the type of imported cheeses and Thirty questionnaires were distributed to supermarkets in these three areas (Khartoum ,Bahry, Omdurman) the data statistically analyzed by SPSS using descriptive statistics the results of the study showed that the main imported cheeses are; Processed, Cream, Cheddar and Mozzarella cheeses . It is found that the percent of the imported cheeses in Khartoum state are; 32.6%, 32.6, 23.9 and 10.8 for the Processed, Cream, Cheddar, and Mozzarella respectively. However, the percent of the processed and Cream cheeses in the three areas (Khartoum, Bahry and Omdurman) are; 33.33% for each of the above areas respectively. While the percent of the Cheddar are; 27.2%, 31.8 and 40.9% in Khartoum, Bahry and Omdurman localities respectively. The percent of the presence of Mozzarella are; 30.%, 50% and 20% for Khartoum, Bahry and Omdurman localities respectively. The cheeses mainly imported from Saudi Arabia, Egypt, UAE and Denmark countries. The percent of the imported cheeses from the imported countries are; 32.9%, 32.9, 24.9% and 9.8% for Suadia Arabia, Egypt, UAE and Denmark respectively .The results showed that all the imported cheeses are of cooked type cheese. It's found that the shelf life of the imported cheeses varies from six months for the processed cheese and one year for Mozzarella, Cheddar and cream cheeses. The most selling and consumable cheeses in the Khartoum state are processed and Cream.

المستخلص

أجريت هّذه الدارسة لمعرفه أنواع الاجبان المستوردة بأسواق ولاية الخرطوم خلال الفترة من ديسمبر حتي يناير 2016 الدراسة شملت ثلاث محليات (الخرطوم، بحري،امدرمان) تم تصميم استبانات لمعرفه أنواع الاجبان المستوردة في هذه المحليات الثلاث تم توزيع 30 استبانة (10الخرطوم،10 بحري،10 امدرمان) تم تحليل البيانات احصائيا باستخدام التحليل الوصفي أظهرت نتائج الدراسة ان الاجبان المستوردة هي شيدر , كريم , موزر يلا والمعالجة. وكانت نسبتها في ولاية الخرطوم 32.6% , 32.6% ,23.9% و10.8% لكل من الاجبان (المعالجة , الكريم, شيدر وموزريلا) علي التوالي .بينما كانت نسبه الاجبان (المعالجة والكريم) في محليات (الخرطوم ,بحري ,امدرمان) 33.33% . لكل المناطق أعلاه ع التوالي. وكانت نسبه جبنه شيدر 27.2% , 31.8% ,40.9% في محليات (الخرطوم ,بحري وامدرمان) علي التوالي. وكانت نسبه جبنه الموزريلا 30% ,50%و20% لكل من الخرطوم ,بحري و امدرمان علي التوالي. تستورد الاجبان من السعودية ,مصر , الامارات ,الدنمارك وكانت نسبه استيراد الاجبان من تلك الدول 32.9% ,32.9%,24.9%, 9.8% لكل من السعودية, مصر, الامارات والدنمارك علي التوالي . كل أنواع الاجبان المستوردة كانت اجبان مطبوخه. وكانت مده الصلاحية 6 شهور للجبنة المعالجة وبينما كانت سنه لجبنه شيدر وموزريلا وكريم. اكثر الأنواع مبيعا كانت جبنه كريم والجبنة المعالجة .

Chapter one

Introduction

Sudan livestock population was estimated at about 138.22 million heads, of which. 40.99 million were cattle,50.39 million were sheep, 42.75 million were goats, and 4.07 were camels(Hussein, 2008).Sudan has one of the largest and most species diverse livestock populations in Africa. It greatly contributes to national economy and export revenue. The importance of traditional dairy products is not of economical only but also represents a cultural heritage for the production area (Salih *et al.*2011).

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, 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 Mudaf–fra (White pickled cheese) and Mish (fermented milk product with spices) (Dirar, 1993).

The major types of cheese in Sudan are Gibna Bayda and Gibna Mudaffara (Hamid and El Owni, 2007). They are varying in composition, texture, color, taste and flavor. The variation is due to composition of milk, methods of produ—ction, microbial flora, type of package, microbial activity during ripening and ripening conditions. Cheese manufacturing is influenced by product composition, processing, and packaging and storage conditions. Control of temperature and

humidity and transportation are dynamic aspect of health hazards (Nour El-Diam and El-Zubeir, 2006).

Although Sudan is a big producer of milk however, the cheese industry is very weak in Sudan that is why the importation of considerable quantity of cheese yearly to fill the gap between the demand and supply of cheese in the country. Cheese is a nutritious and tasty milk product. There are 500–800 varieties of cheese available in the international market (Razzaq 2003).The dairy sector has gained from the general economic growth in Sudan with growing demand for milk and dairy products. However, there has been an asymmetric development between the growth in milk supply and the demand for dairy products with growing import as a consequence.

The milk processing industry in Sudan is mainly of private processors. Because milk is not staple, the government does not control the price of milk by importing milk powder with subsidized prices. The Private dairy processors, who also may import on their own accounts or buy domestic fluid milk, focus on producing more profitable processed dairy products, including yogurt, cheese, butter, sour milk, and dairy desserts, whose prices are not controlled (since they may not be manufactured from subsidized milk powder). The consumption of dairy products has increased in recent years with increased consumers' purchasing power and the increased availability of locally produced products.

Objective of the study:

To identify and assess the different types of imported cheese in Khartoum state.

Chapter Two

Literature Review

2.1. Cheese:-

Cheese is a nutritious food made mostly from the milk of cows, buffaloes, sheep or goats (Dairy co, 2009). Cheese making is aimed to make milk preservation attractive and durable. Its shelf life varies from few days to several years (Walstra *et al*., 1999). Cheese is an important nutrient for humans especially under conditions where other animal proteins are not available (Kosikowski, 1982). Cheese is a nutritious and tasty milk product. There are 500–800 varieties of cheese available in the international market (Razzaq 2003).

2.1.1. Classification of cheeses:-

The classification of different cheese is; hard cheese, soft cheese, cream cheese, processed cheese and whey-cheese (Blom *et al*., 2002). The basic technology for the production of all types of cheese is same with relatively small changes resulting significant differences in the final cheese. The art or science of cheese making comprises five key factors: milk composition, rate and extent of acid development, moisture content, curd manipulation and ripening conditions (Lucey *et al.,* 2003). Other factors that may influence the quality of different varieties of cheese are composition of milk, types of milk, starter cultures and manufacturing technology (Varnam and Sutherland, 1994). More than 900 individual varieties of cheeses are being produced in the world, which is classified based on their form, manufacturing, ripening and chemical composition (Walstra *et al.,* 2006).

2.1.2. Nutritional value of cheese

Nutritious rich food, cheese is made mostly from the milk of cows, buffaloes, sheep or goats, and it is an important food component in the healthy diet of American, Asian and European. It provides a rich source of proteins, peptides, amino acids, short-, medium and long-chain fatty acids, vitamins, and essential minerals including calcium. A large variety of cheeses has been produced in the world to meet the requirements of taste and health need of individuals. But their consumption varies with individual, race, ethnicity of people and type of milk in cheese preparation. Among the varieties, Cheddar was found to be more popular variety in UK and Mozeralla in USA. In recent years, cheese found to be health presence of health promoting factors, such as essential amino acids, free fatty acids and so on (Ash and Wilbey ,2010).

Numerous factors that include type of milk, lactation period, ripening process, type of starter used can vary the nutritional components of the cheese. The fully ripened cheese contains highly water soluble components than its source, milk (Kosikowski and mistry,1997) . It also contains several peptides, which has various bioactive roles in humans. These peptides can be generated not only during the ripening process of cheese but also can generate during the digestion process in human tract. Bioactive peptides generated during the ripening as well as during digestion are found to be health beneficial, such as ACE-inhibitory activity (Smacchi, and Gobbetti , (1998). The peptides derived from the casein and whey proteins are also serving as prominent source for the neutrceutical functional foods. Cheese also generates certain free amino acids by the actions of enzymes produced by the starter culture and rennet. However, the amount of free amino acids present in cheese varies with the source of milk and rennet used. The amount of sulfur containing amino acids is relatively low in cheese peptides when compared to the

source milk proteins. In general, the amino acid index varies between 91 and 97 if the total amino acid of milk protein were considered to be 100. Biogenic amine formed during decarboxylation of free amino acids by the action of microorganisms which are added during the preparation process or by contaminant also lowers the amino acid index in cheese. The enhanced digestibility of cheese can be produced by the breakdown of casein during ripening of cheeses . (Farrell,*et,al,*2004.)

The potential and the nutrient significant of cheese are of wide range due to the presence of potentially significant amount of both saturated and unsaturated fat. However, different type of fats has different health effects and not all saturated fats elevated the plasma cholesterol. Certain fats in cheese are found to be health beneficial, such as conjugated linoleic acid (CLA) which shows various biological activity include anticancer, antithrombotic, antidiuretic and ant atherosclerosis. The average content of CLA in cheese is found to be 0.5 to1.7g/100 g of free fatty acids. These contents found to be unaffected during various processes and storage of cheese. In order to reduce the cholesterol level in cheese certain processes has been used, such as the use of cholesterol-reduced milk fat made by adsorption on to beta cycleodextrin .

Among the various vitamins in cheese, water soluble vitamins are extensively lost during the cheese preparation. But some water soluble vitamins are retained, such as niacin, folate and vitamin B12. Folic acid is important for the reduction of homocysteine in blood. Fat soluble vitamins, such as vitamin A, are essential in immune system which also found high in cheese. Lactic acid bacteria (LAB) also play an important role in the enhancement of nutritional components of cheese by the production of certain exopolysaccharides. It enhances the flavor of cheese during ripening by the action of its enzymes. It also produces certain

peptides and amino acids which increase the bioactivities of cheese (Farrell,*et,al,*2004.)

2.1.3. Cheese ingredients;-

There are a number of ingredients which are essential for cheese making good quality milk from the cow, sheep, goat etc is required. Knowledge of its chemical composition and bacteriological quality is desirable if cheese of consistent quality is to be made. Chemicals etc are not required for all varieties of cheese. Certain cheese varieties require starters (pure cultures of lactic acid bacteria) containing organisms with specific functions, e.g. flavor development. The recipe will indicate good quality milk from the cow, sheep, goat etc is required. Knowledge of its chemical composition and bacteriological quality is desirable if cheese of consistent quality is to be made. (Walstra, *et al* 1999).

The recipe and the market determined if coloring matter should be used. Occasionally it is required to bleach the original color of the milk and to whiten the curd. Chemicals such as calcium chloride and sodium nitrate are recommended in recipes for some varieties of cheese to improve curd quality and prevent the growth of organisms which may cause problems during the ripening or maturing of the cheese. Rennet is the usual coagulant used but the juice extract of some fruits and plants, e.g. lemons and *Calotropis procera* may be used for some cheese varieties, salt (sodium chloride) may be added to some varieties of cheese, the quantity and method of addition depending on the recipe. Salt may be added directly to the milk or curd pieces; it may be rubbed into the finished cheese or the cheese may be immersed in a brine solution .

(Walstra, *et al* 1999).

2.2. World cheese production;-

The world cheese production reached the 20 million MT production mark in 2011 and the growing trend has continued in 2012 and 2013. The global estimation includes all natural cheeses except processed cheese. Cheese from cow´s milk delivered to dairies represents more than 80% of the global natural cheese production. The rest is made up on farm and home-made products, but also cheeses made from other milk (sheep, goat, and buffalo). Europe and Northern America produce more than 75% of the world cheese production.

EU and USA account for 70% of the world cheese production in 2012 and the production of cheese is expected to show dynamic growth until 2020 where the production will amount to 16.6 million MT. However, the relative share of the world cheese production will decrease to 66% in 2020 due to relatively higher growth all other regions of the world except other Europe(IDF, 2009).

EU and USA account for 70% of the world cheese production in 2012 and the production of cheese is expected to show dynamic growth until 2020 where the production will amount to 16.6 million MT. However, the relative share of the world cheese production will decrease to 66% in 2020 due to relatively higher growth all other regions of the world except other Europe. The world cheese production is expected to continue the positive growth trend from the last decade and the expansion from 2012 to 2020 is expected to be 24% equalizing 4.9 million MT of cheese. The major uncertainties are the global economic development and the development in the global demand and supply situation for milk and dairy products in general until 2020. This will be analyzed further in Table (2.1).

Table 2.1 World cheese production 2000-2020

1,000 MT	2000	2012	2012/2000	2020 (prognosis)	2020/2012
EU-28	7,709	9,333	+21 %	1 0 , 6 0 6	+14%
Other Europe	266	291	+9%	338	+16%
CIS	448	866	+93%	1, 072	+24%
North America	4,227	5,618	+22%	6,720	+20%
Oceania	665	7 0 0	+ 5 %	9 3 0	+ 3 3 %
South America	1,118	1,625	+45%	2,067	+27%
Asia	293	456	+ 5 5 %	1,288	+ 1 8 2
Middle East + Africa	744	1 . 5 12	+103%	2,054	%
Total World	**15,470**	**20,401**	**+32%**	**2 5 , 0 7 5**	+36% **+23%**

Source PM Food 2008

2.3.Cheese consumption

The consumption of cheese has been a success story with growth in all regions of the world the last decades. In 1980, the consumption was 8.4 million MT and it grew to 11.2 million MT in 1990 and in 2000 the world consumption of cheese reached 15.3 million MT nearly a doubling of the level in 1980. This has been the case in all regions of the world and the dynamic growth has continued in the new millennium.

EU and North America are the largest cheese consuming areas in the world and the markets are largest both in volume and value. In 2012, they accounted for 70% of the world cheese consumption Surprisingly, the Middle East and North Africa is the third largest consuming area in

the world with 9% share in 2012. The major cheese consuming countries in the region are Egypt and Saudi Arabia and the growth in the recent decades is partly due to economic improvements and partly because of the increasing population(Table 2.2).

In South America, the cheese consumption has more than doubled in the last 30 years. In the remaining the growth has also been positive, although from a low level. The region is now fourth with 8% of the world cheese consumption. In South America the cheese consumption has nearly doubled in the last 40 years. In the remaining the growth has also been positive, although from a low level.

CIS has experienced an incredible increase since the late 1990s because of the economic growth and the area accounts for 6%.

Asia is still at a very low level of consumption with just over 1 million MT in 2012 the area has experienced a growth of 84% from 2000 to 2012 mainly in Iran. In Oceania and other Europe the consumption has remained nearly stable with limited growth compared to other regions of 1% and 30% respectively.

Table 2-2 ;World cheese consumption (2000-2020)

1,000 MT	**2000**	**2012**	**2012/2000**	**2020(prognosis)**	**2020/2012**
EU-	7,502	8,870	18%	9,629	9%
Other Europe	245	318	30%	372	12%
CIS	714	1,150	61%	445	26%
North America	4,390	5,557	27%	6,950	25%
Oceania	266	268	1%	302	13%
South America	918	1,642	78%	2,041	24%
Asia	557	1,023	84%	1,672	63%
Middle East + Africa	1,108	1,840	66%	2,676	45
Total	**1 5,700**	**20,668**	**32%**	**25,087**	21%

SOURCE IDF 2000

2.4.Cheese yield:-

Cheese making is a process concentrating milk components, in particular fat and protein contents which are determinant factors of cheese yield **(**Banks *et al.* 1981**).** Cheese yield is vital in an economic sense for cheese makers since small differences in yield translated into big differences in profits. A difference of 1% in the moisture of Cheddar cheese is equivalent to a difference in yield of 1.8%. Measurement of yield should become a tool not only of cheese making but also of management **(**Emmons, 1993; Lacroix *et al.* 1993 **)**

Cheese yield is defined as the amount of cheese, expressed in kilograms, obtained from 100 kg of milk. It is a very important parameter: the higher the recovered percentage of solids, the greater is the amount of cheese obtained gains in economic terms. It is, therefore, obvious how to elaborate a rapid method that allows for an estimate, before transformation, of the final cheese yield on the basis of the composition of the raw material. In order to make a comparison between the forecast yield and the actual one: this would allow the cheese maker to have a constant check on the efficiency of operations, and to estimate the influence that some technological strategies can exercise on the entire process of cheese making. Equally important is the calculation of the effects that each milk component, and in particular, fat and casein, can have on cheese yield, in order to adopt a milk quality payment system that could remunerate each parameter for its actual value **(**Paolo *et al*. 2008)

Lucey and Kelly (1994) describes different aspects related to cheese yield: characteristics of the milk (contents of protein and fat, genetic variants of proteins, somatic cells), cheese making conditions (incorporation of whey proteins in the curd, homogenization of the fat,

type of coagulant, use of different starters, curd firmness, type of vat, treatment of the curd). The same authors also consider different predictive formulas for determine cheese yield and strategies in order to minimize cheese making losses. Van den Berg et al. (1996) analyze some aspects of the review of Van Boekel (1993), about the transfer of the various components from milk to cheese, focusing mainly on cheese making technology and the treatments which milk undergoes, such as bactofugation, pasteurization, enzyme addition, denaturation of the whey proteins, addition calcium chloride, and the influence that all these aspects have on the transfer of substances in the curd. Utilization of reconstituted skim milk and cow milk cream in Domiati cheese manufacture was found to increase the fresh and pickled cheese yield throughout the storage time, which may be attributed to increased moisture retention (Abd El-Gader 2003, Ismail 2005).

Cheese yield is affected by many factors including milk composition, amount and genetic variants of casein, milk quality, somatic cell count (SCC) in milk, milk pasteurization, coagulant type, vat design, curd firmness at cutting, and manufacturing parameters (Banks et al. 1981, Fenelon and Guinee 1999, Lawrence 1993 b, Lucey and Kelly 1994, Walsh ***et al***. 1998).

Fat and moisture contents were also, higher in the former than in the latter kind of Domiati cheese. Increasing the protein-to-fat ratio (PFR) led to a significant decrease in the actual yield of cheese per 100 kg of milk but a significant increase occurred in the normalized yield of cheese per 100 kg of milk with reference values of fat plus protein (3.4 and 3.3%, wt/wt, respectively). The results demonstrate that alteration of the PFR of cheese milk in the range 0.70 to 1.15 has marked effects on cheese composition, component recoveries and cheese yield (Guinee *et*

al. 2007). Genetic variants of milk protiens there is considerable interest in using milk protein genes as markers for improving the overall efficiency in different sectors of the dairy industry because some genetic variants are associated with: higher milk yield, better milk composition, improved physicochemical properties of milk and dairy products, and better cheese making qualities (Ng-Kwai-Hang 2006).

The yield of the processed cheese and the Sudanese white cheese made out of it from 4.4% fat milk after 15 and 30 days ripening were 2.850 kg and 1.75 kg and 2.750 kg and 1.50 kg respectively. While that made from 2.2 fat % yielded 2.0 kg and 1.25 kg and 2.0 kg and 1.2 kg, respectively. There is possibility of using the Sudanese white cheese as a raw material for preparation of the processed cheese. Moreover, it yielded more quantity that will increase the incomes, in addition to the high prices of the processed cheeses (Nour El Diamand El Zubeir Ibtisam2007). Nowadays, polymorphisms of milk proteins can be determined at protein level and DNA level. Some of these polymorphisms in milk proteins are known to affect milk yield, milk composition, micelle organization, coagulation characteristics and cheese yield (Yardibi et al. 2009).

The cheese yield was the highest for buffalo milk cheese and the lowest for goat milk cheese. The yield of all the cheeses was influenced by the type of milk used and loss of moisture during the storage period (Abd El-Rafee and Abd El-Gawad 2002). The yield and the recovery of cheese milk constituents recorded highest values in buffalo milk and the lowest in cow milk [Abdou et al. 2002]. Mozzarella cheese supplemented with casein ate gave the highest yield and gained highest score for flavor, body and texture compared to control and cheese supplemented with other concentrates (Hassan and Abd El-Gawad 2000). The yield of Mozzarella cheese from goat milk was more affected by addition of

glucono-δ-lactone, (GDL) than, that of buffalo and cow milk cheese. As it is expected and because milk used in cheese manufacture is not standardized, the yield values of buffalo milk cheese were higher than that of cow or goat milk cheese (Ismail *et al*. 2007).

Among the different factors, the role of starter culture and renting pH is of an importance in making of brine cheese. Thus, the effects of commercially available starter culture which is a mixture of mesophilic (*Streptococcus lactic. Lactic* and *Str. Lactis. ceremonies*) and thermophiles (*Str. Thermophilus* and *Lactobacillus bulgaricus*) bacteria(Najaf *et al.* 2008).

Everett and Auty ,(2008) reported that homogenization of milk prior to the manufacture of cream cheese allows the fat globules to interact with the casein matrix and produce a more elastic cheese with less free oil formation. In addition, use of homogenized milk for cheese making will produce higher yields since more moisture will ultimately be retained in the protein network.

A longer rennet coagulation time (firmer coagulum at cutting) resulted in an increase in cheese moisture, as well as an increase in cheese yield (Johnson *et al*. 2001).

The progressive reduction in moisture and salt adjusted cheese yield with increasing pre acidification was caused by a substantial reduction in calcium recovery in the cheese and a tendency for decreased protein recovery in the cheese. This would decrease moisture and salt adjusted yield (Ismail *et al.* 2007, Mtzger *et al*. 2000).

After cutting, the curd is left alone for a short period known as a healing period. During the healing period, a “skin” forms on the outside of the curd, which prevents further losses of fat and moisture. The curds

are then stirred and cooked in order to expel moisture and to promote shrinkage of the protein network (Brown, 2002).

Salt and loss of moisture during ripening a factor affecting the cheese yield of surface-waxed cheeses at the time of consumption, as distinct from curd or green cheese yield, is loss of moisture by evaporation. The rate of evaporation might be expected to vary with the relative humidity and especially with the temperature of the ripening room. In the absence of air conditioning, hot dry summers will be conducive to low yields in matured cheese irrespective of the fat plus casein value of the milk (Lawrence ,1993).

Utilization of reconstituted skim milk and cow milk cream in Domiati cheese manufacture was found to increase the fresh and pickled cheese yield throughout the storage time, which may be attributed to increased moisture retention. The yield of control and experimental cheeses decreased gradually as storage period progressed (Abd El-Gader, 2003, Ismail, 2005).

2.5. Type of imported cheese:-

2.5.1. Processed cheese:-

Is is a dairy product differing from the natural cheese in that it is not made directly from milk, although the main ingredient is the natural cheese. Processed cheese is made by blending shredded natural cheeses of different types and degrees of maturity with various ingredients and emulsifying agents (mostly sodium citrates, sodium orthophosphates or sodium polyphosphates), and optional ingredients such as butter or spices, followed by heating of the blend under a partial vacuum with constant agitation until a homogeneous mass is obtained (Mayer, 2001; Schar and Bosset, 2002).

Processed cheese can be made from a simple basic set of ingredients consisting of cheese, water and melting salts, or from a complex mix of ingredients including different types of proteins, fat, gums, stabilizers, flavorings and added minerals (Lee *et al*., 2003). For a typical industrial processed cheese production, the principal raw material is semi-mature cheese of shorter structure with partially hydrolyzed protein, and the processing markedly changes the structure of natural cheese and results in the development of new structures in the processed cheese (Piska and Štětina, 2004).

Kapoor and Metzger (2008) reported that there are various chemical and compositional properties which have an effect on the functional properties of process cheese, and that only standardizing the fat and moisture content of the cheese formulation does not ensure a product with the desired functional properties, so it is very important to control and monitor factors such as total calcium content, intact casein content, pH, type and amount of emulsifying salts, lactose content, whey protein content and type and amount of rework added in order to produce a cheese with specific physicochemical and functional properties Many investigators reported that processed cheese may contain the following chemical composition: fat 13-37%, protein 12.82-22.6, moisture 38.2-64.21%, ash 1.33 – 4.82, treatable acidity 1.33 -1.60 and pH 4.4 – 6.3 depending on the ingredients used in the manufacture of cheese (Acharya and Mistry, 2005; Kaminarides and Stachtiaris, 2000; Kapoor *et al*., 2007; Kwak *et al*., (2002) Shirashoji *et al*., 2006; Pinto *et al*., 2007). The processed cheese is not a preserved food, but a ‘semi-preserved food’ with limited shelf life of 3-4 months, especially when the product is packaged in plastic foils, while products stored in metal cans may have

longer shelf lives of 6-12 months at room temperature (Schär and Bosset, 2002).

Recently, processed cheese is imported from neighboring countries according to standards set by the government. Processed cheese is a food product made by heating a mixture of cheese, water, emulsifying salts and further optional ingredients such as butter or spices. Production of processed cheese and factors influencing its characteristics have been described in many publications (Caric and Kalab, 1997; Guinee *et al* 2004). According to Chambre and Daurelles (1997), processed cheese products usually retain their good quality for up to 6-12 months at room temperature. Processed cheese is not a preserved food, but a 'semi-preserved food' with a limited shelf-life (Berger *et al*., 1989).

Most of the problems of the shelf life and storage of processed cheese were associated with problems caused by microbial contamination.

2.5.2. Mozzarella Cheese

Mozzarella cheese is the most famous one in US (Dave *et al*.2003). Similarly in Asian countries like Malaysia, has shown a tremendous increase in the consumption of mozzarella cheese as a result of growing trend of fast foods like in pizza pie (Ahmad *et al.* 2001). Moreover, it is estimated that approximately 70% of mozzarella cheese is used in pizza making (Alverez 1986) and the demand for mozzarella cheese is increasing day by day in the global market (Kindstedt 1991). On the other hand, cheese making is almost at its infant stages in Pakistan despite of being the fifth largest milk producing country of the world. Buffalo, known as the 'Black Gold of Asia' contribute a major share in

total milk production of the country and its milk is quite suitable for mozzarella cheese preparation (Considine 1982; Athar and Anwar 1992).

Mozzarella cheese has become one of the most popular cheese varieties in world because of its primary use is in pizza preparation. Its usage is expected to grow as global interest due to the ever increasing demand for pizza and other foods that use mozzarella. Buffalo milk is preferred for Mozzarella due to high fat, vitamin A, protein and low cholesterol (Zicarelli, 2004).

Differences in fat level and hence protein to fat ratio, that occur in milks have marked influences on composition, yield, rheology, flavor and sensory attributes of (Guinee *et al*., 2002). Starter cultures are used in cheese making to promote acid development during curd manufacturing and also to confer distinct textural and flavor properties (Varnam and Sutherland, 1994). The rate of acid production is critical in determining cheese quality. The acidification also contributes to a preservative effect with the result that many pathogenic and spoilage bacteria are inhibited (Banks, 2004).

Recently the incidence of Bovine Spongiform encephalopathy had reduced both supply and demand for bovine rennet (Roseiro *et al*. 2003). As a result, dairy technologists all over the world have turned their attention towards the substitute of calf rennet which will be more cost effective. In relation to this, a great deal of research has already been directed to find a suitable milk coagulating enzyme from plants, micro-organisms and fungi to reduce the dependency on calf rennet for cheese making (Lopes *et al*. 1998). Although many discoveries of proteinases (casein coagulating enzymes) from above mentioned sources have shown satisfactory milk-clotting properties yet they cannot be effectively compared with calf rennet (Ibiama and Griffiths ,1987).

Optimum yield of mozzarella cheese is of vital importance for profit in cheese making operation. Emmons and Binns (1990) reported that accurate estimates of mozzarella cheese yield were of great importance in establishing the relationship between composition of milk and yield of cheese. The theoretical yield of cheese can be estimated from the milk fat and casein or protein contents of milk by using classical equations like Van Slyke Equation; as applied in Cheddar cheese and mozzarella cheese (Barbano and Rasmussen, 1992 ;Rudan *et al.*, 1999).

2.5.2.1. mozzarella Cheese preparation

The samples of milk were first pasteurized at temperature of 65°C for 30 minutes. After this the standardized milks were divided into two parts. Then cooled to 37°C subsequent to this one part of each milk was inoculated with (combined culture of *Lactobacillus bulgaricus* and *Streptococcus thermophilus* 2%) indigenous culture and other part with commercial culture. After ripening for 30 minutes at 37°C curd was set with Chymosin. Approximately 40 minutes after chymosin addition, the curd was cut with 1.9 cm wire knives and then allowed to heal in the whey for 10 minutes with periodic gentle agitation to prevent curd matting. The temperature was increased gradually to 42°C during cooking and stirring of the curd. The whey was drained at pH 6.2 and curd was matted, then cutting of matted curd into pieces and turned every 15-20 minutes and milled at pH 5.2. Then the salt was added at the rate of 1.5% of the curd. The salted curd was then hand stretched in hot water of 70°C until the uniform and elastic cheese

2.5.3.Cheddar Cheese

Cheddar is a very popular cheese and is probably one of the most consumed cheese type worldwide (British Cheese Board, 2013, Bylund, 1995).

Cheddar has it origin in Somerset in England were it has been produced since the middle ages (British Cheese Board, 2013). The cheese has most likely got its name from the town of Cheddar where originally caves were used to store the cheese during ripening (British Cheese Board, 2013). The caves provided a very good environment for the maturation of the cheese due to the caves humidity and its constant temperature (British Cheese Board, 2013). Nowadays cheddar cheese is produced not only in England but in most parts of the world and the manufacturing technic of the cheese has developed a lot since the production of the early cheeses from the 12th century.

Cheddar cheese were traditionally produced as large cylindrical shaped loafs with a weight of around 30 kg but nowadays in the modern industrial process the cheese is instead formed into rectangular blocks to facilitate the handling of the cheese (Walstra *et al.*, 2006). A cheddar cheese has a long shelf life and the color of the cheese may range from white or ivory to light yellow or orange (The Codex Alimentarius Commission, 2013, Walstra *et al.*, 2006). The cheese does not possess any surface flora and are available for consumers to buy both with and without a rind (Walstra *et al.*, 2006, The Codex Alimentarius Commission, 2013). Cheddar is a ripened cheese that consists of approximately 55% of moisture on a fat free basis (MFFB) which classifies the cheddar as a hard cheese (Bylund, 1995). Due to the use of homo-fermentative starter cultures the cheddar cheese does not possess any gas holes which provides the cheese with a closed structure (Bylund,

1995). The texture of cheddar is firm and short, in other words the consistency of the cheese is a bit stiff and nearly crumbly (Walstra *et al*., 2006). There are many factors that affect the consistency of the cheddar cheese. Two of these factors are the production steps of cheddaring and the addition of salt to the cheese curd before the cheese is processed (Walstra *et al.,* 2006). These two production steps are considered very characteristics for the production of cheddar-types cheese and both procedures have an effect on the texture of the cheese (Walstra *et al.*, 2006). The cheddaring affects the structure of the cheese by making the closed structure of the cheese more enhanced due to the removal of entrapped air from the cheese (Walstra *et al.*, 2006).

The addition of salt to the cheese curd on the other hand affect the consistency of the cheese as the salt content has an impact on the firmness of the cheese (Walstra *et al.*, 2006). The salt content in a cheddar cheese should be between 1,75-1,95% as a lower salt content gives the cheese too soft consistency whereas a higher salt content gives the cheese too hard consistency (Walstra *et al.*, 2006, Bylund, 1995). The pH is also a parameter that has a clear effect on the texture of the cheddar cheese (Walstra *et al.,* 2006). Traditional cheddar has a pH of around 4,9 but nowadays there are cheddars present with a pH up to 5,3 (Walstra *et al*., 2006). The higher the pH the softer the texture of the cheese becomes (Walstra *et al*., 2006). The taste of cheddar develops during the ripening of the cheese and therefor the flavour of the cheddar cheese is depending on the time of the maturation (Walstra *et al*., 2006). Acheddar with a short ripening time has a mild creamy taste whilst a more mature cheddar has a more complex slightly nutty flavour (British Cheese Board, 2013).

Strips and piled up (Walstra *et al*., 2006). According to Walstra *et al*. (2006), acid production during cheddaring is of paramount importance.

When pH is dropping the curd expels whey and the importance of acidification here, affects the final moisture and the texture of cheese (CHR Hansen, 2002).

2.5.4. Cream cheese varieties

Cream cheese products are often categorized into two main types based on the different fat content in the initial mix and the final composition. These are double-cream cheese with at least 9- 11% fat content in the initial mix, and single-cream cheese with 4.5-5% fat content in the initial mix (Guinee *et al.,* 1993). There are also other similar kinds of cream cheeses based on different fat and dry matter contents. In the United States, the Food and Drug Administration (FDA) regulations state that cream cheese has to have at least 33% fat and not more than 55% moisture content. The Canadian standard for cream cheese requires at least 30% fat content in the product, and in France, the cream type cheese such as 'Triple creme' has to have at least 75% fat in dry matter content (Sanchez et al. 1996).

The first standard for cream cheese was that issued in 1921 by the Federal Food and Drug Act. It stated that, "Cream cheese is the unripened cheese made by the Neufchatel process from whole milk enriched with cream. It contains in the water-free substance not less than sixty-five per cent (65%) of milk fat." This product would be considered nowadays as a high-fat Neufchatel cheese (Lundstedt, 1954). The cooked-curd method was developed in the early twenties, and later on, the cold-pack and hot-pack methods were developed, and are still used for cream cheese making today (Lundstedt, 1954).

The level of starter culture and the set temperature depend on the incubation period; two of the common incubation conditions are the short-set incubation with 5% starter culture, an incubation temperature of 31ºC and an incubation period of approximately 5 hours, and the long-set incubation with 0.8-1.2% starter culture, a temperature of 22-23ºC, and an incubation period of 12-16 hours. The mix is held at the specific temperature until reaching the desired pH of 4.5- 4.8, as shown in Figure 2A (Singh and Tewari, 1990; Singh and Tewari, 1991; Guinee *et al.*, 1993; Kosikowski, and Mistry, 1999; and Lucey, 2003). The acidification step is achieved by the fermentation of lactose by Lactococcus starter (Fox and McSweeney, 1998). The hot curd is pumped to the packaging device and packed while hot. The shelf life of the hot pack product is around 3 months at 4-8ºC (Singh and Tewari, 1990; Singh and Tewari, 1991; Guinee *et al.,* 1993; Kosikowski, and Mistry, 1999; and Lucey, 2003).

According to USDA (1994), cream cheese and related products should have a uniform white to light cream color with a slightly lactic acid and cultured diacetyl flavor and aroma; off-flavors such as bitter, sulfide, yeasty, and unnatural flavor should not be present. The texture of the products should be smooth without lumps or grittiness, and the products should not show any indication of cracking, or wheying off. The cheese products should be spreadable at room temperature (68ºF or 20ºC) or when cold (45ºF or 7.2ºC) if labeled as 'soft', and the product should be of medium firmness when refrigerated (< 45ºF or 7.2ºC). The compositional standards are shown in Table 3. Defects in cream cheese can occur depending on the final pH of the cheese. The texture of the cheese will be soft, and the cheese will lack flavor, if the pH of the cheese is too high (> 4.7). If the pH of the cheese is too low (< 4.6), the texture

may be too grainy, and the flavor will be too acidic in addition, cream cheese defects include whey separation from the product during storage and agrainy, sandy, or chalky texture, especially in the lower-fat types (Lucey, 2003).

2.6. The Hazard Analysis and Critical Control Point (HAACP) concept

In the food industry today approaches based on good manufacturing practice are being superseded by application of the Hazard Analysis Critical Point (HAACP) concept. This has improved on traditional practices by introducing a more systematic rule based approach for applying our knowledge of food microbiology to the control of microbiological quality. The same system can also be adopted with physical and chemical factors affecting food safety or acceptability, but It should also be remembered that HACCP is primarily a preventative approach to quality assurance and as such it is not just a tool to control quality during processing but can be used to design quality into new products during their development (Martin *et al*., 1990).

The pasteurization is a CCP. ´The time and temperature should be controlled to ensure a high and safe product. The main risk of insufficient heating is inadequate destruction of enzymes and microorganism that can spoil the product or can be harmful for consumers. If the temperature is too high it affects the quality of the product negatively and this is due to high amount of denatured whey proteins affecting the coagulation. (Walstra *et al*, 2006) Therefore, the pasteurization parameters should be - controlled as the heating and its intensity affect the type and extent of the

bacterial flora of the milk, the growth rate, and the enzymatic activity, the activity of the lipase, the rennet ability of the milk, the tendency to show syneresis, and the retention of serum proteins in the cheese. For production of the cheddar cheese the raw milk is pasteurized at 72 0c for about 15 seconds (Walstra *et al*., 1999).

Therefore CCPs in the cheddar cheese production is applied to control the amount of the starter cultures i.e.,. 2 % of the milk and also the amount of added rennet (Walstra *et al*.,1999).

From the quality point of view these steps could be CCP because the moisture content can be affected by the parameters: cut size of the curd, stirring intensity, temperature and time. Therefore these parameters should be rigorously controlled. (Walstra *et al.*, 2006)

2.7. Sensory evaluation of cream cheese

In addition to those attributes, spreadability is one of the most important textural properties for cream cheese (Breidinger and Steffe, 2001), and to determine spreadability a certain force is required to initiate the flow (Konkoly *et al.*, 1999). It has been demonstrated that consumers found the force to initiate the flow, which is generated on the knife during spreading the food on crackers, to be an indication of spreadability for a variety of foods including cream cheese (Kokini and Dickie, 1982).Therefore, another important cream cheese attribute is spreadability, which is a texture attribute performed by hand, and the definition based on them score from the 15-point-unstructured scale are; low = hard to spread (2 mm layer) on a cracker (high resistance), and high = easy to spread (2 mm layer) on a cracker (low resistance) (Wendin *et al.*,2000).

CHAPTER THREE

Materials and methods:

3.1.Expermental design:-

The study was conducted at Khartoum state during the period December to January 2016 included three areas (Khartoum, BAHRY and Omdurman) well-structured questionnaire was distributed to 30 super markets in Khartoum state (10 questionnaire for each of Khartoum, Bahry and Omdurman areas.

3.2. Area of the study:-

Khartoum is the capital and largest city of Sudan. It is located at the confluence of the White Nile and blue Nile it has an area of 22.122km and the estimated population is approximately7.152.102 People (2008) it has many type of livestock such as cows sheep goats and camel. There are three localities of Khartoum state these are Khartoum Bahary and Omdurman.

3.3 Statistical analysis

In this study SPSS program version 16 was used for the analysis of data. Descriptive analysis in terms of percent was used in this work.

Chapter Four

Results

4.1 Imported cheeses in Khartoum state:-

The data in Figure (1) showed that the main imported cheeses are; Processed, Cream, Cheddar and Mozzarella cheese . It is found that the percent of the imported cheeses in Khartoum state are; 32.6%, 32.6%, 23.9 %and 10.8% for the Processed, Cream, Cheddar, and Mozzarella respectively.

The data in table (1) indicated that the percent of the processed and Cream cheeses in the three areas (Khartoum, Bahry and Omdurman) are; 33.33% for each of the above areas respectively. While the percent of the Cheddar are; 27.2%, 31.8 and 40.9% in Khartoum, Bahry and Omdurman localities respectively. The percent of the presence of Mozzarella are 30% ,50% and 20% for Khartoum, Bahry and Omdurman localities respectively.

The data in figure (2) defined that The cheeses mainly imported from Suadia Arabia, Egypt, UAE and Denmark countries. The percent of the imported cheeses from the imported countries are; 32.9%, 32.9%, 24.9% and 9.8% for Suadia Arabia, Egypt, UAE and Denmark respectively.

The results showed that all the imported cheeses are of cooked type cheese. It's found that the shelf life of the imported cheeses varies from six months for the processed cheese and one year for Mozzarella, Cheddar and cream cheeses.

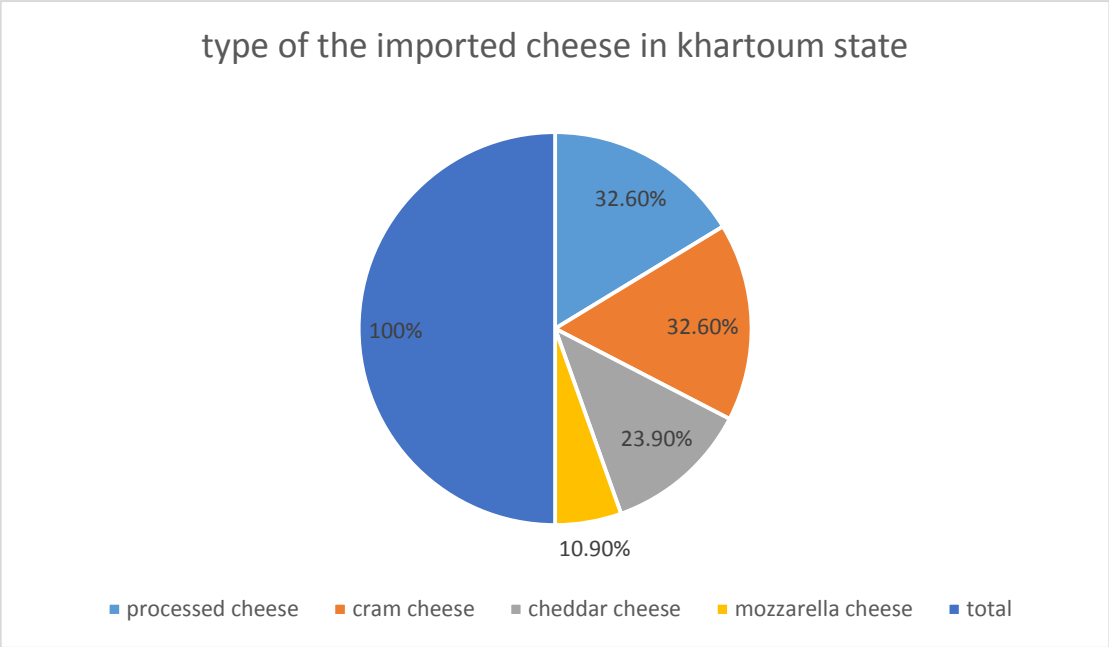

Figure 1 the type of the imported cheese in Khartoum state

Table 1The percent of the imported cheeses in three localities in Khartoum state

Place of super markets	Type of cheese				
	Processed,	Cream cheese	Cheddar cheese	Mozzarella, Cheese	Total
Khartoum	33.33%	33.33%	27.2%	30%	100%
Bahry	33.33%	33.33%	31.8%	50%	100%
Omdurman	33.33%	33.33%	40.9%	20%	100%

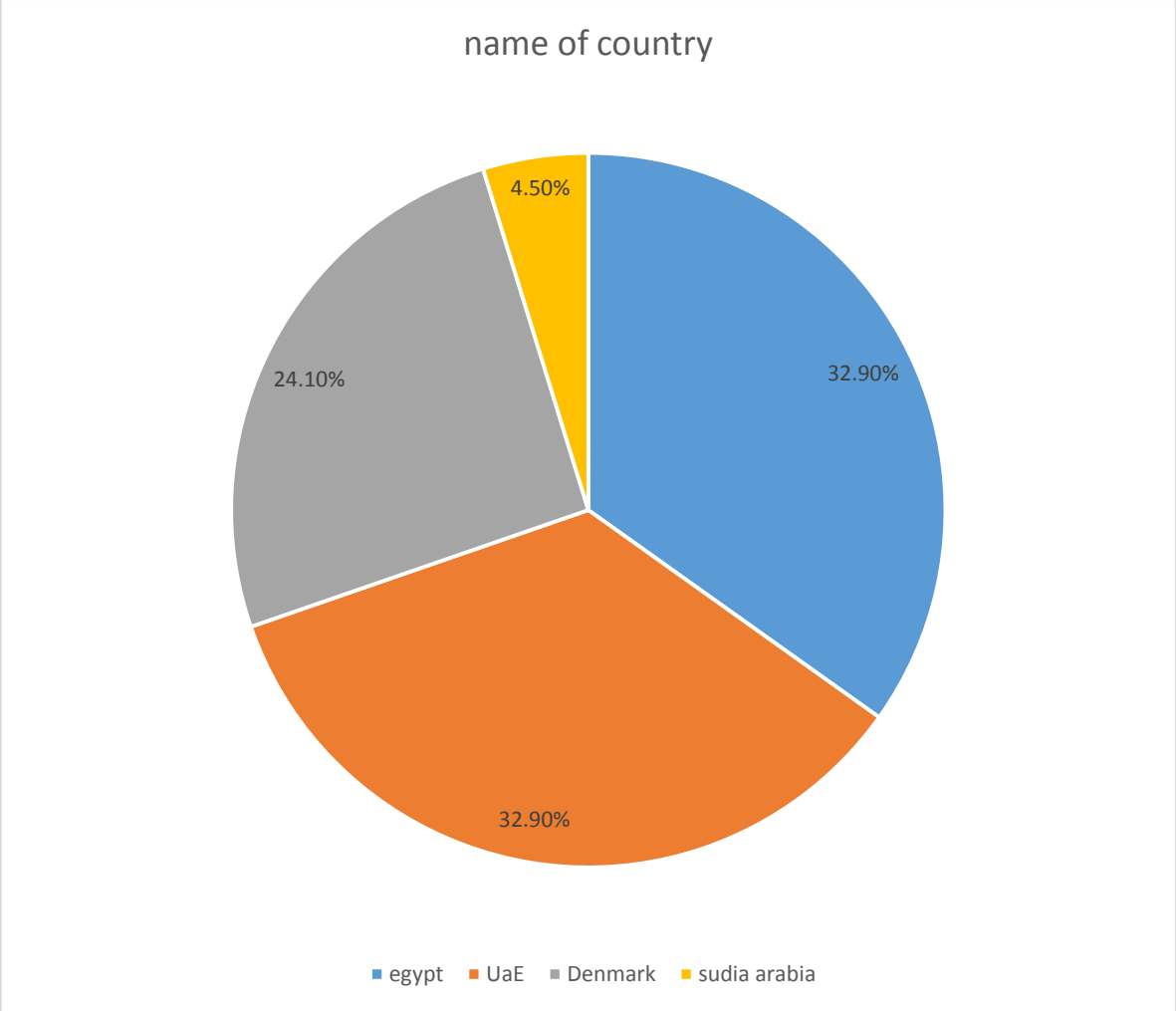

Figure 2 **the percent of the exported countries of the imported cheese in Khartoum state**

The data in table (2) showed that the percent of the most selling cheeses in Khartoum state are processed and cream are 100%, 50% and 60% in Khartoum, Bahry and Omdurman localities respectively. And the percent of (cream and processed cheeses) are 0%, 50% and 40% in Khartoum, Bahry and Omdurman localities respectively.

The data in figure (3) revealed that the percent of the most selling cheeses in the Khartoum state are processed and cream cheeses (70%, 30% respectively).

The data in table (3) showed that the lowest purchasing price was range from 1000-3000 Sudanese Guenah (SG) and their percent are 30%,50%,40% and 46.6% in Khartoum , Bahry, Omdurman localities and overall respectively. And the highest percent of purchasing price more than 9000 SG are; 30%, 10%, 10% and 13.3% in Khartoum, Bahry ,Omdurman localities and over all respectively.

The results table (4) showed that the lowest selling 1300- SG and the percent of it are 80%,90%,100% and 89.9% for Khartoum , Bahry ,Omdurman localities and overall respectively. While the highest percent of selling price was more than 9000 SG their percent are 20%, 10%, 0% and 10.1% for each Khartoum, Bahry, Omdurman localities and overall respectively .

Table 2 Selling of imported cheeses in the localities (Khartoum, Bahry and Omdurman

Place of super Markets	**The most selling**		Total
	Processed cheese	**Cream cheese processed cheese**	
Khartoum	100%	0%	100%
Bhry	50%	50%	100%
Omdurman	60%	40%	100%

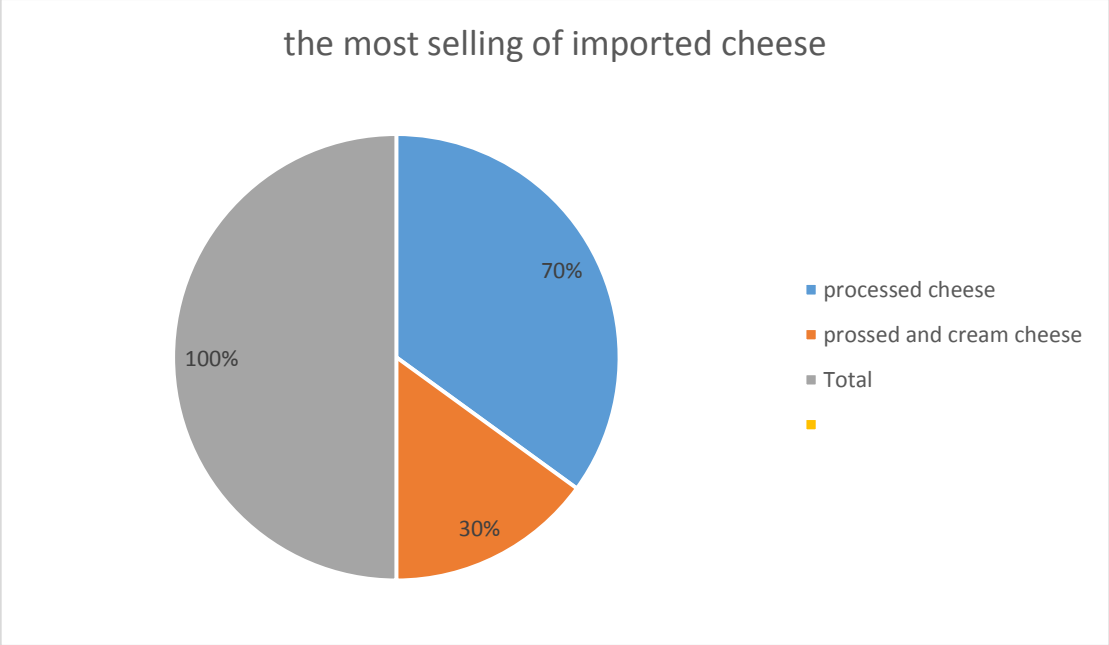

Figure 3 the most selling of imported cheese in Khartoum state

Table 3 The purchasing prices of the imported cheeses in Khartoum localities

Place of super markets		Parchasing price			
	1000 -3000	3000-6000	6000-9000	>9000	Total
Khartoum	30%	20%	20%	30%	100%
Bhry	50%	40%	0%	10%	100%
omdurman	40%	40%	10%	10%	100%
Over all	46.6%	33.4%	6.7%	13.3%	100%

Table 4 the selling price in Khartoum localities

Area	Selling price		
	1300-9000	> 9000	Total
khartoum	80%	20%	100%
Bhry	90%	10%	100%
omdurman	100%	0%	100%
Over all	89.9%	10.1%	100%

CHAPTER FIVE

DISCUSSION:

Worldwide, the dairy sector is one of the fastest growing productive sectors. The dairy industry in Sudan was handicapped by much production, marketing, organizational, governmental and legislative constraints that let situation very complicated. The data of the study showed (figure 1)that there are four types of imported cheese in Khartoum state spite the fact that not less than 400 varieties of cheese were found all over the world. The four imported cheese varieties in Khartoum state are processed, cream, cheddar and mozzarella of which processed and cream cheeses are the most abundant types in Khartoum state this could be due to lack of processing plant in Sudan and shortage of cheese supply and also due to the urbanization and the change of the dairy products consumption recently in Khartoum state. However the low percent of imported cheddar and mozzarella cheeses in Khartoum state might be attributed to the availability of Quazi cheeses mainly Muddafara and white cheesed and their low prices in Sudan markets. The results demonstrated that the distribution of the imported cheeses (Table1) in the localities of Khartoum stated (Khartoum, Bahry and Omdurman) were evenly distributed probably due to the notability and similarities between consumer perceptions and behaviours also most consumers perceive cheese to be expensive and all consumers buy at least some cheese from supermarkets; purchasing habits are driven by economic reasoning (affordability) and taste preference. These results are in accordance with those by Sharma *et al. (*2005).

It’s found that the main exporting countries (figure 2) of the imported cheese in Sudan are Suadia Arabia, Egypt, UAE and Denamark. The reason might be due to the sanction on Sudan by USA since 1998 which causes many drawbacks on foreign trade also most cheese produced for domestic consumption is made by small-scale industrial processors and there is a gap between cheese supply and demand.

The results indicated that(figure3) the most selling and consuming of the imported cheeses in Khartoum state localities (Khartoum, Bahry and Omdurman) were cream and processed cheeses, this could be attributed to availability of these cheeses in different packaging sizes that facilitates their selling. These results were not in agreement with those of Blundel (2002).

The results of this study (Table 2) showed that the high percent of most selling imported cheese was for the processed cheese this could be due to low price in the markets and even could be sold in units in comparisons with the other imported cheeses. It’s found that the purchasing prices (Table 3) of the imported cheeses in the Khartoum state localities supermarkets varied between 1000 to 100000 SG per month the low purchasing prices of the imported cheeses probably due to the limited incomes of the most consumers in the state and its observed that the cheese was not the basic table food for majority of the Sudanese consumers or might be due to the availability of domestic cheeses in the local market with lower prices. However, the data indicated that the selling prices (Table4) of the imported cheeses in Khartoum state ranged between 1300 to 15000 SG for different super markets.

CHAPTER SIX

Conclusion and Recommendation

6.1. Conclusion:

Based on the result and discussion the following conclusions were drawn:

* The main types of the imported cheese are four type founded in of Khartoum state Supermarkets (processed, cream, cheddar and mozzarella).

* All imported cheese founded in markets of Khartoum state are of cooked type.

*The exported countries of the imported cheeses are; Sudia Arabia, Egypt, UAE and Denmark.

*The best-selling or consumption type of imported cheese were cream and processed cheeses.

*There is no deterioration in the quality of the imported cheese in the supermarkets of Khartoum state.

6.2. Recommendations:

*Further research will be required about the important cheese.

* Attention to the manufacture of cheeses locally and Covering the needs of the local market.

* Provision of means for the conservation and transportation of dairy products to save the dairy and take advantage of them.

*Establishment of milk collection points is necessary in rural area.

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APPENDEX:I Questionnaire of the imported cheese in Khartoum state

بسم الله الرحمن الرحيم

جامعه السودان للعلوم والتكنلوجيا

كليه علوم وتكنلوجيا الإنتاج الحيواني

استبيان عن أنواع الاجبان المستورده في ولايه الخرطوم

السوبر ماركت....., المنطقه

رقم السوبر ماركت..... أسماء الاجبان المستورده.....

أنواع الاجبان المستورده جافه ( ) نصف جافه ( ) معامله ( ) مطبوخه ( )

مكان الاستيراد لكل نوع .....

مده صلاحيه الاجبان شهر( ) شهران ( ) 3 شهور ( ) 6 شهور ( ) سنه ( ) اكثر

من سنه ( )

سعر شراء الاجبان مجتمعه .....

سعر بيع الاجبان مجتمعه.....

اكثر الأنواع مبيعا او استهلاكا.....

هل هنالك أنواع معرضه للتلف قبل البيع؟ نعم ( ) لا ( )