Sudan University of Science and Technology

College of Graduate Studies

Chemical and Microbiological Properties of Different Sudanese Porridges Madida

الخصائص الكيميائية والمكروبيولوجية للمدايد السودانية المختلفة

By

Awad Alla Suliman Eisa Alteb

B.Sc. (Honours) In Food Science and Technology,

Um durman Islamic University (2011)

A Thesis Submitted to Sudan University of Science and Technology in Partial Fulfillment for the Requirements of Master Degree in Food Science and Technology

Department of Food Science and Technology,

College of Agricultural Studies

Supervisor Prof. Dr. Ahmed Elawad Elfaki

February, 2016

بسم الله الرحمن الرحيم

قال تعالى

(وَهُوَ الَّذِي أَنزَلَ مِنَ السَّمَاءِ مَاءً فَأَخْرَجْنَا بِهِ نَبَاتَ كُلِّ شَيْءٍ فَأَخْرَجْنَا مِنْهُ خَضِرًا نُّخْرِجُ مِنْهُ حَبًّا مُّتَرَاكِبًا وَمِنَ النَّخْلِ مِن طَلْعِهَا قِنْوَانٌ دَانِيَةٌ وَجَنَّاتٍ مِّنْ أَعْنَابٍ وَالزَّيْتُونَ وَالرُّمَّانَ مُشْتَبِهًا وَغَيْرَ مُتَشَابِهٍ انظُرُوا إِلَى ثَمَرِهِ إِذَا أَثْمَرَ وَيَنْعِهِ إِنَّ فِي ذَٰلِكُمْ لَآيَاتٍ لِّقَوْمٍ يُؤْمِنُونَ)

صدق الله العظيـــــم

سورة الأنعام الآية (99)

DEDICATION

To my family,

Friends

and teachers.....

With respect.

ACKNOWLEDGEMENTS

Prayers and thanks to **ALLAH**, who gave me good health and support to accomplish this study.

I am grateful to my supervisor Prof. Dr. Ahmed Elawad Elfaki who was too patient with me during this study, also for his unlimited assistance and guideness.

Thanks are also extended to my friends and anyone who supported me this study.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF APPENDICES

ABSTRAC

The aim of this study was to determine the nutritive value and safety of medida (Sudanese thin porridges). Samples were collected from different locations in Khartoum State. The samples were medidat tamur, millet medida and medidat um genger.

The moisture content of Um ginger in Khartoum North, Omdurman and Khartoum was 67.57%, 65.45% and 63.83%, respectively. Date medida was 64.48%, 63.09% and 67.19%, respectively. Millet medida was 67.48%, 65.22% and 66.98%, respectively. Ash content of medidat Um ginger in Khartoum North, Omdurman and Khartoum was 0.8%, 0.6% and 0.4%, respectively. Date medida was 0.5%, 0.4% and 0.3%, respectively. Millet medida was 0.5%, 0.5% and 0.4, respectively.

Protein content of medidat Um ginger in Khartoum North, Omdurman and Khartoum was 3.5%, 1.5% and 1.8%, respectively. Date medida was 0.8%, 0.3% and 0.4%, respectively and millet medida was 1.8%, 2.0% and 1.5%, respectively.

Fiber content of medidat Um ginger Khartoum North, Omdurman and Khartoum was 0.6%, 0.3% and 0.2%, respectively. Date medida was 0.3%, 0.2% and 0.3%, respectively. and millet medida was 0.2%, 0.3% and 0.3%, respectively.

Fat content of medidat Um ginger in Khartoum North, Omdurman and Khartoum was 0.8%, 0.4% and 0.7%, respectively. Date medida was 0.2%, 0.1% and 0.1%, respectively. and millet medida was 0.7%, 0.6% and 0.6%, respectively.

Carbohydrates content of medidat Um ginger in Khartoum North, Omdurman and Khartoum was 26.54%, 31.57% and 32.96%, respectively. Date medida was 33.59%, 35.74% and 31.62%, respectively. and millet medida was 29.13%, 31.12% and 29.99%, respectively.

Bacterial Number of medidat Um ginger in Khartoum North, Omdurman and Khartoum was $6.8x10^6$, $4.8x10^4$ and $4.9x10^4$(cfu/g) respectively. Date medida was

$5.6x10^5$, $6.8x10^6$ and $5.5x10^5$(cfu/g), respectively. and millet medida was $6.6x10^6$, $5.5x10^5$ and $5.8x10^5$(cfu/g), respectively.

Moulds and yeasts content of medidat Um ginger in Khartoum North, Omdurman and Khartoum was $3.6x10^3$, $3.5x10^3$ and $2.6x10^3$(cfu/g), respectively. Date medida was $2.7x10^2$, $3.4x10^2$ and $2.6x10^2$(cfu/g), respectively. and Millet medida was $2.5x10^2$, $3.5x10^3$ and $3.5x10^3$(log^{10}cfu/g), respectively.

Staphylococcus aureus content of medidat Um ginger in Khartoum North, Omdurman and Khartoum was $2.8x10^2$, $2.5x10^2$ and $2.6x10^2$ (cfu/g), respectively. Date medida was $2.6x10^2$, $2.6x10^2$ and $2.5x10^2$ (cfu/g), respectively. And Millet medida was $2.7x10^2$, $2.6x10^2$ and $2.8x10^2$(cfu/g), respectively.

Total Coliforms content of medidat Um ginger in Khartoum North, Omdurman and Khartoum was 16.6, 1.0and 0.0 respectively. Date medida was 0.0, 13.3 and 5.3, respectively. and millet medida was 9.0, 7.3 and 12.0(cfu/g), respectively.

E. coli content of medidat Um ginger in Khartoum North, Omdurman and Khartoum was 4.3, 0.0 and 0.0(MPN/g), respectively. Date medida was 0.0, 4.0 and 0.0(MPN/g), respectively. and millet medida was 0.0, 0.0 and 2.0 (MPN/g), respectively.

From the results the *Salmonella* in millet medida was not detected in the different locations (Omdurman, Khartoum and Khartoum North).

Um ginger medida from Khartoum has a positive result of *Salmonella*, while samples from Omdurman and Khartoum have negative result (not detected). The samples of date medida from Omdurman have positive results, while the samples from Khartoum and Khartoum North have negative results (not detected).

According to the results of this study these Sudanese medida are not healthy that they content pathogenic bacteria. Accordingly the consumers should be pay attention and care. Also intensive advice about healthy handling of these products should be made available for both sellers and consumers.

الملخص

الهدف من هذه الدراسة هو تقدير القيمة الغذائية والصحية لبعض المدائد السودانية , تم جمع عينات من المدائد السودانية في مواقع مختلفة من ولاية الخرطوم وكانت العينات عبارة عن مديدة بلح ومديدة دخن وأم جنقر وجد ان محتوي الرطوبة لمديدة ام جنقر في الخرطوم بحرى وأمدرمان والخرطوم هي67.57% و 65.45% و 63.83% علي التوالي. أما لمديدة البلح فكانت 64.48% و 63.09 %و 67.19% علي التوالي . ولمديدة الدخن كانت 67.48%و 65.22 %و66.98% علي التوالي.

اما محتوي الرماد لمديدة أم جنقر من الخرطوم بحرى وأمدرمان والخرطوم كان 0.8 % و0.6%و 0.4% علي التوالي. ولمديدة البلح كان 0.5% و 0.4% و0.3% علي التوالي. ولمديدة الدخن كان 0.5% و 0.5 % و 0.4 % علي التوالي.

ومحتوي البروتين لمديدة أم جنقر في الخرطوم بحري وأمدرمان والخرطوم كان 3.5% و 1.5% و1.8% علي التوالي. اما لمديدة البلح فقد كان 0.8% و0.3% و0.4% علي التوالي. ولمديدة الدخن كان 1.8% و 2.0% و1.5% علي التوالي.

أما محتوي الألياف لعينة أم جنقر في الخرطوم بحري وأم درمان والخرطوم كان 0.6% ,0.3% و0.2% علي التوالي. ولمديدة البلح كان 0.3%, 0.2% و0.3% علي التوالي. ولمديدة الدخن كان 0.2% , 0.3% و 0.3% علي التوالي.

أما محتوي الدهون لمديدة أم جنقر في الخرطوم بحرى وأم درمان والخرطوم كان 0.8% و 0.4% و 0.7% علي التوالي. ولمديدة البلح كان 0.2% و 0.1% و 0.1% علي التوالي. ولمديدة الدخن كان 0.7 % و 0.6% و 0.6% علي التوالي.

أما محتوي الكاربوهيدرات لمديدة أم جنقر في الخرطوم بحرى وأمدرمان والخرطوم كان 26.54% و 31.57%و 32.96% علي التوالي. ولمديدة البلح كان 33.59% و 35.74% و 31.62% علي التوالي. ولمديدة الدخن كان 29.13% و 31.12% و 29.99% علي التوالي.

العدد البكتيري لام جنقر في الخرطوم بحرى وام درمان والخرطوم)6.8 10^6x (cfu/g) و 10^4x4.8 و 10^4x4.9 علي التوالي. ولمديدة البلح 10^5x5.6 (cfu/g) و 10^6x6.8 و10^5x5.5 علي التوالي. ولمديدة الدخن(cfu/g) 10^6x6.6 و 10^5x5.5و 10^5x5.8 علي التوالي.

محتوي الخمائر والاعفان لام جنقر في الخرطوم بحرى وام درمان والخرطوم (cfu/g) 10^3x3.6و 10^3x3.5و 10^3x2.6 علي التوالي. ولمديدة البلح 10^2x2.7 (cfu/g) و10^3x3.4 و10^2x2.6 علي التوالي. ولمديدة الدخن 10^2x2.5 (cfu/g) و10^3x3.5 و10^3x3.5 علي التوالي.

اما محتوي البكتيريا الذهبية العنقودية لام جنقر في الخرطوم بحرى وام درمان والخرطوم)10^2x2.8 (cfu/g) و10^2x2.5 و10^2x2.6 علي التوالي. ولمديدة البلح 10^2x2.6($\log^{10}$cfu/g) و 10^2x2.6 و10^2x2.5 10^2علي التوالي. ولمديدة الدخن 10^2x2.7(cfu/g) و 10^2x2.6 و 10^2x2.8علي التوالي.

اما محتوي باكتيريا القولون لام جنقر في الخرطوم بحرى وام درمان والخرطوم(MPN/g)16.6 و1.0 و 0.0علي التوالي. ولمديدة البلح (MPN/g)0.0, 13.3و 5.3 علي التوالي. ولمديدة الدخن 9.0, 7.3 و 12.0علي التوالي.

اما محتوي *E. coli* لام جنقر في الخرطوم بحرى وام درمان والخرطوم كان (MPN/g)4.3, 0.0 و0.0علي التوالي. ولمديدة البلح (MPN/g) 0.0 و0.4 و0.0 علي التوالي. ولمديدة الدخن (MPN/g)0.0 و 0.0 و 2.0علي التوالي.

كما اوضحت النتائج أن بكتيريا السالمونيلا في مديدة الدخن لم توجد في الخرطوم بحري وامدرمان والخرطوم. بينما وجدت في مديدة أم جنقر من الخرطوم بحري في عينتين ولم توجد في امدرمان والخرطوم. أما في مديدة البلح فان السالمونيلا وجدت في أمدرمان (عينتين) ولم توجد في الخرطوم والخرطوم بحري.

اثبتت هذه الدراسة ان الناحية الصحية لهذه المدائد السودانية تحتوي علي ميكروبات ممرضة مما يترتب علي المتناولين لها الحيطة والحذر. كما ولابد من التثقيف الصحي للمنتجين والبائعين والمستهلكين لهذا النوع من الأغذية .

CHAPTER ONE
INTRODUCTION

A stiff porridge, together with some sort of sauce, more than anything else, makes the staple dish of the African. Miracle (1965) mentioned that dough-porridge was the staff of life in most African families. Quin (1964) stated that cereal meal porridge determined the very existence of the Pedi of southern African whose women prepared 48 varieties of porridge.

In this respect that Sudan is not different from other African countries. The stiff porridge, aceda, is the major form in which cereals or cassava tubers and famine foods, such as wild grasses, are consumed. Cailliaud (1826 cited in Dirar,1993) found the sorghum and millet stiff porridge, which was made from fermented dough, to be throughout the Sudan in the early 19th century. Lorenzen (1948 cited in Dirar,1993) wrote that sorghum was consumed by the Dinka (the biggest tribe in the Sudan) as a thick gruel and as porridge. The Bari, around Juba town, cultivates various kinds of sorghum which they also eat as a thick gruel and as porridge. Larken (1927 cited in Dirar,1993) mentioned that bakinde (a stiff porridge) was the only form in which cereals and other farinaceous crops were eaten by the Zande of southwestern Sudan. Titherington (1927 cited in Dirar,1993) mentioned that the stand-by food of the Raik Dink of Bahr El Ghazal, was a meal formed of a porridge mixed with fat, some meat or fish boiled or singed on the embers. The kerish of the southwest make porridge from sorghum and eat it with sauce (Lorenzen, 1948 cited in Dirar,1993). Porridge of sorghum mixed with cow's milk is the staple diet of the Nuer of the northern part of the southern region (Jackson, 1923 cited in Dirar,1993).

Recent food consumption surveys conducted in kordofan and Darfur Regions showed conclusively that the stiff porridge, aceda, and not the thin bread, kissra, is

the staple of the western Sudan. This also holds true for most of the rural areas of the country (Dirar, 1993).

What follows is a discussion in some detail of the various kinds of thick and thin porridge as well as cereal foods prepared in the form of balls, granules or coarse meals.

There are many types of thin porridges in all over the Sudan, which include different types of cooked foods such as millet, date, sorghum, and some additives such as aradeib and hilba (Dirar, 1993).

Cereal grains are utilized as food worldwide. In Africa the majority of porridge and naturally fermented products medida, the Sudanese cereal thin porridge is prepared for fasting, sick or convalescent people, nursing mothers, and weaned infants. The word nasha is used to replace the word medida in urban areas (Dirar, 1993).

Um ginger cooked with sour milk (rob) and added some spices which include ginger are consumed within 1-3 hours after being prepared.

During above mentioned different storage periods, the prepared medida become subjected to the microbiological, chemical and sensory changes with different levels. However, the contamination by different types of micro-organisms may be during the different steps of processing .The microbial contamination of medida could be soil, air, used water, bad handling and other sources.

On the other hand chemical contamination could be mainly from cooking vessels beside the other sources of contamination.

In general food and food products may transmit certain food poisoning by microorganisms that can lead to either food borne infection or toxification.

The first type of poisoning infection is caused after the growth of Salmonella, *Staphylococcus aureus*, Bacillus cereus, pathogenic *Escherichia coli* and the other pathogenic microbes. While the second type of infection of food poisoning

(infection) occurs when toxins are released as the microorganisms multiply (Pinger and Cooke 1985).

Therefore the primary goal of food service programs is to protect the consumers from any food contamination or at least to reduce the effect of any health hazard although it is difficult to prevent the contamination by different microorganisms which are found in every where (Monteny and Gould 1988).

This study was carried out to fulfill the following objectives:-

Main objective:

To determine the safety and nutritional value of medida (Sudanese thin porridges).

Specific objectives:

1. To study the microbiological properties of the Sudanese thin porridges.
2. To study the chemical composition of medida (the Sudanese thin porridges).

CHAPTER TOW

2. LITERATURE REVIEW

2.1. Thin porridge

The word medida comes from the Arabic madda, to extend medida, accordingly, means extensible or, in the food context, gelatinized.

Porridges in the Sudan are either aceda, ranged or medida, in decreasing order of stiffness. Any thin porridge that is freely flowing under gravity while still hot is traditionally called medida in the Sudan. In c1assical Arabic medida refers to forage or animal feed, and medida is water in which flour, sesame or barley has been strewn and is given to animals to drink (Gassim, 1985).

Raghida is a kind of porridge that falls between aceda and medida in thickness and in water content. It is fluid when hot but solid when cold. After cooking, it is spread all over the inner surface of a large container and left to solidify in this position. It is the food of shepherds and the more known among certain tribes such as the Reshayda of the east and the Hawawir of North Kordofan. Raghida is usually eaten with camel milk or sheep milk. The product and the name have almost gone into oblivion today and most Sudanese do not know either .Raghida is nothing more than a thick medida except it is sometimes cooked with sour milk and eaten with samin (Dirar, 1993).

Sudanese cereal thin porridge have stable flowing characteristics and meet the whole protein and energy requirements for infants and children aged 1-10years old (kabeir *et al*, 2004).

Fermented cereal porridge made from malted brown rice is a suitable food system for the delivery of *B. longum BB* 536 with a relatively stable shelf life (kabeir

et al., 2005). also it has found that development of fermented probiotic medida power from malted brown rice flour is possible employing suitable outlet temperature and heat adaptation (kabeir *et al*., 2009)

2.2. Medida preparation

Medida prepared from part of the dough destined for kissra and abreh sheets and then mixed with the mother dough to help produce thin breads is called mudded meaning extender , as it makes the dough more extensible .

In urban areas the word nasha is being increasingly used to replace the word medida for the same product. However, there is a newly emerging difference in the usage of the two words which clearly divide thin porridges into two categories.

2.1.2. Types of medida

The preparation of plain medida is very simple .Small quantity of sour or unfermented dough is mixed and boiled with continuous stirring in a large amount of water. However, there are various kinds of medida which have extra ingredients or additives combined with the dough. Moreover, the dough itself could be made from sorghum, millet or wheat flour. Standard ajin, damirga flour or jir may also be used in the preparation of medida.

More commonly medida is made from the cereal dough and a single additive the name of which is suffixed at the end of the word medida to give the final name of the specific porridge thus there is medida hilba (Fenugreek medida) , medida-aradeib (tamarind medida) etc. The list of additives is very large, including gamardin (apricot preserve), guddem (*Grewiatenax fruit*) mahareib- a scented grass (*Cymbopogonproximus*) garad (*AcuciArabica fruit*) (Culwick 1951), gunguleiss (*Adansoniadigitata fruit*), lalob or hijllij (*Balanitsaegyptiaca*) (Al-Tunisi, 1850 cited in Dirar,1993) . Various spices may also be added and these include cardamom, cinnamon, ginger and black pepper (Monawar and badi, 1987). Sugar is usually added as sweetener just before consumption of the porridge .The

nomads add either fresh milk or rob to medida just before consumption (Dirar, 1993).

It is noticed that most of these medida types especially those containing fruits or spices as additives are largely prepared for new mothers and even the word medida itself is becoming more and more linked to this category of target consumer (Dirar, 1993).

2.1.2.1. Medidat-hilba

The most famous of all medida types is medidat – hilba specifically prepared for nursing mothers, this fenugreek medida is mostly unfermented and prepared from wheat or millet flour. Although sorghum is not completely excluded these seems to be reluctance in using it for this particular medida.

In some areas, as in parts of the River Atbara (sorghum produsing), nursing mothers are prevented from eating any sorghum food during the first week after child birth; It is claimed than sorghum impedes the process of self-cleansing of the womb.

A similar belief exists as far south as the Acholi tribe of the Sudan – Uganda border ,Grove (1919) wrote that for three days after the birth of a girl (four days for a boy) in some villages of the Acholi, the mother may not eat sorghum porridge flavoured with aradeib (tamarind) fruit(Dirar,1993).

In the past fenugreek (*Trigonella foenim – graecum*) was boiled and its extract given to new mothers and to their babies. This is believed to increase the mother's milk production and help protect both mother and child against stomach problems, such as flatulence which is a common ailment of these women who are prevented from undue movement for about 40 days (Corafi, 1983; Shagaly and Salih, 1984). Similar beliefs also exist in neighboring Ethiopia (Aykroyd and Doughty, 1964) and Egypt (Elmadfa and Kuhl, 1976).

Fenugreek seeds are very rich in certain nutrients and they, no doubt, add to the nutritive value of medida. The seeds contain about 28.0%

crude protein, 5.3—8.5% fat, 48.5—53.2% carbohydrate. 9.2% crude fiber, 4.5% ash and 4.5% water (Beam, 1908; Henry, 1955; Corafi, 1983). The seeds also contain 6% lysine, expressed as per cent of protein (Axtell et aL, 1982) and are very rich in iron (Aykroyd and Doughty, 1964 cited in Dirar,1993). Hillba, or fenugreek, could possibly serve also as a source of niacin since it is believed that its content of trigonelline is converted to niacin when the seeds are roasted or cooked in tamarind juice (Rajalakshmi *et al.*, 1964 cited in Dirar,1993) as is commonly practiced in the Sudan.

The other fruits and seeds used as additives for the medida of nursing mothers (medidat-nafasa), tamarind, or aradeib, is the most commonly used. Unlike hilba, however, aradeib extract is added to medidas for other targeted consumers. Tamarind seems to be used widely in savannah Africa. For example, kunnu tzamia is a boiled porridge of ground millet and tamarind water made in West Africa (Muller, 1970) and (tuwo) is a thick porridge made from sorghum and tamarind water in Burkina Faso (Rooney and Murty, 1982).

2.1.2.2. Date medida

Nursing mothers are also given thick slurry of boiled and well-beaten date fruits called medidat-tamur (date medida). But this may contain no cereal or starchy material of any sort - only pure dates.

The major aim behind these enriched porridges for nursing mothers. Coupled with their prohibition from doing work, is to finally produce, after the prescribed 40 days, a fat woman. Such a woman would be able to summon enough energy to do her normal routine work in addition to the extra work created by the advent of the newborn. Here again, is another situation which indicates that calorie deficiency rather than protein deficiency is the main nutritional problem in these areas. To be fat is a blessing, here, not a curse. This might come as a surprise to most Europeans and Americans. In China a glutinous rice product, lao-chao, is given to nursing mothers to help them regain their normal strength (KO, 1982).

2.1.2.3. Agoud

This porridge is specially prepared for certain patients as a medicament about seven different kinds of spices are included in the batter for madida as additives.

The most frequently used of these spices are ginger, galangal (ghurunjal) cardamom, cinnamon, tamarind and cumin (shamar). The spices are washed dried and powdered before being added to the boiling medida.

Some women add the unground spices either free or tied in a small piece of clean cloth to the cooking medida. If needed, the medida may be strained before consumption particularly when unground, free spices are present (Dirar, 1993).

The primary characteristic of agoud, and one from which its name derives, is the prolonged boiling on low heat, to extract the spices. This kind of cooking is called agid and the final product is agoud. These words are used in other situations where prolonged boiling and extraction are used. For example, when sugar and water are boiled for long and stirred until brown syrup is obtained, the sugar is said to have become agoud. Similarly, in the past a certain poison probably from snake glands, was obtained by prolonged boiling and was called agoud-el-sim. The Nigerian word agidi, a cooked stiff ogi jelly (Kuboye, 1985), may have the same origin.

Agoud medida is given to patients suffering from stomach troubles, particularly nausea caused by malaria or by prolonged hunger. Agoud is more commonly used in the Ga"alin area around the town of Shendi in the Northern Region .In the Cezira area of the Central Region the name agoud is given to any kind of medida (Dirar, 1993).

2.1.2.4. Ajinat-Um-ginger

A similarly spiced medida, called ajinat-Um-ginger, is prepared from millet cooked with sour milk (rob) and an assortment of spices which include ginger, cinnamon, cardamom and black cumin. The medida thus prepared is given to Ramadan fasters as part of their evening breakfast time, perhaps after adding a little sugar (Dirar, 1993).

2.1.2.5. Nasha

As mentioned above, the word nasha has largely replaced the word medida in urban areas. Lately, however, a new tendency assigns the words nasha and medida to two different types of thin porridge. Generally speaking nasha denotes a thin and refined medida that is prepared in particular for the sick and the fasting. Normally, if an additive is at all required, it is just a dash to give flavour. Medida, on the other hand, is not refined, has large amounts of the additive ingredient and is mostly associated with new mothers. In addition, nasha seems to denote more a fermented porridge while medida may either be fermented or unfermented (Dirar, 1993).

Although the name of this thin porridge is in the literature as nasha It would be more accurately written as nasha or nashat ‘the word comes from the Arabic nisha, meaning starch, and this is, no doubt, the reason why El-Gendy (1983), writing about the fermented foods of Egypt and the Sudan, gave the name ‘starch’ to the product, instead of the original name nasha. As shall shortly be seen, nasha is not made from pure starch. ‘The Sudanese word for pure starch, as given above, is jir. The word nisha, for starch, probably first entered the Sudan with the Turko-Egyptian army of 1821 or with the Anglo-Egyptian army of 1898. The word spread across sthe country through the mediation of the Sudanese soldiers enlisted in these armies. Starch was and still is used to size military khaki outfits to give them firmness (Dirar.1993).

2.1.2.5.1. Nasha preparation

Perhaps the primary difference between nasha and medida should be taken as the difference between two methods of thin porridge preparation: the one involving decantation and the one that does not. The best thin and refined nasha is that produced via a method of decantation. Traditionally, the standard fermented ajin produced by the quern method is the starting material for this kind of nasha. Three parts of water are added to one part of the stiff dough and mixed with the hand until it forms slurry. The aim is to dissolve as much of the constituents of the ajin as possible. The suspension is now left to stand without disturbance, in a few minutes the coarser particles settle to the bottom of the container. Very gently, the supernatant. Is decanted into another clean container, the supernatant is again left to stand, this time for a longer period. A second decantation is then carried out very carefully. The process is repeated until practically no more precipitate forms.

Nasha is made from the final supernatant, i.e. from the extract of ajin. about three parts of the original four of the suspension are recovered as supernatant extract to be turned into nasha by cooking while continuously stirring. The consistency of the product is adjusted by either adding a little more water or by evaporating off excess water by heating for a longer period (Dirar. 1993).

Nasha produced in this manner is of top quality, often described ‘as smooth as bone marrow’. The decantation process together with the preparation of ajin by the stone quern take plenty of time and nowadays many women in the cities use flour prepared by modern milling and strain, rather than decant, the batter for nasha. The final product is never ‘as smooth as’ bone marrow’, and the irritating grittiness can be felt in the throat. Some women circumvent this problem by using bleached, wheat flour which gives a smooth nasha but, somehow, never identical to the sorghum or millet product (Dirar, 1993).

Although nasha prepared in this way is typically made from pure cereal, sometimes clear extracts of either huln-mur or tamarind may be added.

Both of these additives are sour and so augment the usually slightly sour taste of plain nasha, and impart a brownish colour to the porridge.

2.1.2.6 Millet medida

Millet flour, fermented milk and sugar were well mixed and cooked and a little amount of hot water was added to millet flour and blended with the blender. After that small added some amount of boiled water to be added the mix true and blended until we get a thick texture. The pan then taken off the fire and millet medida served hot.

2.2. Nutritional aspects of thin porridges

Nasha and medida belong to the family of sour, nonalcoholic, thin porridges, so widely known in Africa. Only little has been written about these food-beverages and, with the possible exception of ogi and mahewu, those products mentioned in the literature have hardly been discussed in depth.

With respect to the method of preparation, uji of Kenya is probably the nearest of the African porridges to medida of the Sudan. In its preparation, the fermented maize dough is diluted, cooked, sweetened and consumed, apparently in liquid form (Mbugua, 1987).

In West Africa the best documented sour, thin porridge related to nasha is ogi porridge, prepared from various grains, including sorghum (Muller, 1970; Banigo and Muller, 1972). However, a basic difference in the preparation of these two thin porridges is that while ogi is prepared from the precipitated corn starch, nasha is made from the supernatant or extract of cereal dough.

About three sour, thin porridges have been reported to exist in South Africa: mahewu (magou), letting and .mdogo (metogo) (Golberg and Thorp, 1946; Quiz,. 1964; Novellie, 1982), of these reports on Bantu nonalcoholic drinks, Mahewu is the best. Mahewu differs in its preparation from medida and nasha in that it is

made from two cereals, mainly maize and a little wheat. It is fermented after boiling and its fermentation takes a longer time (20-36 hours).

The above discussed African thin porridges are not prepared by decantation procedure and are, therefore, more related to medida than to nasha.

The African thin porridges are all consumed by healthy adults as daily foods. Mahewu, for example, is industrialized and is used to feed strong adults such as mine and factory workers (Schweigart and Fellingham, 1963; Novellie, 1982). Ogi is considered both as a breakfast for adults and as a weaning food for children.

Nasha and medida are traditionally prepared for three major target groups: the sick, the fasting and the nursing mother. Healthy adults or children are never seen consuming nasha, or medida under normal conditions. Sick or convalescent persons (typically malaria patients) have nasha or medida as the standard nourishment. An official report issued by the Ministry of Health, Khartoum (Welcome Chemical laboratories, 1967 cited in Dirar,1993), on folk medicine, described medida as the 'invalid gruel made from feterita sorghum. It is claimed that while other foods are rejected by nauseated stomachs, nasha holds on tenaceously and may even reduce tendencies to vomit.

In the Muslim fasting month of Ramadan a person refrains from eating and drinking for about 14 hours each day for 29 or 30 days. A standard item in the evening breakfast is nasha or medida, normally consumed warm. An empty stomach is treated like a sick one and is given nasha which stays there and at the same time satiates hunger and quenches thirst.

A rare use of medida is to be found among the very poor families, particularly among the nomadic Hadendowa of eastern Sudan. Medida is used here as a sauce to dress aceda. In essence, a stiff porridge is eaten with a thin porridge. Naturally no extra nutritional value is gained but the thin porridge is

simply used to break the monotony of using pure water to dress the dumpling. The one function of either water or medida here is to lubricate the aceda morsels to be swallowed. Anderson (1911 cited in Dirar,1993) described a similar use of medida (containing sesame oil in addition to sorghum) among the Nyam-Nyam and Gour tribes of Bahr El Ghazal,

The decantation procedure followed in the preparation of the best kind of nasha takes into the product all the solubles in the fermented sorghum dough in addition to the very fine suspendables and colloidal particles.

What is left behind as a precipitate depends both in quantity and quality on the type of milling originally followed in the preparation of the dough.

Women have noticed that in the case of murhaka aajin the precipitate consists mainly of relatively large, flat fragments of the skin of the grain.

Indicating that the milling process has produced a very fine dough. In the case of flour produced with the modern mill the precipitate consists visibly of coarse flour particles.

The scanty research carried out to date on nasha does not concern itself with the product made by decantation, but with nasha produced from sieved or unsaved batter, so that the product may actually be categorized as medida.

Chemical analyses of dabar nasha (medida) showed that the product contained 95% water. 3.2% starch. 1.3% crude protein, 0.3% crude fibre,0.4% ash, 0.2% fat and 230 calories per 100g (Manawar, 1983; Manawar and Badi, 1987).

The only comprehensive feeding trials research conducted on nasha(medida) is that carried out by Graham *etaI*. (1986). Then nasha used in these nutritional studies was prepared in the following way. One kilogram of whole sorghum flour (including a 10% ajin starter) was fermented in 18 litres of water at 30^0 C for 12 hours. After fermentation, the batter was slowly added to 9.3 liters of boiling water while stirring continuously.

Cooking was carried out for 3-5 minutes on low heat until the mixture became thick. The porridge was then freeze dried (apparently for research convenience). For feeding trials, the calculated amount of nasha was placed in a pot and just covered with water. This was then heated to boiling and maintained thus for 10 minutes after which period the product was ready for the tests.

In the feeding trials the nasha thus prepared was fed to convalescent malnourished infants and small children. The results obtained showed that the apparent absorption of protein (even when nasha was supplemented with lysine) was significantly less than that from a casein diet (73—74% vs.85—86%). Apparent retentions of nitrogen from nasha (26%) were significantly lower than those from lysine-supplemented nasha (34%) and casein diets (35—49%).

Nevertheless, the authors (Graham *et al.*, 1986) stated that their studies not surprisingly indicated that a traditional Sudanese fermentation technique markedly enhanced protein and energy digestibility's of a mixture of two whole-grain sorghum flours (one of which has previously been shown to be very poorly digested by infants and children). The authors went on to say that the apparent retentions of nitrogen from nasha without supplemented lysine ‘were impressive’ and supplementation increased them by approximately 30%.

2.1.4 Porridges and child weaning

In the words of MacLean *et aI.* (1983), feeding the weaned infant remains the single most difficult nutritional problem facing the developing nations.

In Africa, babies are usually weaned on sour paps, or where milk is available, on soured milks (Novellie, 1982). In Kigezi, Uganda, millet is germinated, ground and allowed to undergo a slight fermentation before it is given as gruel to children (Burgess, 1962 cited in Dirar,1993). In West Africa, the sour porridges ogi and koko are used as weaning foods (Banigo and Muller1972; Anda and Muller, 1973).

2.1.5 Feeding the weaned infants in the Sudan

It is perhaps because paps are used as '.weaning foods in Africa that some authors think nasha is primarily used in the Sudan as a weaning food (Monawar, 1983; Graham *et al*., 1986; Monawar and Badi, 1987).

This stand, however, has, of late, been corrected and nasha is being looked at as a possible base for a new weaning food recipe (Karles and Monawar, 1989). It is true, however, that some families in Khartoum city use fortified nasha to wean babies, but this is by no means a traditional practice and is certainly a new development.

Nasha has never been considered a weaning food at anytime, anywhere in the Sudan. As is also true for neighboring Egypt (Ruck, 1983), there is no special weaning food in the Sudan. This has been noticed by previous writers on nutrition in the Sudan, Culwick (1955 cited in Dirar, 1993), working in the Gezira area, stated, 'This was the first time I had encountered a community which made on pap and other soft foods especially for its babies'. Similarly, Shazali (1973) wrote that although there were many Sudanese food preparations, there was no special food or separate cooking for children.

Of course, infants in the Sudan, as is also the case elsewhere, are weaned and they are fed. However, the foods on which children are weaned here are certain foods that are also normally consumed by adults; in fact they are the two staples of the country - milk and aceda.

Unlike the case with most African countries, milk in the Sudan is a staple for many tribes. Paul (1950 cited in Dirar, 1993) mentioned that the staple diet of the Hillman among the Beni Amer of eastern Sudan is milk. The staple food of the Beirs of south eastern Sudan is the traditional milk and blood (Collins, 1960 cited in Dirar, 1993).

Milk is the most important food of the Missairiya Humur of Kordofan (Cunnison, 1954), and the Baggara tribes, in general, largely live on milk (Reid, 1930 cited in Dirar, 1993). McLean (1985) stated that in the Sudan milk was an important part of the rural diet. The author estimated that in 1984 the average family in Northern Kordofan possessed 52 heads of livestock.

Babies in the Sudan are weaned mainly on fresh milk, primarily unboiled raw milk. Boiled milk is sometimes kept to feed the child during the daytime but this is not the general practice. Milk is fed normally in the evening when the animals are back from grazing and in the early morning before the animals leave for the grazing land. Although sour milk is given to weaned babies, this is not common. Goat's milk is the milk of choice for feeding a' weaned baby or an orphaned infant. A general practice is to keep a goat in the house to feed a baby, particularly an infant whose mother has died before it has been weaned. The goat in this case is milked three or four times a day (Dirar 1993).

In connection with this, the system of maniha, so widespread in the Sudan, should be mentioned. Maniha is a lactating goat, sheep or cow given temporarily to a family with a child that needs milk. When the animal is dry and provides no more milk, it is replaced with another in milk. Evans-Pritchard (1937 cited in Dirar, 1993) mentioned that the Nuer family could generally obtain milk for the little child because a kinsman would lend a lactating cow or give them part of its milk if they did not themselves possess a cow in the lactating period. This practice was and still is one of the most important obligations of kinship throughout the Sudan. It is not only the Nilotic tribes such as the Nuer who practice this social obligation but also all the animal-owning Arab tribes of the north. The word maniha itself is Arabic for 'donated' (Dirar1993).

Not all African countries are endowed with a substantial animal wealth as are the Sudan and Ethiopia, For example. It seems that those African countries that wean their children on cereal paps are the ones which have no such large numbers

of livestock. In West Africa, for instance Ghana, until recently, only a limited amount of milk was produced locally and neither the goat nor the sheep was used as a source of milk (Aylward, 1961 cited in Dirar, 1993).

Feeding the weaned child in the Sudan depends equally on the availability of milk and sorghum or millet. As mentioned above, milk is mainly given to the child in the evenings and in the morning. during the daytime, the major nourishment of the child comes from aceda combined with mullah shermout, a sauce containing fermented dry meat and dry okra powder among other ingredients, such as oil, onions and salt. This dish, aceda-bimulah, is the staple for most of rural Sudan. Traditionally, the aceda is made from murhaka ajin (quern stone fermented dough), and it must be emphasized that kissra sheets are generally not smooth enough to be given to weaned babies. Acada is very smooth and has about 80% water; whereas kissra is not as smooth and has 50% water (Dirar 1993).

The smoothness of aceda is augmented by the mucoid weika (dry okra powder) of mulah shermout. When old ‘women say a1layug-bezid-aItayug (mucilage held’s develop the brain), they mean that the mucilaginous okra sauce helps the little child take in as much aceda and meat as possible as these slip down the throat very easily. It is always the practice to encourage the child to take in more food, particularly aceda made from feterita sorghum (Dirar 1993).

In trying to assess the effectiveness of these weaning systems, it should not be forgotten that in rural Sudan the weaning age is usually two years, not earlier. This has been clearly stipulated by the holy Koran. Among the nomads, it seems, children are weaned even later than the age of two. It is not uncommon to see a child play with its peers and then run back to its mother to suckle, with mouth full of teeth. This delayed weaning practice has led to the exaggeration that the boy would ‘wrestle his mother down to suckle’. Of course some women use the prolonged suckling as an expedient to control birth. Such a child drinks milk and eats aceda at the same time that it is suckling.

In summary, most Sudanese people believed that enough milk and aceda (made from murhaka ajin and consumed with a meat-containing sauce) are available, and then the weaning stage can he passed successfully (Dirar 1993).

The nutritional value of milk is unquestionable but the use of sorghum aceda as nourishment for both child and adult has been debated locally and internationally, particularly by the elite. The simple Sudanese who has been thriving on sorghum for thousands of years has no doubt about its nutritional value. A clinical survey carried out in 'Khartoum Teaching Hospital (paediat-rics section) showed that all children studied, who were suffering from malnutrition, depended mainly on kisra and aceda as a source of energy and for growth (El-Mahdi, 1985). Dundas and Futrell (1986) reported that all children in Um Sagata (a refugee camp) were malnourished and only3% of the children in Oliab and Nuba villages, near Khartoum. were normal. The authors found that 47% of the mothers in Oliab believed that kiesra and aceda were good weaning foods while 67% of them said these foods' were not good for babies.

It should be mentioned that the above nutritional survey (Dundas and Futrell, 1986) was carried out in the period September 1983 to March 1984, in the midst of the famous famine year. Many families had been receiving donated foods and many would have liked more of them, and in order to get more they would rather say their foods were either not good or were insufficient. Moreover, the proximity of the village to Khartoum must have definite influence on the attitudes of these villagers, especially young mothers, towards sorghum foods. A similar survey to be carried out in a good crop year, out in deep rural Sudan, might give a different picture about the nutritive value of aceda.

Yousif and Khattab (1967 cited in Dirar,1993) carried out a nutritional and clinical examination of children in Hag Yousif village, near Khartoum, and found that 22% of them suffered from deficiencies in the vitamins C, A and B complex. The authors, who noticed that all the people of the village ate sorghum as a staple,

concluded that had it not been for the high level of protein in sorghum, more cases of malnutrition among infants would have been found' (Dirar 1993).

In some reports, written by both Sudanese and non-Sudanese, concerning the nutritive value of sorghum foods, one can read an unfounded or hasty incrimination of these foods between the lines. The bias against sorghum seems to be very strong both inside the Sudan (in the cities) and outside the Sudan. The story of Mr. Troupe, the Swiss missionary doctor of Omdurman town, in the 1950s, became very famous as a proof of this bias. The doctor used to tell everybody with a stomach problem who frequented his infirmary that the cause of his ailment was the consumption of kissra. On the other hand, in the late 1980s, a European woman doctor, affiliated with the British non-governmental organization Christian Outreach in Khashm El Girba, in the east,became famous for recommending aceda and mullah shermout for feeding children as a measure against malnutrition (Dirar 1993).

It is clear that a thorough study of the existing systems of child weaning and child feeding in the Sudan should be well grasped first before any incrimination or praise be assigned to them. The stigma that may accompany foods due to hasty assessment may prove difficult to erase (Dirar 1993).

Traditional nasha is low in protein, fat and calories but high in moisture. Its dry matter content (5%) is below the recommended dietary allowance for children, which is 15—18% (Monawar and Badi, 1987). It is therefore logical that the Sudanese do not use nasha as a weaning food. Its high water content and relatively high ash content is more suitable for Ramadan fasters and vomiting malaria patients who are subjected to dehydration.

On the other hand, aceda with about 20% dry matter and a gravy containing dry powdered meat is more suitable for feeding a baby, especially if the aceda is very smooth. Graham et al. (1986) found nasha to be satisfactory weaning food when supplemented with relatively small amounts of lysine-rich foods such as milk, fish

or legumes. Clearly, the authors came very close to recommending aceda and mullah shermout as weaning food. Aceda has a higher total solids and lysine is supplemented by the dry meat or the other ingredients of the sauce such as milk, fish or lubia. It would be interesting to find out the performance of this traditional Sudanese weaning recipe in experiments carried out in a way similar to that followed by Graham *et al*. (1986), especially when the dough from which aceda is made is prepared from feterita sorghum milled in the traditional murhaka manner. The human subjects used in such experiments should be traditional sorghum eaters (Dirar 1993).

2.1.6 Attempts at developing new baby foods

In recent years a disruption in the traditional weaning system has occurred.

In rural areas, the problems of drought and desertification led to a scarcity in both milk and sorghum or millet. Large sectors of the rural populations migrated to the cities in search of food as they lost their livestock and crops. In their new habitat they were given cereals usually milled by modern mills. The wet milling system using the quern was immediately dropped. Children had to eat aceda made from dry-milled flour, a gritty product that passes through the young stomach to finally give conspicuously gritty excreta. Even worse, these families under the social pressures of the urban community changed their food from aceda to kissra which the children had no choice but to eat. The difference in smoothness between aceda and kissra is readily demonstrable by suspending each in water to make a moss (Dirar 1993).

Milk had to be bought at increasingly high prices in the city. Even if the family could buy milk the weaned child could never dream of getting the quantity it was used to out in the country when conditions were better.

One more unspoken choice is the ready-made weaning or baby food available in the market. All ready-made baby foods of the country are imported commodities of Western or other external sources. Because they are very expensive, these foods

serve only a small slice of rich people. As is also true for other developing countries (Cameron and Hofvander, 1974).

When poor families try to buy these baby foods, the scarce house hold financial resources become depleted, leading to tragic consequences to the infant population (Stanton, 1988).

The development of an inexpensive baby food recipe that poor families can afford to buy is becoming more and more necessity. It seems logical to start research in this area by assessing all the traditional baby foods of the country and to use these foods as a launching pad for such an Endeavour, instead of introducing a wholly new recipe the ingredients of which might not be locally available. After all, traditional baby foods might not altogether useless. For instance, an assessment of the Pakistani home-made weaning foods revealed that these foods were not bad at all, compared to commercial, imported foods, and that some of them made quite a good basis for a local formula (Khan and Sattar, 1983).

In the Sudan, the Food Research Centre at Shambat tried to develop an instant, nutritious nasha containing 17% total solids, to be used as weaning food. In order to lower the ‘viscosity of the porridge caused by the high solids content, 15-30% barley malt or 0.1% enzyme were included in the recipe. Further, to improve the nutritional status of the food, O.4% synthetic lysine and 20% Full-cream or skimmed milk powder were found suitable (Monawar, 1983; Monawar and Badi, 1987).

The recipe, naturally, did not meet with any success since most of its ingredients, i.e. the lysine, the enzyme, the barley malt and the powdered milk, were all imported ingredients. It is imperative that local material be used in developing such a food. For example, when the Koreans incorporated lysine into the gelatinized wheat product called milssal, the practice made ‘sense because lysine was produced locally in Korea (Kwon *et al.*, 1974).

If milk is available in any form in the Sudan, it is better to give it to children as it is, without incorporating it into nasha. However, if the protein source is non-conventional then it becomes logical incorporate it into a food that is, both well liked and consumed daily, to ensure its intake. A good example is the fortification of mahewu, a thin porridge taken daily by laborers in South Africa. The porridge has been experimentally harnessed as a vehicle to supply the workers with additional protein in the form of whey protein soy flour food yeast fish meal and ground-nut flour as well as skimmed milk powder. Schweigart and Fellingham (1963 cited in Dirar, 1993) pointed out that if milk and soured milk products were available and cheap there was no need for the fortification of mahewu.

Dundas and futrell (1986) proposed a recipe for a weaning food for Sudanese infants. The food had a chemical score for the most limiting amino acids (methionine and cysteine) of 89% and provided 25g of protein and met ‘the amino acid requirements for a child. The recipe was made up of 100 g sorghum flour and 50g lentils. The authors hoped that their recipe might help alleviate the problem of the weaning food ‘since the ingredients are inexpensive, nutritious and available’. However, lentils are imported and the cost of one kilogram was 1.0 Sudanese pound (SL) in 1983, SL 1.5in 1986, SL 9.0 in 1988, being obtained only from the black market through secret mediators, and by 1990 the Salvation Government decreed that lentils could only be obtained by paying hard currency to its duty free shops, so that only a small stratum of the population could enjoy the now precious product. Economic changes in a least developed country, like the Sudan, are absolutely unpredictable; nevertheless. when a food recipe is based on locally produced materials it stands better chances of success.

A possible substitute or lentils in the above recipe is lubia *(Vigna anguiculata)* which is widely produced in rain-fed areas of the country. The composition of lubia, as Beam (1906 cited in Dirar, 1993) has pointed out, is

almost identical to that of lentils. If lentils or ‹Lubia are available, however it is likely that people would prefer to give them to children either as soups to drink or as a dressing for aceda, to encourage them to take more of the latter.

A dehydrated, fortified baby food based on nasha does not seem to be hard to develop. Nasha has been drum dried experimentally but no further developments have taken place. African products akin to nasha have been dehydrating in form of convenience powders. Examples of such products include mahewu (Schweigart and Filingham, 1963 cited in Dirar, 1993) and ogi (Adeniji and Potter, 1978).

CHAPTER THREE
MATERIALS AND METHODES

3.1 Materials

Samples of Date, Um ginger and Millet Madida used in this study were obtained from Khartoum, Khartoum North and Omdurman towns. The samples were carefully kept in cold tightly closed containers until needed for the different investigations. Three replicates were conducted for each analysis.

3.2 Methods

3.2.1 Chemical methods

3.2.1.1 Moisture content

The moisture content in each sample was determined following the standard method described by the AOAC (2003).

Two grams of well mixed sample was weighed accurately in cleaned, dried Petri dishes using a sensitive balance (Item No: AR2140 Made for OHAC, S CORO. USA). Then, the samples were placed in an oven (Carblite, sheffield, England) at 105˚C for five hours. After that the Petri dishes were transferred to a desiccator and re -weighing after cooling to room temperature. Again, the dishes were transferred to the oven and weighed after two hours and this was repeated till a constant weight was obtained. Then, the moisture content as percent was calculated as the loss in weight after drying:

$$\text{Moisture content (\%)} = \frac{(Ws - Wd)\ 100\%}{\text{Sample weight (g)}}$$

Ws = weight of sample before drying.

Wd = weight of sample after drying.

3.2.1.2 Protein content

The crude protein content in the sample was determined by the micro-Kjeldahl method following the method of AOAC (2003).

Principle:

Madida samples were digested with a strong sulphuric acid so that the sample releases its nitrogen content which can be determined by a suitable titration technique. A conversion factor of 6.25 (equivalent to 16 g nitrogen per 100 grams of protein) was used in this method to calculate the sample protein content. The kjeldahl method is divided into three steps which can be summarized under the following:

A) Digestion

The Madida sample (0.2grams) was transferred into a digestion flask and heated for 2-3 hours in (3.5N) sulphuric acid. The digestion process was catalyzed by a mixture 0.4 of 10 parts K_2SO_4 to one part of $CuSo_4$. The heating was continued till the black colour turned to pale blue and the fumes disappeared which indicate that the digestion process was completed.

B) Distillation

After the digestion has been completed the digestion flask was cooled and transferred to a distillation unit using a minimum volume of water. The solution in the distillation unit was then turned alkaline by addition of 20 ml of sodium hydroxide (40%) to release the ammonia. Then, the released ammonia was distilled

into 20 ml of 2% boric acid in a conical flask with 2 to 3 drops of bromochresol methyl red as indicator.

C) Titration

The nitrogen content in the sample was then estimated by titration of the ammonium borate formed with a standard hydrochloric acid (0.1N). The titrations continued till the colour of the solution turned to red (pink). The following formula was used to determine the protein concentration as percenage

$$\% \text{ Crude Protein} = \frac{(TV \times N \times 14.00 \times F)\ 100\%}{1000 \times \text{sample weight (g)}}$$

Where:

TV: actual volume of HCL used for sample titration (ml HCL – ml blank).

N: normality of HCL.

F: protein conversion factor = 6.25

3.2.1.3 Fat content

The sample oil content was determined by using a continuous extraction apparatus (Soxhlet type), as described by Pearson, (1970). About five grams (5 ± 1) samples were weighed and transferred to an extraction thimble covered with a piece of glass wool and then placed in the soxhlet apparatus. After that, the solvent (petroleum ether) was added into a dried weighted Soxhlet flask and the extraction process continued for about six hours. Then, the oil sample was dried in an oven (Carblite, sheffield, England) for a 30 minutes to eliminate any remaining amounts

of the solvent and the flask was reweighted. The fat percent was calculated by using the following equation:

$$\% \text{ Crude fat} = \frac{(W2 - W1)\ 100\%}{\text{Sample weight (g)}}$$

Where**:**

W1=weight of the empty Soxhlet flask (g).

W2=weight of Soxhlet flask with oil content (g).

3.2.1.4 Carbohydrates content

The total carbohydrates as percent were calculated by difference as described by West *et. al*. (1988).

3.2.1.5 Fibre content

The crude fibre was determined according to the AOAC (2003). About two grams sample were weighed and two hundred (200) ml of sulphuric acid (0.26N) were added, boiled for 30 minutes and then filtered. The residue was washed three times using hot water and after that 200 ml of NaOH was added, boiled again for 30 minutes and filtered. Then, the residue was carefully washed three times with hot water until it was free from alkali. After that, the sample was transferred to an oven (Carblite, sheffield, England) at 105° C (overnight) and reweighed. The residue was ached in a muffle furnace (LEF- 103S, watts: 2KW10A serial no: 07033002, Korea) at 550° C for three hours till a light gray ash was formed and a constant weight was obtained. Then, the total crude fiber per-cent was calculated using the following equation:

$$\text{Crude fibre } \% = \frac{(W_1 - W2)\ 100\%}{\text{Sample weight (g)}}$$

Where:

W_1 = weight of the sample before ignition (g).

W_2 = weight of sample after ignition (g).

3.2.1.6 Ash content

The ash content of the sample was determined according to AOAC (2003). The empty crucibles were accurately weighed and then two grams of madida were transferred to each crucible using a sensitive balance. Then, the crucibles and their content were placed in a muffle furnace (LEF- 103S, watts: 2KW10A serial no: 07033002, Korea) at 550◦ to 700◦ C for more than 6 hours until white to grey ash was obtained. After that, the crucibles were transferred from the furnace to a desiccator to cool to room temperature and re-weighed. The ash content was calculated by using the following equation:

$$\text{Ash content (\%)} = \frac{(W_1 - W_2)\ 100\%}{\text{Sample weight (g)}}$$

Where:

W_1 = weight of crucible with the remaining ashed sample (g).

W_2 = weight of the empty crucible (g).

3.2.2 Microbiological methods

The microbiological analysis of medida was determined as follows:

3.2.2.1 Preparation and sterilization of glass wares

All glassware used were soaked overnight in tap water and Soap then washed in running tab water and allowed to dry. Pipettes were plugged with cotton wool and put in canister; also Petri dishes were placed in Petri dishes cans. Sterilization was done in an oven at 160°C for 3 hours.

3.2.2.2 Preparation of Plate count agar (PCA) medium

Plate count agar was prepared by suspending 23.5gm of plate count agar base (M091)in 1000ml distilled water, and boiled to dissolve the ingredients completely, and sterilized in an autoclave at 121°C for 15 min.

3.2.2.3 Preparation of McConkey broth medium

McConkey broth was prepared by suspending 40gm of Scharlau McConkey broth in 1000 distilled water and distributed in test tubes, then sterilized in an autoclave at 121°C for 15 min.

3.2.2.4 Brilliant green bile broth medium

brilliant green bile broth was prepared by suspending 40gm of Oxoid limited, London, ES19HF in 1000ml distilled water, well mixed distributed in fermentation tubes and sterilized in an autoclave at 121°C for 15min.

3.2.2.5 Potato dextrose agar medium

Potato dextrose agar was prepared by dissolving 39 gm in 1000 ml distilled water, boiled to dissolve the ingredients completely, sterilized in an autoclave at 121°C for 15 min, cooled to 50°C and poured into sterile Petri dishs.

3.2.2.6 *Staphylococcus* medium No.110 (oxoid)

Staphylococcus medium No.110 was prepared by dissolving 105 gm in 1000 ml distilled water, steamed to dissolve completely, sterilized in an autoclave at 121°C for 15min.

3.2.2.7 Bismuth sulphite agar medium

Bismuth sulphite agar was prepared by dissolving 52gm of dehydrate Bismuth sulphite agar in 1000 ml distilled water, steamed to dissolve completely, sterilized by boiling in water bath at 100°C for 10 minutes.

3.2.2.8 Preparation of sample dilution

The samples were taken aseptically and weighed in sterile stomacher bags. Ten gm of medida was added to warm 90 ml distilled water and blended by the stomacher for two minutes. One ml of the bag contents was pipetted into separate tubes containing 9 ml of peptone water; the liquids were then mixed carefully by aspirating 10 times with a sterile pipette. With the same pipette one ml was transferred to another dilution tube containing 9 ml of peptone water, and mixed with fresh pipette. Serial dilutions of 10^{10} were obtained by repeating the steps of mixing and transferring.

3.2.2.9 Total bacterial viable count method

One ml of the suitable dilution was transferred aseptically into sterile petri dishes immediately and 15 ml of the melted agar medium that cooled to 45°C were poured into petri dishe. Aliquots were mixed with agar medium and allowed to solidify. When medium was solidified, the dishes were inverted and incubated at 37°C for 48hr. Plates were examined and the colonies were counted as colony forming units per ml (cfu/ml) (Harrigan,1998).

3.2.2.10 Coliform count method

3.2.2.10.1 Presumptive test for coliforms

1ml of each of three first dilutions (10^{-1}, 10^{-2}. and10^{-3}) was inoculated in triplicates of 9ml of Mac Conkey broth in test tubes with Duraham tubes. Then the tubes were incubated at 37°C for 48 hour .the production of acid together with sufficient gas to fill the concave of the Duraham tubes is recorded as positive presumptive test(Harrigan,1998),

3.2.2.10.2 Confirmed test for coliforms

A fermentation tube of brilliant green 2% broth was inoculated by using sterile loop from every showing positive result in presumptive test. Then the tube were incubated at 37°C for 48 hours the most probable number of total coliform (MPN) was recorded by using the table of the most probable number from the combination of positive and negatives tube Harrigan,1998).

3.2.2.11 *Staphylococcus* count method

One ml from the suitable dilution was transferred aseptically into sterile Petri dishes immediately and 15 ml of staphylococcus medium No.110 was added. Aliquots were mixed with agar medium and allowed to solidify. Plates were then incubated at 37°C for 48 hours and count was expressed as colony forming units (cfu/g) (Harrigan, 1998).

3.2.2.12 Yeasts and moulds count method

A sample 0.1 ml from suitable dilution was pipette on to sterile Petri dish containing 15 ml solidified potato dextrose agar (PDA). The Petri dishes were incubated at 28°C for 2-3 days. All colonies were counted by using a colony counter. The number of yeasts and moulds were computed per gram

by multiplying the reciprocal of the dilution used as colony forming unit (log_{10} cfu/g) (Harrigan, 1998).

3.2.2.13 Presence of *Salmonella* method

Ten ml of sample were added to conical flask (100ml) of sterile Nutrient Broth and incubated at 37°C for 24 hours. A loop full of 24 hours incubated Nutrient Broth was transferred aseptically into serilized selenie cystine broth and incubated at 37°C for 24 hours. A loop full of 24 hours inoculums was streak – plated on Bismuth sulphite agar surface and incubated at 37^0C for 24-----72 hours.

Black metallic shine discrete colonies indicated the presence of Salmonella.

A confirmatory test was carried out by taking a discrete black shine colony and sub culturing it in triple sugar iron agar tube. After incubation 37ºC for 24hours the production of a black color at the bottom of the tube confirmed the presence of the *Salmonella* (Hrrigan, 1998).

3.2.2.14 *E. coli* method

A fermentation tube of *E .Coli* was inoculated from every tube showing positive result in the presumptive test .the tubes were incubated in water bath at 44.5°C for 4 hours. The presence of *E.Coli* was recorded. For further confirmation of *E. Coli* test a plate of Eosin Methylene Blue A gar (EMB)agar was aseptically inoculated by streaking from a tube of *E .coli* broth showing positive result .The plates were incubated at 37°C for 48 hours .Colonies with metallic green sheen showing a positive result (Harrigan,1998).

3.3 Statistical analysis

The data obtained in this study were subjected to statistical analysis by using the Statistical Package for Social Science (SPSS). Mean values were obtained by

the Analysis of Variation (ANOVA). Probability of 5% was used to indicate the significances according to Duncan's Multiple Range Test (DMRT) as described by (Mead and Gurnow, 1983).

CHAPTER FOUR

RESULTS AND DISCUSSION

4.1Chemical properties

4.1.1Moisture content

Table (1) and appendix (1) show the moisture contents of different medida types. The moisture content of Um ginger medida from Khartoum North, Omdurman and Khartoum were 67.57%, 65.45% and 63.83% respectively. While Date medida from Khartoum North, Omdurman and Khartoum were 64.48%, 63.09% and 67.19% respectively. and Millet medida from Khartoum North, Omdurman and Khartoum were 67.48%, 65.22%, and 66.98% respectively. These results were different to Monawar and Badi (1987) who reported that the moisture content of Nasha was 95%.

4.1.2Ash content

Table (2) and appendix (2) show the ash contents of different medida types. The ash content of Um ginger medida from Khartoum North, Omdurman and Khartoum were 0.8%, 0.6% and 0.4% respectively. While Date medida from Khartoum North, Omdurman and Khartoum were 0.5%, 0.4% and 0.3% respectively. and Millet medida from Khartoum North, Omdurman and Khartoum were 0.5%, 0.5%, and 0.4% respectively. These results were in agreement to Monawar and Badi (1987) who reported that the Ash content of Nasha was 0.4%. .

4.1.3 Protein content

Table (3) and appendix (3) show the protein content of different medida types. The protein content of um ginger medida from Khartoum North, Omdurman and Khartoum were 3.5%, 1.5% and 1.8% respectively. While Date medida from Khartoum North, Omdurman and Khartoum were 0.8%, 0.3% and 0.4% respectively. and Millet medida from Khartoum North, Omdurman and Khartoum were 1.8%, 2.0%, and 1.5% respectively .These Results were near to Monawar and Badi (1987) who reported that the protein content of Nasha was 1.3%.

4.1.5 Fibre content

Table (4) and appendix (4) show the fibre content of different medida types. The fibre content of Um ginger medida from Khartoum North, Omdurman and Khartoum were 0.6%, 0.3% and 0.2% respectively. While Date medida from Khartoum North, Omdurman and Khartoum were 0.3%, 0.2% and 0.3% respectively. and Millet medida from Khartoum North, Omdurman and Khartoum were 0.2%, 0.3%, and 0.3% respectively. These results were in agreement with Monawar and Badi (1987) who reported that the fibre content of Nasha was 0.3%.

4.1.6 Fat content

Table (5) and appendix (5) show the fat contents of different medida types. The fat content of Um ginger medida from Khartoum North, Omdurman and Khartoum were 0.8%, 0.4% and 0.7% respectively. While Date medida from Khartoum North, Omdurman and Khartoum were 0.2%, 0.1% and 0.1% respectively. and Millet medida from Khartoum North, Omdurman and Khartoum were 0.7%, 0.6%, and 0.6% respectively. These results were near to Monawar and Badi (1987) who reported that the fat content of Nasha was 0.2%.

Table (1): Moisture content (%) of medida from different locations in Khartoum State

Type of medida	Locations		
	Khartoum North	Omdurman	Khartoum
Um ginger	67.57% ± 0.24 [a]	65.45 %± 0.73 [b]	63.83% ± 1.26 [cd]
Date	64.48% ± 1.03 [bcd]	63.09% ± 1.05 [d]	67.19 [%]± 0.17 [a]
Millet	67.48% ± 0.54 [a]	65.22 %± 0.91 [bc]	66.98% ± 0.59 [a]
$Lsd_{0.05}$	1.38		
SE±	0.4644		

Values are mean ± SD.

Means sharing same superscripts in rows are not significantly different ($P \leq 0.05$) according to DMRT.

Table (2): Ash content (%) of medida from different locations in Khartoum State

Type of medida	Locations		
	Khartoum North	Omdurman	Khartoum
Um ginger	0.8 % ± 0.07 [a]	0.6 % ± 0.10 [b]	0.4% ± 0.06 [de]
Date	0.5% ± 0.10 [bcd]	0.4% ± 0.11 [cde]	0.3% ± 0.06 [e]
Millet	0.5% ± 0.08 [bcd]	0.5% ± 0.01 [bc]	0.4% ± 0.08 [bcd]
$Lsd_{0.05}$	0.1329		
SE±	0.04472		

Values are mean±SD.

Means sharing same superscripts in rows are not significantly different ($P \leq 0.05$) according to DMRT.

Table (3): Protein content (%) of medida from different locations in Khartoum State

Type of medida	Locations		
	Khartoum North	Omdurman	Khartoum
Um ginger	3.5% ± 0.51 [a]	1.5% ± 0.03 [ab]	1.8% ± 0.56 [b]
Date	0.8% ± 0.21 [c]	0.3% ± 0.09 [c]	0.4% ± 0.220 [c]
Millet	1.8% ± 0.54 [b]	2.0% ± 0.01 [b]	1.5% ± 0.0 [b]
$Lsd_{0.05}$	0.5715		
SE±	0.1924		

Values are mean ± SD.

Means sharing same superscripts in rows are not significantly different ($P \leq 0.05$) according to DMRT.

Table (4): Fibre content (%) of medida from different locations in Khartoum State

Type of medida	Locations		
	Khartoum North	Omdurman	Khartoum
Um ginger	0.6% ± 0.11 [a]	0.3% ±0.5 [b]	0.2% ± 0.05 [b]
Date	0.3% ± 0.10 [b]	0.2% ± 0.12 [b]	0.3% ± 0.05 [b]
Millet	0.2% ± 0.10 [b]	0.3% ± 0.02 [b]	0.3% ± 0.15 [b]
$Lsd_{0.05}$	0.1627		
SE±	0.05477		

Values are mean±SD.

Means sharing same superscripts in rows are not significantly different ($P \leq 0.05$) according to DMRT.

Table (5): Fat content (%) of medida from different locations in Khartoum State

Type of medida	Locations		
	Khartoum North	Omdurman	Khartoum
Um ginger	0.8% ± 0.08 [a]	0.4% ± 0.06 [c]	0.7% ± 0.10 [ab]
Date	0.2% ± 0.08 [d]	0.1% ± 0.03 [d]	0.1% ± 0.17 [d]
Millet	0.7% ± 0.05 [ab]	0.6% ± 0.03 [b]	0.6% ± 0.02 [ab]
$Lsd_{0.05}$	0.1435		
SE±	0.0483		

Values are mean±SD.

Means sharing same superscripts in rows are not significantly different ($P \leq 0.05$) according to DMRT.

4.1.6 Carbohydrates content

The results of carbohydrates were shown in table (6) and appendix (6). From the results date medida from Khartoum North and Omdurman has the high carbohydrates content compared to that of Khartoum; um ginger medida from Khartoum has a high carbohydrate content compared to those from Omdurman and Khartoum North, while millet medida from Khartoum and Omdurman has the lowest carbohydrates content compared to that of Khartoum North.

4.2 Microbial characteristics

4.2.1 Viable count of bacteria

The results of viable count bacteria were shown in table (7) and appendix (7). From the results the viable count of bacteria of Um ginger medida from Khartoum North, Omdurman and Khartoum were $6.8x10^6$, $4.8x10^4$ and $4.9x10^4$ (cfu/g), respectively. While Date medida from Khartoum North, Omdurman and Khartoum were $5.6x10^5$, $6.8x10^6$ and $5.5x10^5$ (cfu/g), respectively. and Millet medida from Khartoum North, Omdurman and Khartoum were $6.6x10^6$, $5.5x10^5$ and $5.8x10^5$ (cfu/g), respectively. From the results it has been found that date medida has the low viable count of bacteria. These results were in a good agreement with those reported by (Sali, 2010) who reported that the viable count of bacteria of shawrma was $5.3x10^3$.

Table (6): Carbohydrates content (%) of medida from different locations in Khartoum State

Type of medida	Locations		
	Khartoum North	Omdurman	Khartoum
Um ginger	26.54% ± 0.42 ^{g}	31.57% ± 0.71 ^{cd}	32.96% ± 1.21 ^{bc}
Date	33.59% ± 1.04 ^{b}	35.74% ± 1.06 ^{a}	31.62% ± 0.22 ^{cd}
Millet	29.13% ± 1.02 ^{f}	31.12% ± 0.88 ^{de}	29.99% ± 0.14 ^{ef}
$Lsd_{0.05}$	1.427		
SE±	0.4803		

Values are mean±SD.

Means sharing same superscripts in rows are not significantly different ($P \leq 0.05$) according to DMRT.

Table (7): Total viable count of bacteria (cfu/g) of medida from different locations in Khartoum State

Type of medida	Locations		
	Khartoum North	Omdurman	Khartoum
Um ginger	$6.8x10^6 \pm 0.04^{a}$	$4.8x10^4 \pm 0.09^{e}$	$4.9x10^4 \pm 0.06^{e}$
Date	$5.6x10^5 \pm 0.05^{b}$	$6.8x10^6 \pm 0.05^{a}$	$5.5x10^5 \pm 0.09^{d}$
Millet	$6.6x10^6 \pm 0.06^{b}$	$5.5x10^5 \pm 0.07^{d}$	$5.8x10^5 \pm 0.09^{c}$
$Lsd_{0.05}$	0.1213		
SE±	0.04082		

Values are mean±SD.

Means sharing same superscripts in rows are not significantly different ($P \leq 0.05$) according to DMRT.

4.2.2 Yeasts and moulds

The results of yeasts and moulds were shown in table (8) and appendix (8). From the result the yeasts and moulds of Um ginger medida from Khartoum North, Omdurman and Khartoum were $3.6x10^3$, $3.5x10^3$ and $2.6x10^3$ (cfu/g), respectively. While Date medida from Khartoum North, Omdurman and Khartoum were $2.7x10^2$, $3.4x10^3$ and $2.6x10^2$ (cfu/g) respectively. and Millet medida from Khartoum North, Omdurman and Khartoum were $2.5x10^2$, $3.5x10^3$ and $3.5x10^3$ (cfu/g), respectively. These results were in a good a agreement with those reported by Sali (2010) who reported that the Yeasts and moulds of shawrma $3.1x10^{2.}$

4.2.3 *Staphylococcus aureus*

The results of staphylococcus aureus were shown in table (9) and appendix (9). From the results the *staphylococcus aureus* of Um ginger medida from Khartoum North, Omdurman and Khartoum were $2.8x10^2$, $2.5x10^2$ and $2.6x10^2$ (cfu/g), respectively. While Date medida from Khartoum North, Omdurman and Khartoum were $2.6x10^2$, $2.6x10^2$ and $2.5x10^2$ (cfu/g) respectively. and Millet medida from Khartoum North, Omdurman and Khartoum were $2.7x10^2$, $2.6x10^2$ and $2.8x10^2$ (cfu/g), respectively. These results were near to those Sali (2010) reported that the *Staphylococcus* aureus of shawrma was $4.3x10^2$.

4.2.4 Coliforms

The results of Coliforms were shown in table (10) and appendix (10). From the results the Coliforms of Um ginger medida from Khartoum North, Omdurman and Khartoum were 16.6, 1.0 and 0.0 (MPN/g) respectively. While Date medida from Khartoum North, Omdurman and Khartoum were 0.0, 13.3 and 5.3 (MPN/g) respectively. and Millet medida from Khartoum North, Omdurman and Khartoum

were 9.0, 7.3 and 12.0 (MPN/g) respectively. These results were in different to those reported by Sali (2010) reported that the Coliforms of shawrma was 2.6x10.

4.2.5 *E. coli*

The results of *E. coli* were shown in table (11) and appendix (11). From the results E. coli of Um ginger medida from Khartoum North, Omdurman and Khartoum were 4.3, 0.0 and 0.0 (MPN/g) respectively. While Date medida from Khartoum North, Omdurman and Khartoum were 0.0, 4.0 and 0.0 (MPN/g) respectively. and Millet medida from Khartoum North, Omdurman and Khartoum were 0.0, 0.0and 2.00 (MPN/g) respectively.

4.2.6 Detection of *Salmonella*

The results of *Salmonella* were shown in Table (12). From the results the salmonella content of millet medida not detected of the different location Omdurman, Khartoum and Khartoum North. Also from the results um ginger medida from Khartoum has appositive result of salmonella while a sample from Omdurman and Khartoum has a negative result (not detected). The samples of samples date medida from Omdurman has appositive results while the samples from Khartoum and Khartoum North has a negative results (not detected).

Table (8): Yeasts and moulds (cfu/g) of three types of medida from different locations in Khartoum State

Type of medida	Locations		
	Khartoum North	Omdurman	Khartoum
Um ginger	$3.6x10^3 \pm 0.05^{a}$	$3.5x10^3 \pm 0.13^{ab}$	$2.6x10^3 \pm 0.11^{c}$
Date	$2.7x10^2 \pm 0.0^{c}$	$3.4x10^3 \pm 0.16^{b}$	$2.6x10^2 \pm 0.04^{c}$
Millet	$2.5x10^2 \pm 0.08^{c}$	$3.5x10^3 \pm 0.09^{ab}$	$3.5x10^3 \pm 0.11^{ab}$
$Lsd_{0.05}$	0.1715		
SE±	0.05774		

Values are mean±SD.

Means sharing same superscripts in rows are not significantly different ($P \leq 0.05$) according to DMRT.

Table (9): *Staphylococcus aureus* (cfu/g) of medida from different locations in Khartoum State

Type of medida	Locations		
	Khartoum North	Omdurman	Khartoum
Um ginger	$2.8x10^2 \pm 0.03^{a}$	$2.5x10^2 \pm 0.16^{c}$	$2.6x10^2 \pm 0.12^{bc}$
Date	$2.6x10^2 \pm 0.10^{bc}$	$2.6x10^2 \pm 0.15^{c}$	$2.5x10^2 \pm 0.05^{c}$
Millet	$2.7x10^2 \pm 0.16^{abc}$	$2.6x10^2 \pm 0.06^{bc}$	$2.8x10^2 \pm 0.06^{ab}$
$Lsd_{0.05}$	0.1879		
SE±	0.06325		

Values are mean±SD.

Means sharing same superscripts in rows are not significantly different ($P \leq 0.05$) according to DMRT.

Table (10): Total coliforms (MPN/g) of medida from different locations in Khartoum State

Type of medida	Locations		
	Khartoum North	Omdurman	Khartoum
Um ginger	16.6 ± 2.08 [a]	1.0 ± 0.7 [e]	0.0 ± 0.0 [e]
Date	0.0 ± 0.0 [e]	13.3 ± 1.5 [b]	5.3 ± 1.5 [d]
Millet	9.0 ± 1.7 [c]	7.3 ± 2.08 [cd]	12.0 ± 1.0 [a]
$Lsd_{0.05}$	2.641		
SE±	0.8888		

Values are mean±SD.

Means sharing same superscripts in rows are not significantly different ($P \leq 0.05$) according to DMRT.

Table (11): *E. coli* (MPN/g) of medida from different Locations in Khartoum State

Type of medida	Locations		
	Khartoum North	Omdurman	Khartoum
Um ginger	4.3 ± 3.79^{a}	0.0 ± 0.0^{b}	0.0 ± 0.0^{b}
Date	0.0 ± 0.0^{b}	4.0 ± 1.73^{a}	0.0 ± 0.0^{b}
Millet	0.0 ± 0.0^{b}	0.0 ± 0.0^{b}	2.00 ± 1.73^{ab}
$Lsd_{0.05}$	2.578		
SE±	0.8678		

Values are mean±SD.

Means sharing same superscripts in rows are not significantly different ($P \leq 0.05$) according to DMRT.

Table (12): Detection of *Salmonella* of medida from three different locations in Khartoum State

Type of medida	locations		
	Khartoum North	Omdurman	Khartoum
Um ginger	+ + -	- - -	- - -
Date	- - -	+ - +	- - -
Millet	- - -	- - -	- - -

CHAPTER FIVE

5. CONCLUSIONS AND RECOMMENDATIONS

5.1 Conclusions

The obtained results of this study pointed out the following:

1. Um ginger from Omdurman was the best of the microbial quality among the three samples, following Um ginger of Khartoum while the sample of Khartoum North was the worst.

2. Date medida from Khartoum was the best concerning the microbial quality among the three samples followed by Khartoum North while the samples of Omdurman were the worst.

3. Millet from Omdurman was the best of the microbial quality among the three samples followed by medida of Khartoum North while the sample of Khartoum was the worst.

4. Um jinger medida from Khartoum and Khartoum North has the high protein content compared to that of Omdurman samples. Millet medida from Omdurman has high protein content compared to those from Khartoum and Khartoum North, while date medida has the lowest protein content among the different location (Khartoum, Khartoum North and Omdurman).

5.2 Recommendations

The following recommendations are suggested to make sure that the quality of the Medida types is quite safe for the consumers:

1. Before eating one must look at the way the food is sold and the workers who do it and the way it is presented.
2. Laws and regulations must be found for thin porridges by the official bodies.

3. Standards and regulations must be enforced to protect the consumer from hazards expected from thin porridges.
4. There should be health recorded cards for individuals working or selling their products (personal hygiene).
5. Stainless steel or glass containers for serving the products to avoid cross (contamination).
6. Potable water should be used for washing utensils.
7. Restricted legislations for ready to use street foods including thin porridges, should be imposed.
8. Further Studies are recommended.

REFERENCES

Abdulla, A.S. (2010). MSc, Sudan University of Science and technology, Microbiological and chemical characterises of some Sudanese Streets foods.

Adeneji, A.O. and Potter, N.N. (1978). Properties of ogi powders made from normal fortified and opaque-2 corn. Journal of food science, 43, 1571 1574.

Al-Tunisi, M.O. (1850 cited in Dirar,1993). Tashhidh Al-Athhan Bi-Sirat Bilad A-Arab wa-L-Sudan. edited by K.M. Asakir and M.M. Musad (1965 cited in Dirar,1993). Egyptian General Organization for Authorship, Information and Publication, Cairo. {In Arabic.}

Andah, A. and Muller, H.G. (1973). Studies on koko, a Ghanaian fermented maize porridge. Ghana Journal of the Agricultural Science 6, 103-108.

Anderson, R.G. (1911 cited in Dirar,1993). Some Tribal Customs and their Relation to Medicine and Morals of the Nyam-Nyam and Gour People Inhabiting The Eastern Bahr-El-Ghazal. Fourth Report of the Wellcome Tropical Research Laboratories, Vol. B. Khartoum, Sudan , PP. 239-277.

AOAC (2003). Official methods of analysis. Association of official Analysis chemist Agrlington, Virginia, USA.

Axtel, J.D., Ejeta, G. and Munk, L. (1982). Sorghum nutritional quality – progress and prospects. In; Sorghum in the Eighties, Vol. 2. Proceedings of the International Symposium on Sorghum, 2-7 Nov. 1981, Pantacheru, India, ICRISAT, pp. 589-603.

Aykroyd, W.R. and Doughty, J. (196 cited in Dirar,19934). Legumes in Human Nutrition. FAO Nutritional Studies No. 19. FAO, Rome. Pamphlet, 138 pp

Aylward, F. (1961 cited in Dirar,1993). Report to the Government of Ghana on Foods Nutrition. FAO, Rome.

Banigo, E.O.I. and Muller, H.G. (1972). Carboxylic acid patterns in ogi fermentation, Journal of science, Food and Agriculture 23, 101-111.

Beam, W. (1906 cited in Dirar,1993). Report of the Chemical Section. Second Report of The welcome Research Laboratories. Khartoum, Sudan, pp. 205-244.

Beam, W. (1908 cited in Dirar,1993). Report of the Chemical Section. Third Report of the Wellcome Research Laboratories. Khartoum, Sudan. pp. 385-450.

Burgess, H.J.L. (1962 cited in Dirar,1993). Cereal foods used in Uganda. 1. Millets and Sorghum. East African Medical Journal 39(7), 437-448.

Cailliaud, M.F. (1826 cited in Dirar,1993). Voyage a Meroe, au Fleuve Blanc, au-dela de Fazoql dansle midi du Royaume de Sennar, a Syouah et dans cinq autres Oasis; fait dansles annees 1819, 1820, 1821 et 1822. 4 volumes. Imprimerie Royale, Paris.

Cameron, M.E. and Hofvander, Y. (1974). Weaning foods in developing countries. Proceeding of the Fourth International Congress on food Science and Technology 5, 403-406.

Collins, R.O. (1960 cited in Dirar,1993). Patrol against the Beirs. Sudan Notes and Records 41, 35-58.

Culwick, G.M. (1951 cited in Dirar,1993). Diet in the Gezira Irrigated Area, Sudan. Sudan Survey Department, Khartoum, No. 304. Pamphlet.

Culwick, G.M. (1955 cited in Dirar,1993). Social factors affecting diet. In: Food and Society in the Sudan. Proceedings of the 1953 Annual Conference of the Philosophical Society of the Sudan. Khartoum, pp. 173- 192.

Cunnison, I. (1954 cited in Dirar,1993). The Humr and their land. Sudan Notes and Records 35 (Part 2) 50-68.

Dirar, H.A. (1993). The indigenous fermented Foods and beverages of Sudan. In: Applications of Biotechnology to Food Processing in Africa. Selected papers from the IDDA Expert Group Meeting, Ibadan, Nigeria, and December, 1991. United Nations Industrial Development Organization. Pp. 23-40.

Dundas, M. L. and Futrell, M.F. (1986). Socio-economic influence on the use of sorghum products and nutritional status of children in Sudan. Nutrition Reports International 33(5), 793-802.

El-Gendy, S.M. (1983). Fermented foods of Egypt and the Middle East. Journal of Food Protection 46, 358-367.

Elmadfa, I. and Kuhl, B.E. (1976). the quality of fenugreek seed protein tested alone and in a mixture with corn flour. Nutrition Reports International 14(2), 165-172.

El-Mahdi, Z.M. (1985). Microbial and biochemical characteristics of legume protein- supplemented kissra. MSc thesis, University of Khartoum, Sudan.

Evans-Pritchard, E.E. (1937 cited in Dirar,1993). Economic life Nuer: cattle. Sudan Notes and Records 20, 209-245.

Gassim, O.E. (1985). Dictionary of the Colloquial Language in the Sudan. Second edition. The Modern Egyption Bureau, Cairo, Egypt. {In Arabic.}

Golberg, L. and Thorp, J.M. (1946 cited in Dirar,1993). A survey of vitamins in African foodstuffs. 6. Thiamin, riboflavin and nicotinic acid in sprouted and fermented cereal foods. South Africa Journal of Medical Sciences 11, 177-185.

Gorafi, A.E.A. (1983). The use of fenugreek (helba) by lactating mothers and infants. Graduation Dissertation, Ahfad University College for Women, Omdurman, Sudan.

Graham, G.G., MacLean, W.C., Morales, E., Hamaker, B.R., Kirleis, A.W., Mertz, E.T., and Axtell, J.D. (1986). Digestibility and utilization of protein and energy from nasha, a traditional Sudanese fermented sorghum weaning food. Journal of Nutrition 116, 978-984.

Grove, E.T.N. (1919 cited in Dirar,1993). Customs of the Acholi. Sudan Notes and Records 2, 157-182.

Harrigan, W.F. (1998). Laboratory methods in Food microbiology .3rd education, A academic Press, London and san Diego.

Henry, A.J. (1955 cited in Dirar,1993). Sudan food values. In: Food and Society in Sudan. Proceedings of the 1953 Annual Conference of the Philosophical Society of the Sudan, Khartoum, pp. 167-172.

Jackson, H.C. (1923 cited in Dirar,1993). The Nuer of the Upper Nile Province, Part C. Sudan Notes and characteristics Records 6, 59-189.

Kabeir, B.M. and Mustafa Shuhaimi[1], Kharidah Muhammad[2], Suraini Abd-Aziz[3] & Abdul Manap Yazid[1]. (2004). A Nutritious Medida(Sudnese Cereal Thin Porridge) Prepared by Fermenting Malted Brown Rice Flour with *Bifidobaterium* Longum BB536.Mal J Nutr 10(2): 183-193, 2004.

Kabeir, B.M. and S.Abd-Aziz[2], k. Muhammad[3], M. Shuhaimi[1] and A.M. yazid[1.] (2005). Growth of *Bifidobacterium longum* BB536 in medida (fermented cereal porridge). Letters in Applied Microbiology 41, 125-131 dio: 10. 1111/j.1472-765x.2005.01735.x.

Kabeir, B.M. and Shuhaimi Mustafa[2], Stephenie Wong[1] and Nazamid Saari[3], Abdul Manap Yazid[1]. (2009). Heat adaptation towards improving survival of *Bifidobacterium longum* BB 536 during the spray drying of Sudanese fermented Medida. African Journal of Biotechnology Vol. 8 (8), pp. 1615-1618, 20 April, 2009 Available online at http: //www.academicjournals.org/AJB ISSN 1684-5315@2009 Academic Journals.

Khan, M.A. and Sattar, A. (1983). Nutritional evaluation of some home-made and commercial baby foods. In: McLoughlin, J.V. and Makenna, B.M. (eds) Research in Food science and Nutrition. Vol. 3. Boole Press, Dublin, pp. 98-99.

Kirleis, A.W. and Monawar, L.Y. (1989). Nutritional quality of sorghum. Paper presented at the ARC/INTSORMIL Sudan Sorghum and Millet Workshop, 28 Oct-2 Nov., 1989, Wad Medani, Sudan.

Ko, S. D. (1982). Indigenous fermented foods. In: Rose, A.H. (ed.), Fermented Foods. Academic Press, London, pp. 15-38.

Kuboye, A.O. (1985). Traditional fermented foods and beverages of Nigeria. In: Development of Indigenous Fermented Foods and Food Technology in Africa. Proceeding from the IFS/UNU workshop, Douala, Cameroon, Oct. 1985. International Foundation of Science, Stockholm, Sweden, pp. 224-236.

Kwon, T.W., Cheigh, H.S. and Pyun, Y.R. (1974). Fortification of milssal as a potential vehicle of providing lysine in Korean food system. Proceedings of the Fourth International Congress of Food Science and Technology 5, 18-24.

Larken, P.M. (1927 cited in Dirar,1993). Impression of the Azande. Sudan Notes and Records 10, 85-134.

Lorenzen, A.E. (1948 cited in Dirar,1993). A note on nutrition in Equatoria Proyince. In: Tothill, J.D. (ed.), Agriculture in the Sudan. Oxford University Press, London, pp. 263-271.

McLean, M. (1985). A Report on the Nutritional Status of 4575 Children in Kordofan Region September/October 1985. OXFAM, UNICEF and Kordofan Regional Government Nutritional Status and Drought Monitoring Project. Health Unit, OXFAM, 274 Banbury Road, Oxford, UK.

MacLean, W.C., de Romana, G.L., Gastanaduy, A. and Graham, G.G. (1983).The effect of decortication and extrusion on the digestibility of sorghum by preschool children. Journal of Nutriton 113, 2071-2077.

Mbugua, S.K. (1987). The nutritional and fermentation characteristics of the uji produced from dry-milled maize flour (unga baridi) and whole wet-milled maize. Chemistry Microbiology Technology Lebensm. 10, 154-161.

Miracle, M.P. (1965 cited in Dirar,1993). Food technology in tribal Africa. In: Peterson, M.S. and Tressler, D.K. (eds), Food Technology the World Over. Vol. 2. The AVI Publishing Company, Inc., Westport, Connecticut, pp. 107-154.

Monawar, L.Y. (1983). Food value of Sudanese indigenous cereal grains. PhD Thesis, University of Khartoum, Sudan.

Monawar, L.Y. and Badi, S.E.M. (1987). Instant Nasha: Sorghum and Millet Baby Food. Food Research Center. Shambat, Sudan Pamphlet. 10pp.

Montney, J.G. and Gould, A.W. (1988). Practical food microbiology and technology 3ed. Avi books, published by van No. stand Reinald Company, New York.

Muller, H.G. (1970). Traditional cereal processing in Nigeria and Ghana. Ghana Journal of Agriculture and Science 3, 187-195.

Novellie, L. (1982). Fermented porridges. In: Proceedings of the International Symposium on Sorghum Grain Quality. ICRISAT, 28-31 Oct. 1981, Pantacheru, India, pp. 121-128.

Paul, A. (1950 cited in Dirar,1993). Notes on the Beni Amer. Sudan Notes and Records 31, 223-245.

Pearson, H.T. (1970). The chemical analysis of food 6th. J.A. Churchill, London, PP – 510-515.

Pingar, T.A and Cooke, M.E. (1985). *E. coli* vetail processed food. J. Hrg. Comb. 95:39.

Quin, P.J. (1964 cited in Dirar,1993). Foods and feeding habits of the Pedi. South Africa Medical Journal 38, 969-971.

Rajalakshmi, R., Nanavaty, K. and Gumashta, A. (1964 cited in Dirar,1993). Effect of cooking procedures on the free and total niacin content of certain foodstuffs. Journal of Nutrition and Dietetices 1, 276-280.

Reid, J.A. (1930 cited in Dirar,1993). Some notes on the tribes of the white Nile Province Sudan Notes and Records 13, 149-209.

Rooney, L.W. and Mutry, D.S. (1982). Evaluation of Sorghum food quality. In: Sorghum in the Eighties. Vol. 2. ICRISAT, Pantacheru, India, pp. 571-588.

Ruck, N. (1983). the food habits of mothers and children in minya governorate, Egypt. In: McLoughlin, J.V. and McKenna. B.M. (eds), Research in Food Science and Nutrition. Vol. 3. Boole Press, Dublin, pp. 106-107.

Schweigart, F. and Fellingham, S.A. (1963). A study of fermentation in the production of mahewu, an indigenous sour maize beverage of South Africa. Milchwissenschaft 18(5), 241-246.

Shagaly, A.G.E. and Salih, W.M.Y. (1984). Comparison in food habits during pregnancy and lactation periods between Khartoum and Red Sea (Kassala, Port-Sudan) Provinces, Graduation Dissertation, Ahfad University College for Girls, Omdurman, Sudan.

Shazali, H. (1973). Home- made weaning foods for Sudanese children. In: Food and Nutrition in the Sudan. Proceedings of the Sudan. Proceedings of the First National Food and Nutritional Seminar, March 1922. National Council for Research, Khartoum, Sudan, pp. 147-153.

Stanton, W.R. (1988). Tropical fermented foods: a scenario for the future. In: Robinson, R.K. (ed.), Developments in Food Microbiology. Vol. 4. Elsevier Applied Science, London, pp. 223-243.

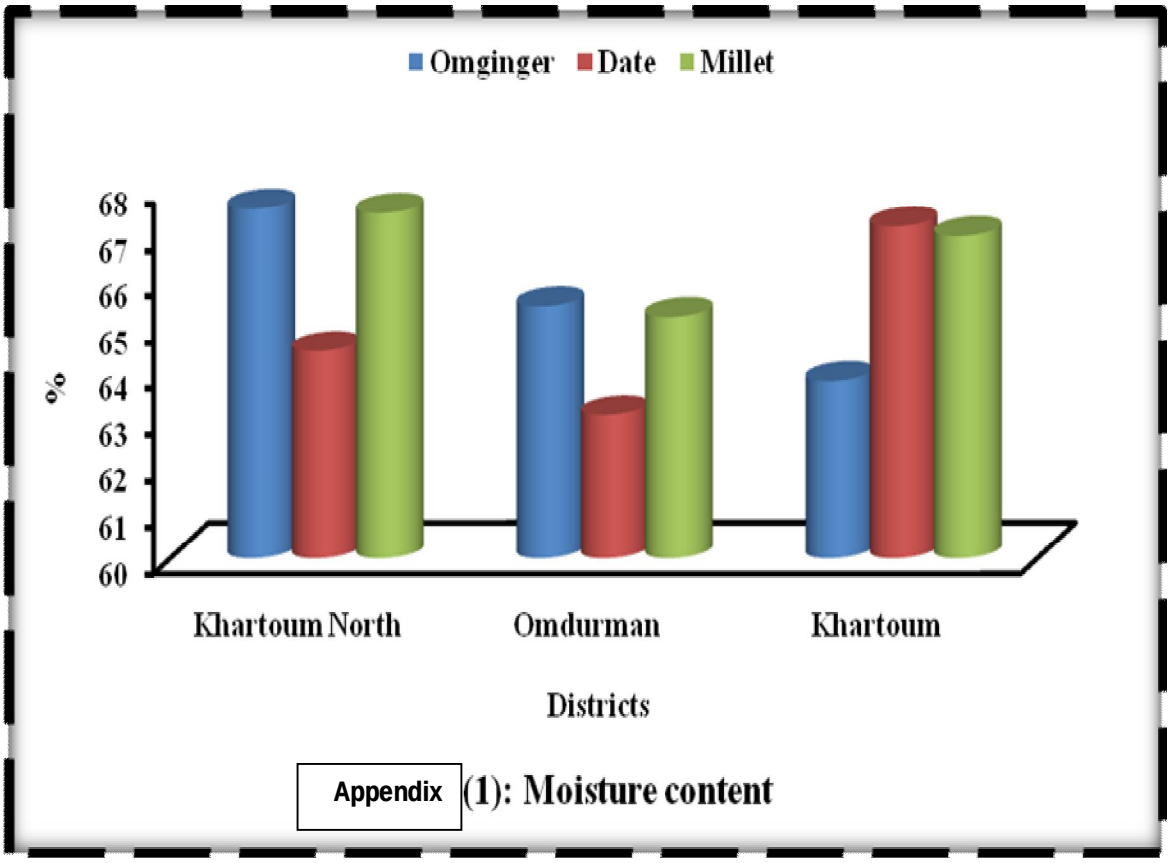
Titherington, G.W. (1927 cited in Dirar, 1993). The Raik Dinka of Bahr El Ghazal Province. Sudan Notes and Records 10, 159-209.

West, C. E. Repping, F. and temal lwa, C .R. (1988). the composition of food commonly Eaten in East Africa – published by wagening, Nether lands, vol. 290.

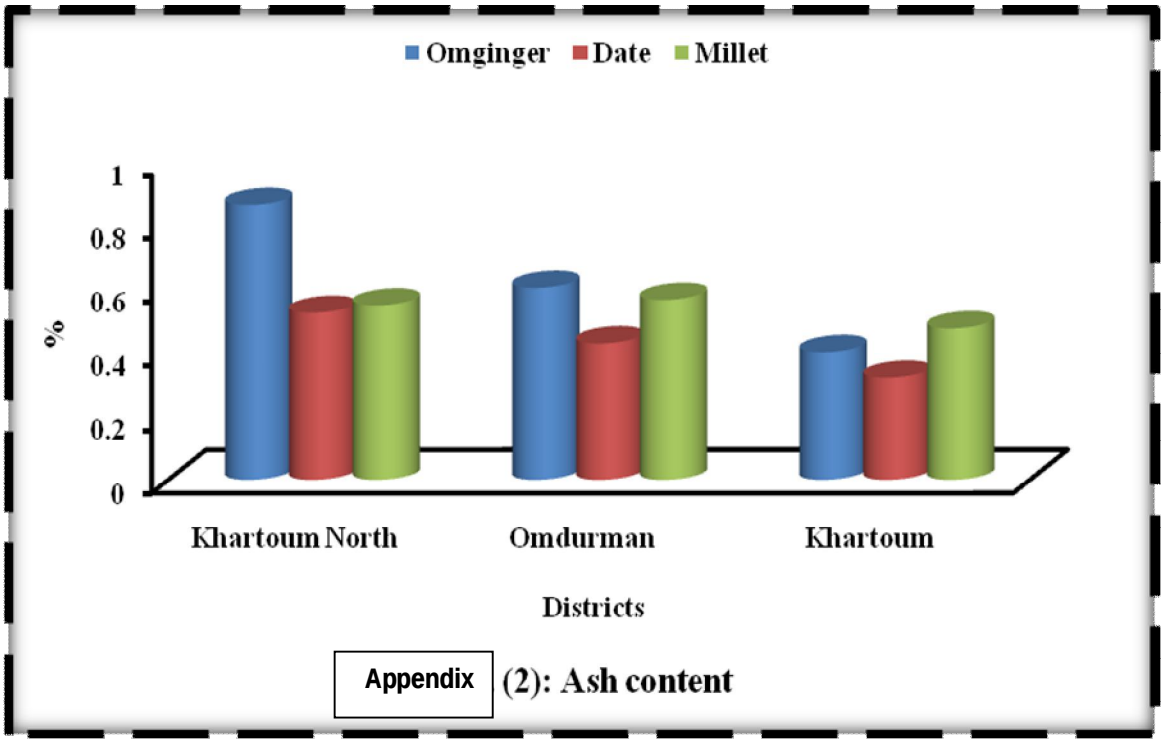
Wellcome Chemical Laboratories (1967 cited in Dirar,1993). Folk Medicine and Materia Medica: Catalogue of Vegetable Samples with Notes on Uses. Wellcome Chemical Laboratories, Ministry of Health, Khartoum, Sudan, pp. 30-31.

Yousif, M. and Khattab, A.H. (1967 cited in Dirar,1993). A nutritional survey of Hag Yousif rural community. Sudan Medical Journal 5, 76-81.

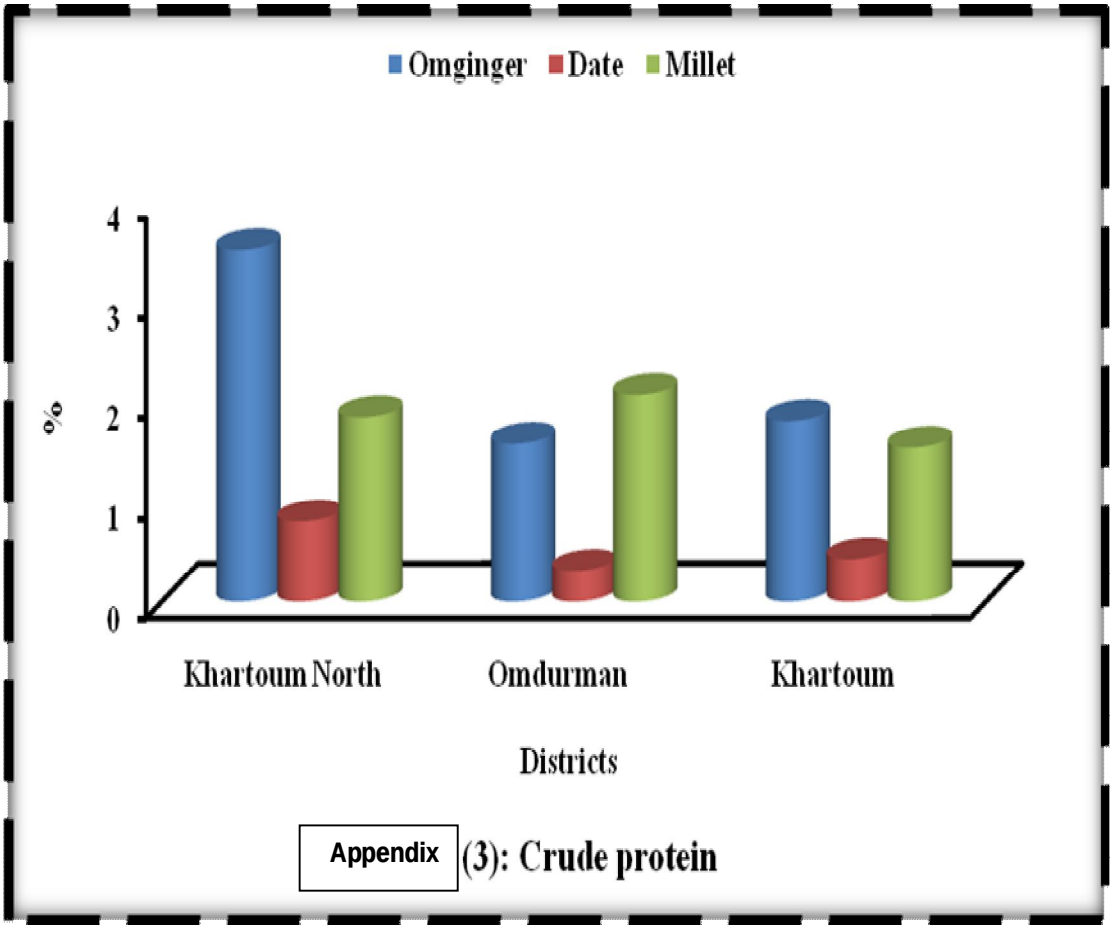
APPENDICES



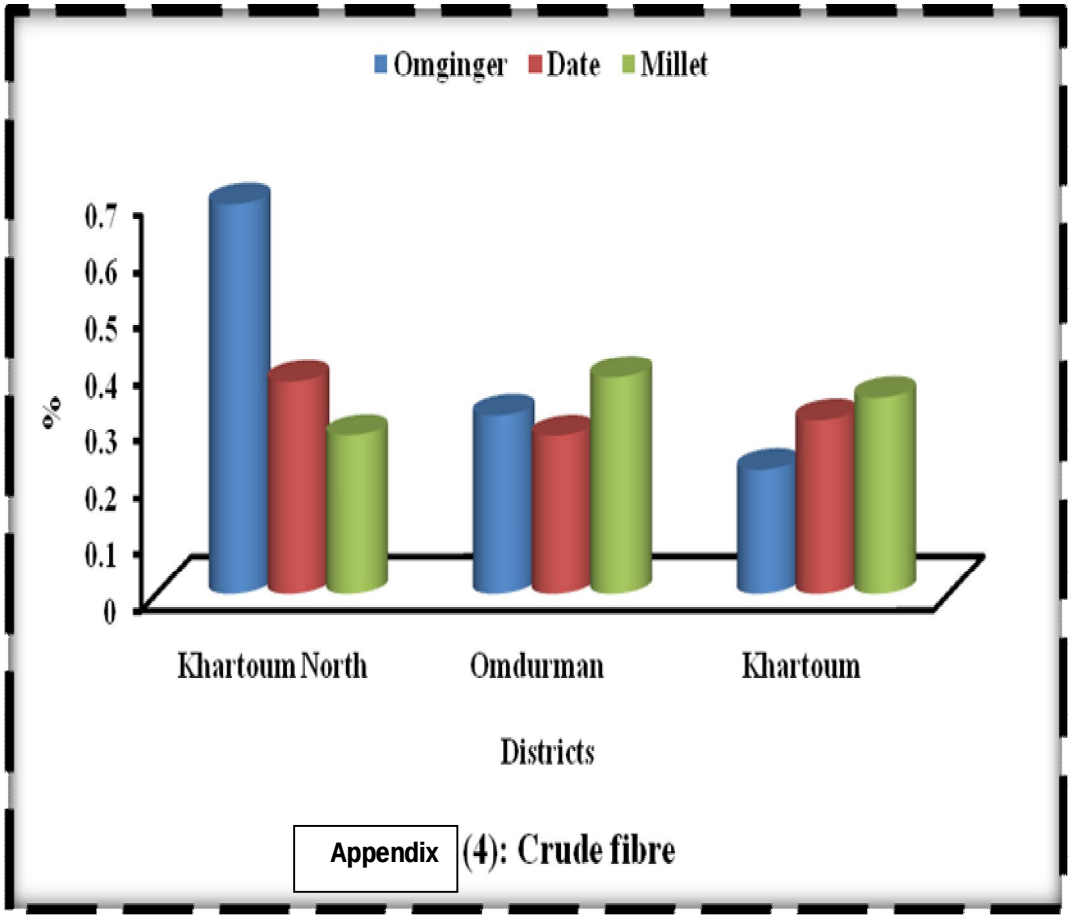
Appendix (1): Moisture content



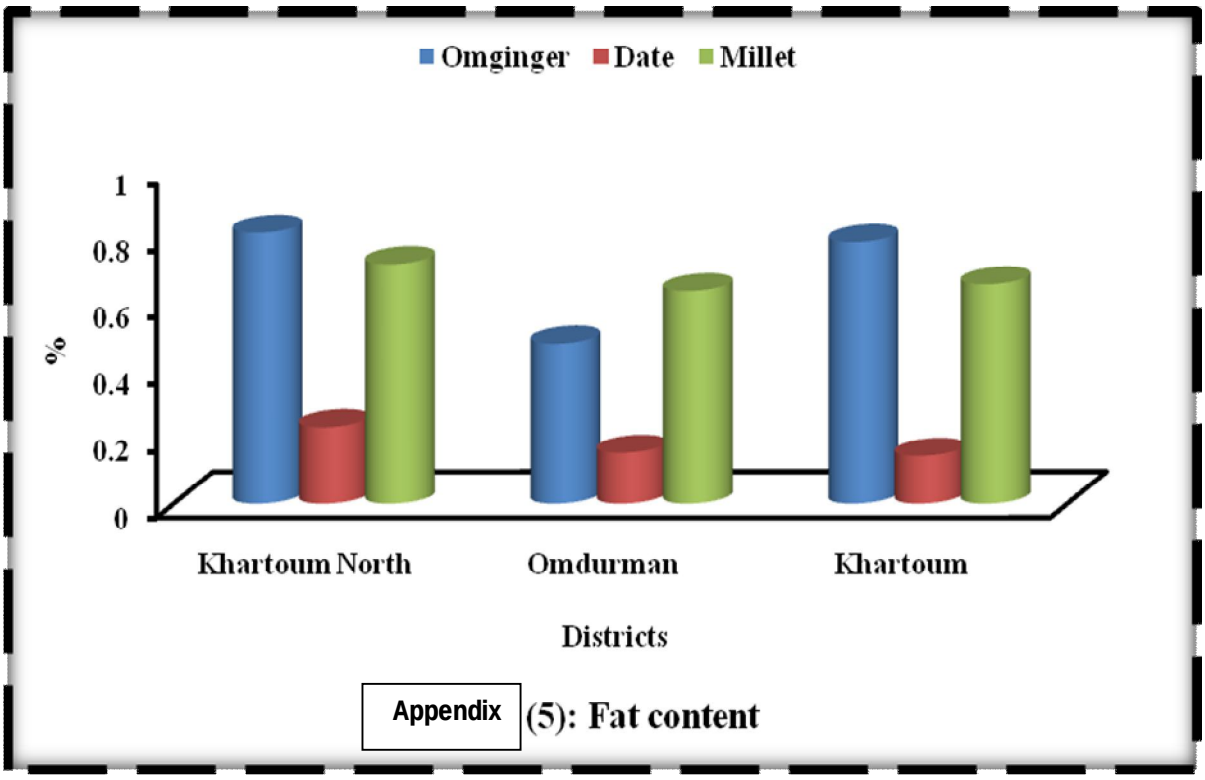
Appendix (2): Ash content



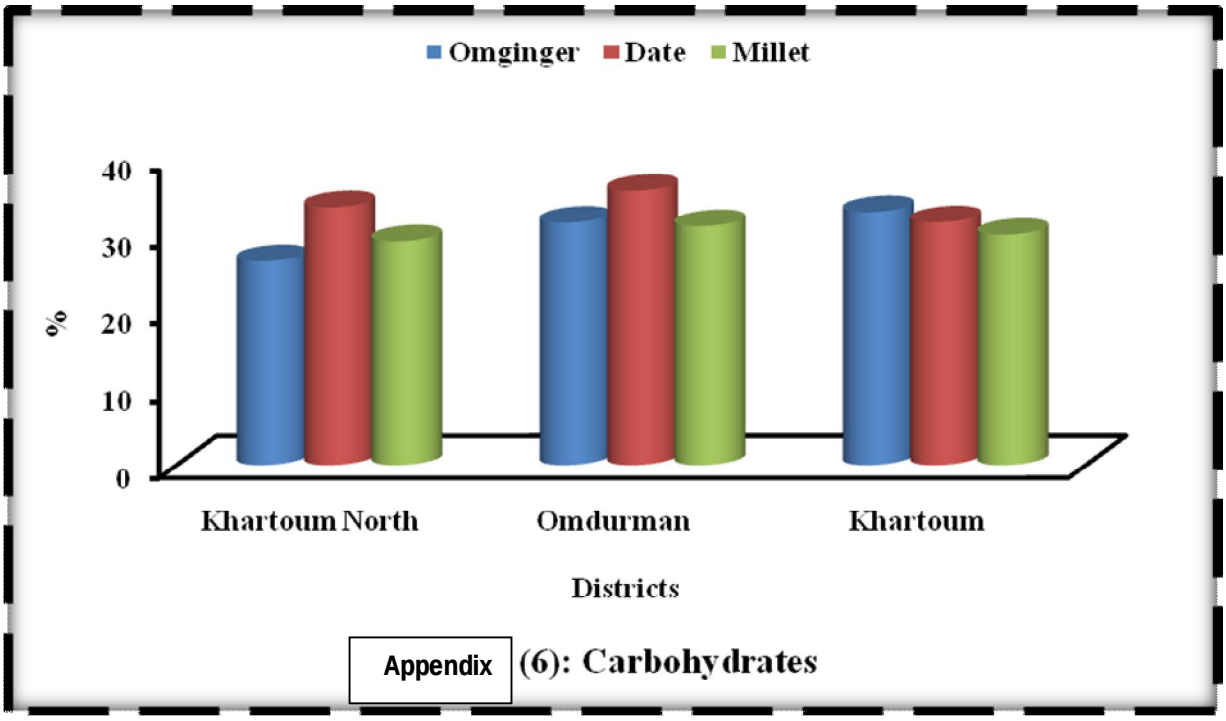
Appendix (3): Crude protein



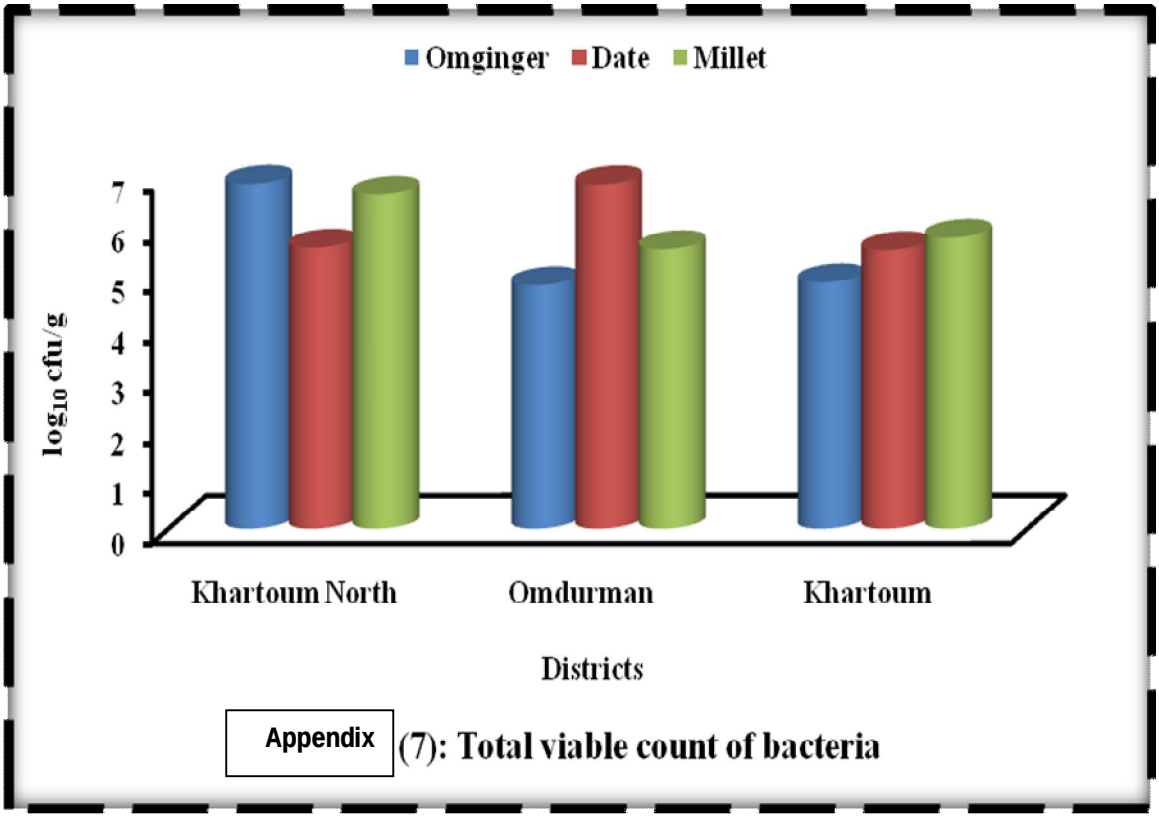
Appendix (4): Crude fibre



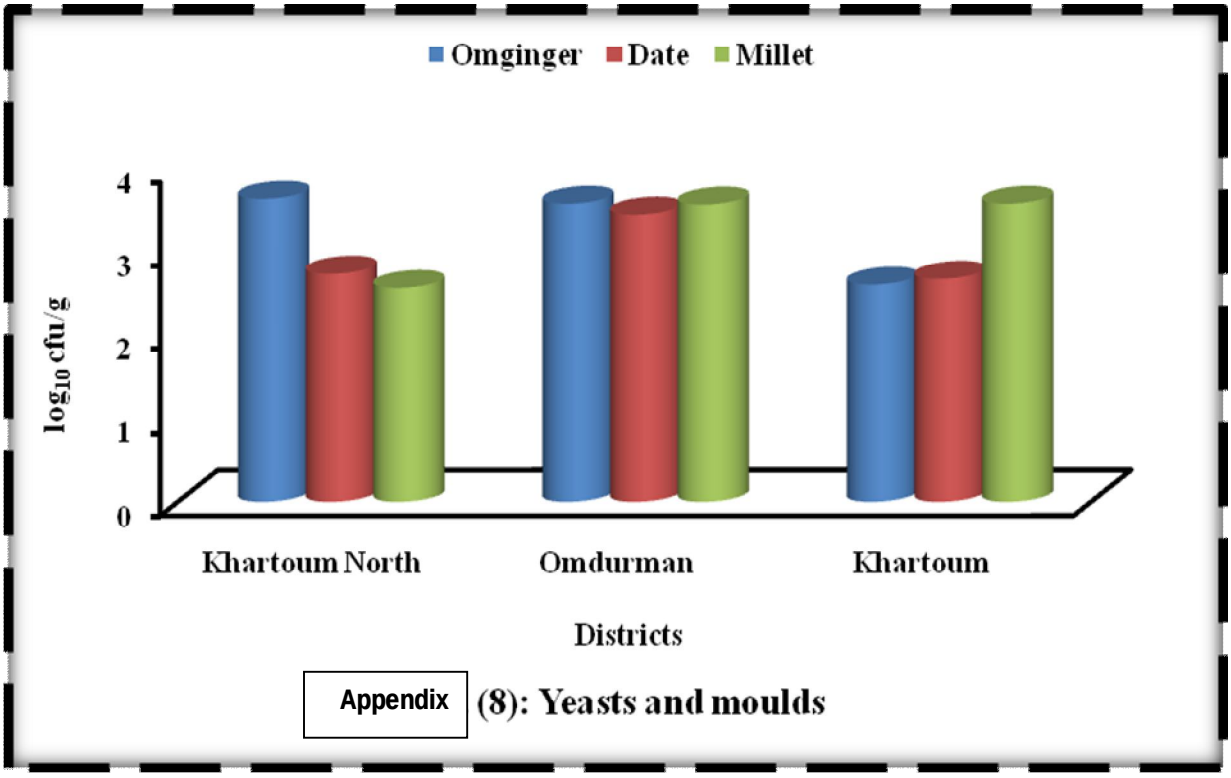
Appendix (5): Fat content



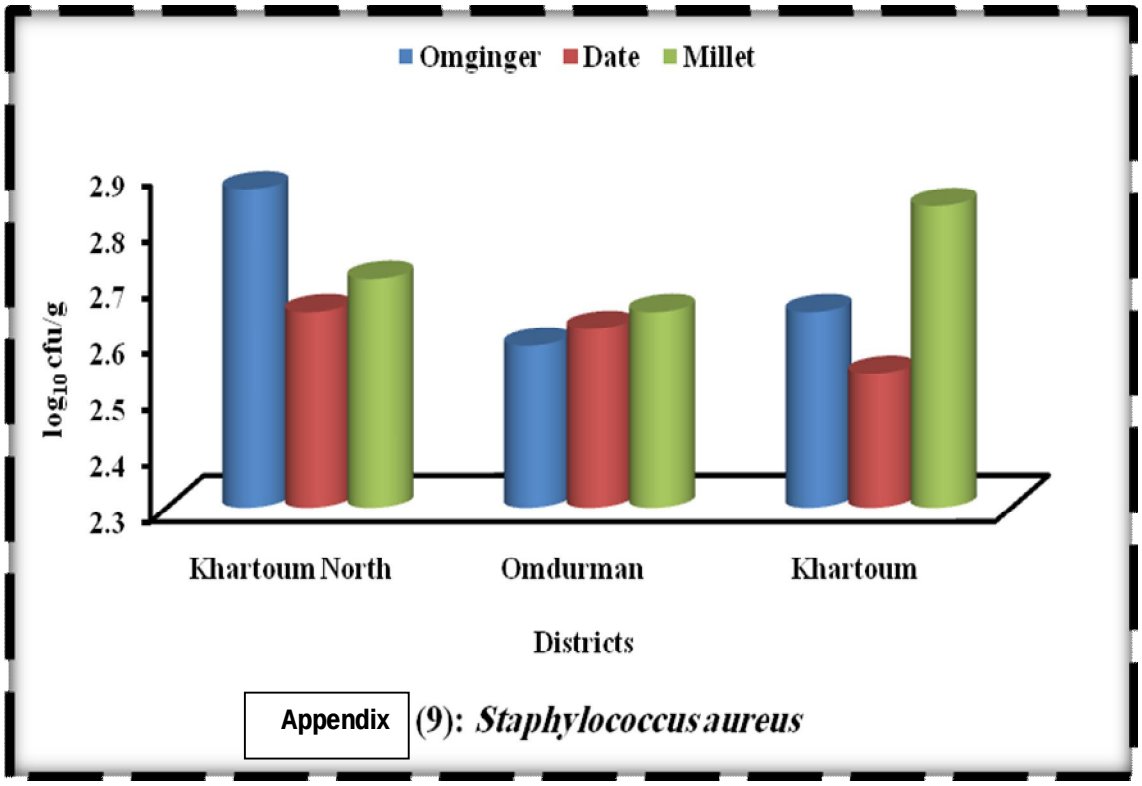
Appendix (6): Carbohydrates



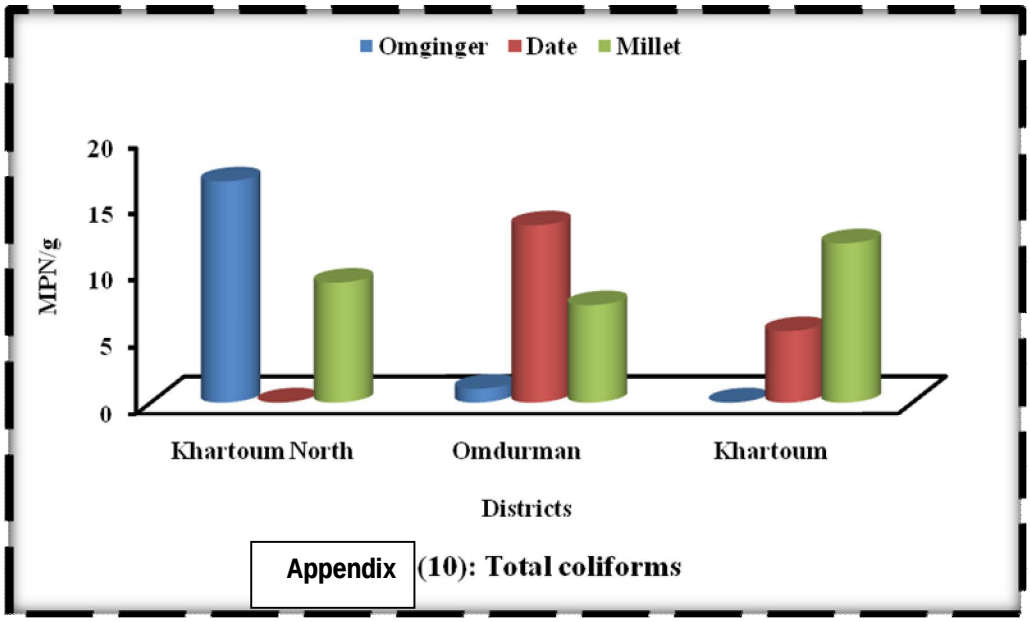
Appendix (7): Total viable count of bacteria



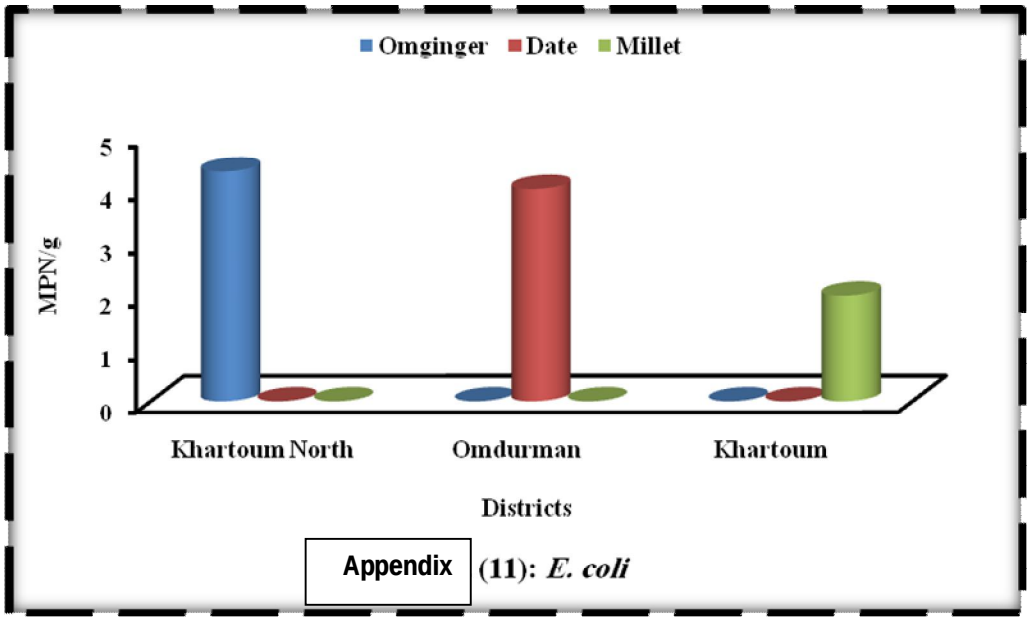
Appendix (8): Yeasts and moulds



Appendix (9): ***Staphylococcus aureus***



Appendix (10): Total coliforms



Appendix (11): *E. coli*