



Sudan University of Science and Technology  
College of Agricultural Studies  
Department of Plant Protection



## Analytical Study of Natural Bee Honey, of South Kordofan State

دراسة تحليلية عن عسل النحل الطبيعي من ولاية  
جنوب كردفان

B.Sc (Honours) Graduation Research in Plant Protection

By:

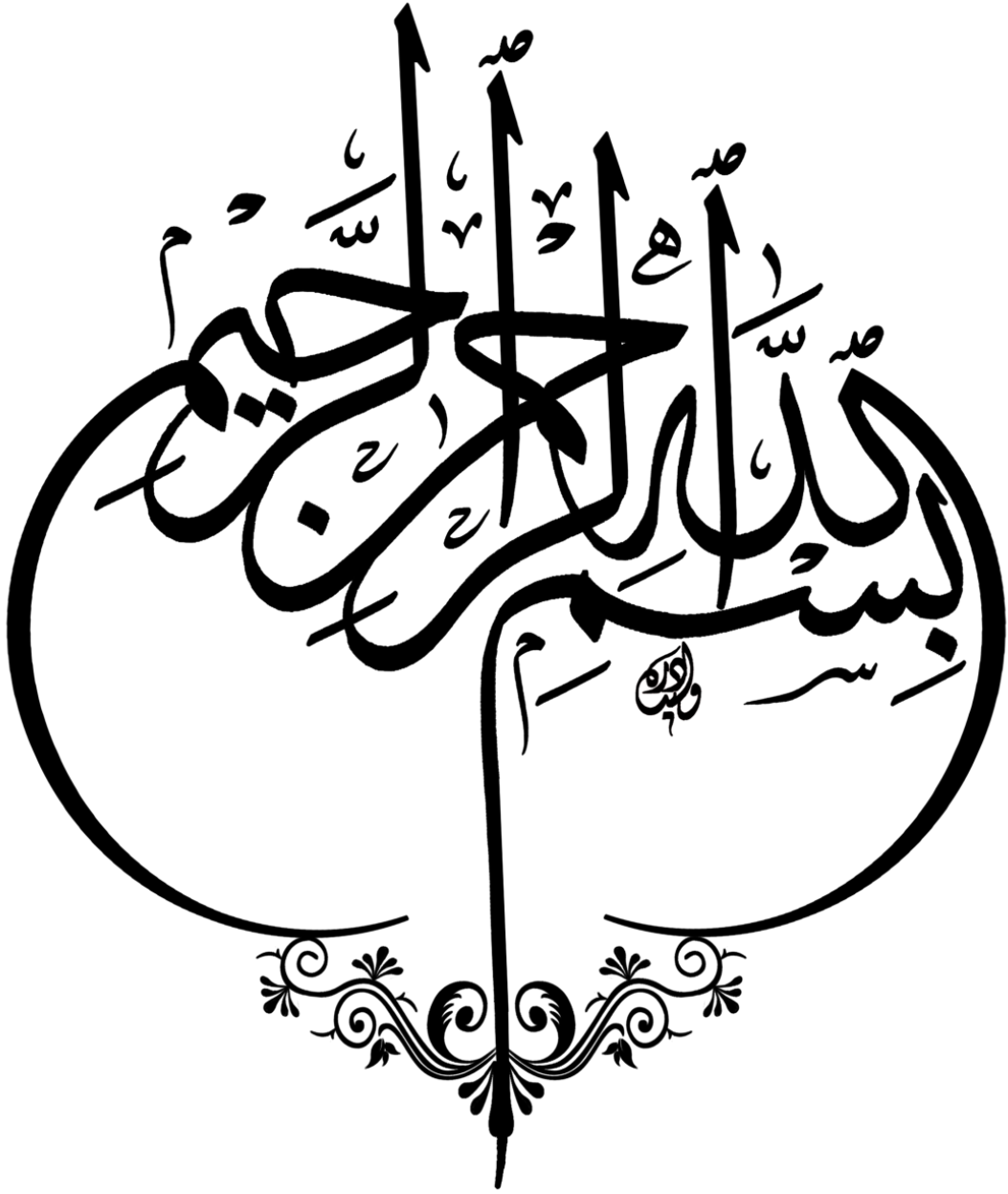
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# الآية

قَالَ تَعَالَى:

﴿ وَأَوْحَى رَبُّكَ إِلَى النَّحْلِ أَنْ اتَّخِذِي مِنَ الْجِبَالِ بُيُوتًا وَمِنَ الشَّجَرِ وَمِمَّا يَعْرِشُونَ ﴿٦٨﴾

ثُمَّ كُلِي مِنْ كُلِّ الثَّمَرَاتِ فَاسْلُكِي سُبُلَ رَبِّكِ ذُلًّا يَخْرُجُ مِنْ بُطُونِهَا شَرَابٌ

مُخْتَلِفٌ أَلْوَانُهُ فِيهِ شِفَاءٌ لِلنَّاسِ إِنَّ فِي ذَلِكَ لَآيَةً لِقَوْمٍ يَتَفَكَّرُونَ ﴿٦٩﴾

صدق الله العظيم

سورة النحل الآية (68-69)

# **DEDICATION**

**To the one who lit the dark night of my way.**

**To those who have lived for my ambition and my  
right in the night ranks.**

**To those who watched and supported and  
struggled to see me crowned the necklace of  
honor graduation.**

**To whom I see life from the illusion of hope  
emanating from her eyes to my precious  
mother**

**To the most radiant and brightest lamp of my  
study career and my beloved**

**Father**

**I give you my graduation research**

# ACKNOWLEDGMENTS

**Firstly, my deep thanks for Allah for giving me ability**

**And health to finish this work. I would like to express**

**My gratitude and appreciation to my supervisor Dr. Abdel BagiElsayed Ali for his guidance and help to complete this work.**

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**Continuous help and support.**

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## ملخص البحث

أجريت هذه الدراسة لمقارنة المحتوى الكيميائي لعينات العسل الطبيعي التي أحضرت من ولاية جنوب كردفان - كادوقلي ( 1.ناما ، 2.أبو ليكري ، 3.الدبب) وتم تحليل العينات كيميائيا في معمل جايجا بكلية الدراسات الزراعية جامعة السودان للعلوم والتكنولوجيا. أجرينا تحليل محتوى كيميائي لعناصر كل من: السكريات، الحموضة ، المواد الصلبة الذائبة المواد الصلبة، الرماد ، نسبة الرطوبة ، قلوية العسل.

خلصت نتائج تحليل رطوبة العينة 1 ناما 17.24%، والعينة (2) أبو ليكري 16.43%، والعينة (3) الدبب 15.55%، بينما كانت قراءة متوسط المواد الصلبة في العينة (1) ناما 82.77%، والعينة (2) أبو ليكري 83.57%، والعينة (3) الدبب 84.45%.

بينما كانت نتيجة المواد الصلبة الذائبة في العينة ( 1 ) ناما 5.3%، والعينة ( 2 ) أبو ليكري 6.6%، والعينة (3) الدبب 6.3%.

نتيجة الحموضة في العينة ( 1 ) ناما 0.23%، والعينة ( 2 ) أبو ليكري 0.5%، والعينة (3) الدبب 0.57%.

نتيجة القلوية في العينة (1) ناما 3.46%، والعينة (2) أبو ليكري 3.22%، والعينة (3) الدبب 3.69%.

نتيجة الرماد في العينة (1) ناما 0.26%، والعينة (2) أبو ليكري 0.28%، والعينة (3) الدبب 0.31%.

أما بالنسبة للسكريات عامة فكانت في العينة ( 1 ) ناما 85.33%، والعينة ( 2 ) أبو ليكري 88.88%، والعينة (3) الدبب 96.72%.

نتيجة السكريات المختزلة في العينة ( 1 ) ناما 79.23%، والعينة (2) أبو ليكري 86.43%، والعينة (3) الدبب 93.89%.

وأخيرا نتيجة السكريات غير المختزلة في العينة ( 1 ) ناما 5.60%، والعينة ( 2 ) أبو ليكري 2.44%، والعينة (3) الدبب 2.83%

## Abstract

Chemical analysis of Natural Bee Honey of South Kordofan State of i.e. (moisture content - Total solid - TSS - Titrable acidity - pH of honey - Total Ash - Total sugar - Reducing sugar - Non reducing sugar) was conducted in **JICA** laboratory in College of Agriculture Studies, Sudan University of Science and Technology.

-Result of moisture content of sample(1)Namma is 17.24%, sample(2) Abo lekriy is 16.43%, sample(3)Eldebab is 15.55%.

- Result of Total solid% of sample(1)Namma is 82.77%, sample(2) Abo lekriy is 83.52%, sample(3)Eldebab is 84.45%.

- Result of TSS% of sample(1)Namma is 5.3%, sample(2) Abo lekriy is 6.6%, sample(3)Eldebab is 6.3%.

-Result of Titrable acidity% of sample(1)Namma is 0.23%, sample(2) Abo lekriy is 0.5%, sample(3)Eldebab is 0.5%.

-Result of pH% of sample(1)Namma is 3.46%, sample(2) Abo lekriy is 3.22%, sample(3)Eldebab is 3.69%.

- Result of Total Ash% of sample(1)Namma is 0.26%, sample(2) Abo lekriy is 0.28%, sample(3)Eldebab is 0.31%.

- Result of Total sugar of sample(1)Namma is 85.32%, sample(2) Abo lekriy 88.88%, sample(3)Eldebab is 96.72%.

- Result of Reducing sugar of sample(1)Namma is 69.23%, sample(2) Abo lekriy 86.43%, sample(3)Eldebab is 93.89%.

-Result of Non reducing sugar% of sample(1)Namma 5.60%, sample(2) Abo lekriy 2.44%, sample(3)Eldebab 2.83%.

# CHAPTER: ONE

## Introduction

### 1-1: Introduction:

**Honey** is defined as a naturally sweet mixture produced by bees from nectar of flower, from secretion of the living plants or excretion of plant sucking insect on the living part of plant that the honey bee collect, transform and combine with specific substances of their own ( such as enzyme) , deposit , dehydrate , store and leave in the bee wax honey combs to ripen and mature (OJEC.,1974), Honey gets its sweetness from the monosaccharides fructose and glucose, and has about the same relative sweetness as granulated sugar. It has attractive chemical properties for baking and distinctive flavor when used as a sweetener. Most microorganism do not grow in honey, so sealed honey does not spoil, even after thousands of year.

The historical background and culture of bees honey, the use and production has a long and varied history. In many cultures honey has association that go beyond its use as a food. It is frequently used as a talisman and symbol of sweetness. Honey collection is an ancient activity, humans apparently began hunting for honey at least 8000 years ago, an evidenced by a cave painting is a Mesolithic rock painting, showing to honey hunters collecting

honey and honey-comb from a wild bee nest.

Honey contains a wide variety of vitamins, minerals, amino acid, antioxidants, sugar and Ash.

Some samples of honey from different regions of south kordofan state ( Kadogli) was analysis in food science of Agricultural studies.

## **1-2: Objectives of the Study:**

1- To survey different plant honey sources from South Kordofan State.

2-To study of different samples of natural bee honey in south kordofan state.

3- ToAnalysis of samples for identification pH - TSS- Moisture content- Total sugar - Ash.

# CHAPTER: TWO

## Literature Review

### 2-1: Bee honey:

Honey, obtained from the sealed comb cells, is naturally converted from sugary food from the nectar of flowers and other plant exudation, systematically collected and stored by honey bees.

- Honey assumes different colors and possesses varied flavour and aroma depending on the floral source from where it has been collected. (Mahindry, 2007)

Honey of dark color with strong flavours is characteristic of (Berberislyceum) (Royle) and (Fagopyrum esculentum (moench) honey of dark amber color and strong flavour is obtained from (Dalbergiasissoo)

Honey is derived either from a single plant species or from different floral sources. The former is known as Unifloral honey and the latter as multifloral honey. (Mahindry, 2007)

### 2-1-1: Unifloral Honey:

Some of the Unifloral honeys recorded from the western , are known by the plants from which they are obtained.

### 2-1-2: Local Names plant sources:

i-Actinodaphne angustifolia (Ness) syn. A

nookeri (Meissen).

ii- (Carvicollusa) (Ness) Bremek.

iii-(Syzgiumcumini) (Skeels) syn Eygeniajambalon alum

iv-(Leucasstelligera) (Wall)

v-(Nilgirianthusheyneanus) (Ness)

vi-(N. reticulatus) (Bremek)

vii-(Pogostemonparviflorus) (Benth)

viii-(Xeromphispinosa) (Thumb)

key syn. Randiadumetorum (Retz) Lamm

ix-(Thelepaleixiocephalia) (Benth)

-Honeys of Unifloral type vary in their physico-chemical characteristics. Colour of burambi honey (iv) above, is reported to

be white. Pisa and Neem honey are dark amber. While honey from Terminal species is light yellow. Flavour is reported to be

rosy as in litchi (Litchichenosis) (sonn) syn. Nepheliumlitchi

(corn bees) mild as in sahan (Moringaoleifera) (Lam) syn.

M. pterygosperma (Gaerten) or pungent as in jambul or jamun. Karvi honey exhibits reversible viscosity (thixotropy) since it shows a tendency to form a jelly when it remains static, becoming easy flowing when agitated, and again settling into a jelly on prolonged keeping. In this respect it resembles certain protein complexes or pectin and other polymers from arabinose.

Honey has been mostly extracted in the past from wild honey bee colonies by very crude unhygienic and destructive methods like squeezing the combs and straining out the honey. (Mahindry, 2007)

## 2-2: Characteristic of honey

Honey is considered to be a natural plant food where it is collected as a nectar of plant-specific gland, then it undergoes several natural and chemical changes until it is converted into a mature honey. Stored honey, it is known as a sweet substance with a thick texture, somewhat.

The Philips have developed in 1930 another definition of honey as a thick material, aromatic, sweet. The nectar is produced by

bees, which convert them to a more dense liquid as food and

stores it. It has an acidic effect and consists mainly of two types of monocrystalline sugars: namely dextrose and levulose, with some other carbohydrates. And levulose sugar may be predominant in honey, it also contains mineral salts, plant dyes and some enzymes and pollen.

There are several colors of honey that have degrees and these colors are:

- water white.
- Extra white
- White
- Extra light amber
- Light amber
- Amber
- Dark amber. (Ahmed, 1974)



## **2-3: Composition of honey:**

Water 18%

Glucose 35%

Fructose(levulose) 40%

Other sugars 4%

Other substances 3%

The part that makes honey unique is the vast mixture of substances found in the 3 percent of other substances. (Ted Hooper, 1976)

Abrea known of this 3 percent is girenin the next table which shows that it includes vitamins, pigments, enzymes and various biologically active substances such as plant growth hormones rooting compounds choling and acetyl-choline.

Constituent parts of the 3 percent(other substances in honey)

About 15 organic acids including acetic, butyric, gluconic, malic and sussinic

About 12 mineral elements including potassium, calcium, sulphur, chlorine and iron.

About 17 free amino acids including praline, glutamic acid, lysine.

About 4-7 proteins.

- Honey has a built in antibacterial substances based upon the production of peroxide by an enzyme which is added by the bee.

This active sterility of honey has caused it to be used from wound

dressing together with its other advantages of complete lack of any side effect upon healthy tissue and the fact that does not dry out.(Ted Hooper, 1976).

## **2-4: Kinds of honey:**

Honeys are classified by the principal sources from which the bees gathered the nectar Although bees may work only one plant source at a time the chances are that there is nectar from several plant types in most honeys. Honey is identified by one or more prominent floral. Source names as (gall berry honey) or (alfalfa honey) or by two names are also used, such as fall flower and (spring blend) it has been held by the food and Drug Administration (Merrick 1948) that honey may be not labeled with the name plant or blossom except where the particular plant is the chief floral source of the product. (Ted Hooper, 1983)

Another system of classifying honey is by method of production and preparation for market:

1- Extracted honey: also known as strained honey is honey that has been separated from the comb by centrifugal force, gravity, straining or by other means.

2- Comb honey: is honey contained in the cells of the comb in which it produced .it appears on the market in several forms:

a- Section comb honey: produced in squares  $4\frac{1}{4} \times 4\frac{1}{4} \times 1\frac{7}{8}$  inches or rectangles  $4 \times 5 \times 1\frac{3}{4}$  inches called section. Such novelty from as circular sections may be seen.

b- Individual section comb honey: is produced in small sections usually one quarter the size of ordinary sections.

c- Bulk comb honey: is comb honey produced in shallow extracting frames fitted with thin super foundation. These combs may be sold when filled as complete units.

d- Cut comb honey: is bulk comb honey cut into pieces of various sizes, the edges drained or extracted, and the individual pieces wrapped in cellophane or polyene bags.

e-Chunk honey: consist of cut comb honey packed in a container which is filled with liquid extracted honey.(Ted Hooper, 1983)

## **2-5: Physical properties of honey:**

- The hygroscopicity of substance is its ability to remove moisture from the air. It is commonly expressed by relative humidity of the moisture.

The exact degree of hygroscopicity of honey depends upon the specific composition of the samples is not large. Honey (17,4 percent moisture) has been found by martin(1939) to be in equilibrium with air at 58% relative humidity. This honey would gain water if exposed to air dryer than 58 percent R.H.

Moisture change would continue until the honey reached a moisture content in equilibrium with the ambient relative humidity.has determined the equilibrium moisture content of honey exposed to various atmospheres.Martin(1958)

- The viscosity of material is simply its resistance to flow. The bee keeper call sit (body).

A heavy- bodied honey has a high viscosity and flows only slowly. Like other physical properties, viscosity of honey depends upon its composition of moisture content of honey by a viscosity measurement. She used the

time of fall of a steel ball in a special apparatus and claimed an accuracy equal to direct drying.

- Honey viscosity is of great practical importance to the bee keeper and honey processor. The high viscosity of honey makes it difficult to empty containers and to extract it from the comb. It retards the rate of straining and clarification, including (settling) and clearing of entrapped air bobbies. As all bee keepers know,

the body of honey is reduced by heating.

- The density of substance is its weight per unit volume. It usually is expressed as pounds per cubic foot, pounds per gallon, or gram per milliliter.( Mahindry, 2007).

The most familiar expression for honey is in pounds per gallon honey meeting the grading requirements for U.S. fancy or choice most have a density of at least 11 pounds, 120 unces per gallon.

- The refractive index of substance is actually the ratio of the velocity of light in the substance to that in air. This apparently abstruse and difficult measurement provides the simplest and possibly the most accurate method of determining the water content of honey.

- Color is an optical property of honey. Inasmuch as it is the result of the different degree of absorption of light of different wave lengths by the constituents of honey. Honeys may vary from

virtually colorless to deep red in color through shades of yellow. Amber and Brown with greenish or reddish tints.(Mahindry, 2007).

## **2-6: The composition of honey:**

### **2-6-1: Moisture content:-**

The natural moisture of honey in the comb is that remaining from the nectar after ripening. Its concentration is thus a function of the factors involved in ripening, including weather conditions and original moisture of the nectar. The moisture content of honey may change after removal from the hive as result of storage conditions after extraction. It is one of the most important characteristics of honey, having a profound influence on keeping quality, granulation and body yet a few beekeepers trouble to measure it relying instead on rule of thumb. (Ted Hooper,1976).

### **2-6-2: The sugars of Honey:**

Since honey is above all a carbohydrate material with 95 to 99.9 percent of the solids being sugars, they have been studied for

many years. Recently much new information has been published about the sugars found in honey.(Ted Hooper,1976).

## **2-7: Flowering calendar of shrubs and trees considered as honey sources of South Kordofan area:-**

### **1-*Acacia nilotica* L.**

Vernacular names: Arabic: Sunt, Garad (fruit).

English name of *Acacia nilotica* is Egyptian thorn.

Flowering calendar: from June to September and may extend to March.plate(C).

## **2-*Acacia Seyal* Del.**

Vernacular names: Arabic: Taleh.

English name of *Acacia Seyal* is Thirsty thorn.

Flowering calendar: extend from November to April. Plate(A).

## **3-*Acacia polyacantha* Willd.**

Arabic name: Um sienanna.

Flowering calendar: March to August, (Souanel, 1984) Plate(H).

## **4-*Acacia Senegal* (Linn).**

Vernacular names: Arabic: Hashab and Alloba.

Flowering: extend between November and February. (Souanel 1984) .

## **5-*Acacia mellifera* (vahl)**

Vernacular names: Arabic: Kitir.

English name: Wait a bit thorn.

## **6- *Azadirachta indica* J**

Vernacular names: Arabic: Neem.

Flowering: March to September.

## **7-*Boswellia papyrifera* (Del.) Hochst**

Vernacular names: Arabic: Tarag-tarag and Gafal.

English name: Frankincense tree and elephant tree.

Flowering time: extend between March and April. Plate(D).

**8-*Combretumghsalense***Engl& Diels.

Vernacular names: Arabic: Habil.

Flowering time: November to February.

**9-*Combretumlamprocarpum*** Diels.

Vernacular names: Arabic: Habila.

Flowering: January to February.(Souanel, 1984).

**10-*Combretumhartmannianum***Schweinf.

Vernacular names: Arabic: Habel.

Other Arabic name: Subagh, Sobakh and Sobakh soda.

Flowering: April to may6.(Souanel, 1984).

**11- *Combretumglutinosum*:**

Vernacular names: Arabic: Habel and Habel el gebel.

Flowering: October to December.(Souanel, 1984).

**12-*Dalbergiamenaloxylon***Guill.

Vernacular names: Arabic: Babanous, Abanous.

Flowering: October to March.

**13-*Guierasenegalensis* J.F.**

Vernacular names: Arabic: Ghobeish.

The other Vernacular Arabic names of the tree is Robbeish. Plate(E).

**14-*Ziziphusspina-christi* L.**

Vernacular names: Arabic: Al- sider, Al-nabag (fruit).

Flowering: August to December. (Souanel, 1984) Plate(B).

**15-*Sclerocarybirrea*. (R.Rich)**

Vernacular names: Arabic: Homaid.

Flowering: November to January. (Souanel, 1984) Plate(F).

**16-*Balanitesaegyptiaca*(L.)**

Vernacular names: Arabic: Hajleej (tree), Laloub( fruit).

English name: Soapberry tree.

Flowering time extend between November and April. (Souanel, 1984).

**17-*Diospyros mespiliformis*.**

Vernacular names: Arabic: Joghan and Ubo- sebela.

Flowering: January to February. (Souanel, 1984).



**18- *Bauhinia rufescens* Lam.**

Vernacular names: Arabic: Kharob and Kolkol.

English name: Carob.

Other Arabic local name: Abu khamera.

Flowering: December to March. (Souanel, 1984)Plate(H).

**19- *Eucalyptus microtheca*.**

Vernacular names: Arabic: Cafoor and Ban.

English name: Coolabah and flooded box.

Flowering time: July and August.

**20- *Eucalyptus camaldulensis* Dehnh**

Vernacular names: Arabic: Cafoor and Ban.

**21- *Tamarindus indicus*. L.**

Vernacular names: Arabic: Ardaib.

English name: Tamarind and Indian date.

Flowering: November to December and May to August.(Souanel,1984).

**22- *Khayasenegalensis***

Vernacular names: Arabic: Mahogany ,Maraya and hamra.

English name: Senegal mahogany, African mahogany.

Flowering time: is during February and March.

**23-*Ximenia Americana* Linn**

Vernacular names: Arabic: Mideka, Lemon el Gaba.

Flowering: from January to May.(Souanel, 1984).

**24-*Adansoniidigitata*. L.**

Vernacular names: Arabic: Tebaldi.

English name: Baobab.

Flowering: is from June to July. (Kess, 1995)Plate(G).

**25-*Terminaliaavicennioides* Guill&perr**

Vernacular names: Arabic: Darot.

Flowering: begins in October and ends in November. (Souanel,1984).

**26-*Albiziaamara* (Rokh) Boiv.**

Vernacular names: Arabic: Arrad el Goz.

Flowering: Rainy season .

**27-*Dichrostachya cinerea*.**

Vernacular names: Arabic: Kadad, Hegam, Hurgam, Kadada, Um kedad and Hurgan.

Flowering: April to June.(Souanel, 1984).

**28-*Parkinsoniaaculeata*L.**

English name: Jerusalem thorn, Horse bean tree, Takataka tree  
and Barbados.

Flowering: October to December.

# CHAPTER: THREE

## Materials and Methods

### 3-1 Site location:-

#### 3-1-1 Kadogli area:-

The State of South Kordofan Located between two longitudes(13-9/32-29) in the east and Two Latitude(9-59/12-36) in the north. The State occupies a border position with the States of upper Nile Unity , north Bahr el Ghazal and Arrab it is located on the east side of the white Nile State, north of north Kordofan state, Darfur.[www.portalsks.gov.sd](http://www.portalsks.gov.sd)>aboutstate.

Characterized by geographical and climatic diversity and ethnic and traditions , which are different and from a peaceful and peaceful coexistence of peace and love and unique composition of the population reflects the image of the life of the people Sudan.  
[www.portalsks.gov.sd](http://www.portalsks.gov.sd)>aboutstate.

#### 3-1-2 Laboratory:-

In JICA laboratory , Sudan University of Science and Technology, College of Agricultural Studies the samples was analysis.

## **3-2 : Materials of the study:-**

### **3-2-1: samples of honey from different regions and villages of Kadogli:**

Sample(1):Namma honey

Sample(2): Abo lekri honey.

Sample(3): Al debab honey.

### **3-2-2 Laboratory equipments and materials:-**

#### **Ash materials:-**

Sensitive Balance, Porcilincrucibles, Maffulefwrance, For clips and Samples.

#### **TSS:-**

Refractometer, Tissues, Distilled water, PH meter, Distilled water, Buffer solution (4-7), Beakers and Samples.

#### **Titration acidity:-**

Sensitive Balance, NaoH flakes, NaoH O.1, Burriete, FunnelandpH meter.

#### **Moisture:-**

Sensitive Balance,Alummenur dishes, For clips, Dissicator, Oven and Samples.

### **3-3: Methodology of the study:-**

#### **3-3-1 Moisture content:-**

The moisture content was determined according to the standard methods of the Association of Official Analytical chemists (AOAC, 2003).

**Principle:**The moisture content in a weighed sample is removed by heating, the sample in an oven 105C. then, the difference in weight before and after drying is calculated as a percentage from the initial weight.

**Procedure:**A sample of  $2 \pm 0.001$  g was weight into a pre-dried and tarred dish. Then, the sample was placed into an oven (No.03-822, FN 400, Turkey) at 105C Until a constant weight was obtained. After drying the covered sample was transferred to desiccators And cooled to room temperature before reweighting. Triplicate results were obtained for each sample and the mean value was reported to two decimal points according to the following formula:

#### **Calculation:**

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

Sample weight

#### **Where:**

**Ws** = Weight of sample before drying.

Wd = Weight of sample after drying.

**Where:**

W1= Weight of sample before ignition.

W2= Weight of sample after ignition.

### **3-3-2 Total sugars, Reducing and Non- reducing sugars:-**

The total sugars as well as reducing and non-reducing sugars were determined according to Lane and Eynontitrometric methods as described by the association of Official Analytical Chemists(AOAC,1984).

**Principle:** Reducing sugars in pure solution in plant materials after suitable pre-treatment (to remove interference substances ) may be estimated by using copper sulphate as oxidizing agent in a standard Fehling solution.

#### **Sample preparation:**

(A) **Reducing sugars:** A sample of  $10 \pm 0.001$  g was weight and transferred to 250 ml volumetric flask. 100 ml of distilled water was carefully added and then neutralized with 1.0 N NaOH to a Ph 7.5 - 8.0 Then, about 2 ml of standard lead acetate (No.23500, BHD, England) was added and the flask was shaken and left to stand for 10 min. After that, 2 ml of sodium oxalate were added to remove the excess amount of lead

acetate and the solution was made up to volume (250 ml) with distilled water And filtered.

**(B) Total sugars:** from the previous clear sample solution, 50 ml were taken into a 250 ml conical flask and  $5 \pm 0.001$  g citric acid and 50 ml distilled water were added slowly. Then, the mixture was gently boiled for 10 min to complete the inversion of source and left to cool at room temperature. After that, the solution was transferred to 250 ml volumetric flask, neutralized with 20% NaOH solution in the presence of few drops of phenolphthalein (NO.6606 J.T Baker, Holland) until the colour of the mixture disappeared and the sample was made up to volume before titration.

**Procedure:**A volume of 10 ml from the mixture of Fehling (A) and (B) solutions was pipette into 250 ml conical flask. Then, sufficient amount of the clarified sugars solution added from burette to reduce Fehling s solution in the conical flask. After

that, the solution was boiled until a faint blue colour is obtained.

Then, few drops of methylene blue indicator ( S-d- FINE-CHEM LIMITED) were added to Fehling's solution and titrated under boiling with sugars solution until brick-red colour of precipitate cuprous oxide was observed. Finally, the titer volume was recorded and the amount of inverted sugars was obtained from Lane and Eynon Table. The total



sugars, reducing and non-reducing sugars were calculated by using the following formulas:

### **Calculation:**

$$\text{Total sugars (\%)} = \frac{\{\text{invert sugar(mg) dilution factor}\}}{\text{Titre sample weight(g) 1000}} \times 100\%$$

Titre sample weight(g) 1000

Reducing sugars(%) =

$$\frac{\{\text{invert sugar(mg) dilution factor}\}}{\text{Titre sample weight(g) 1000}} \times 100\%$$

Titre sample weight(g) 1000

Non- reducing sugars(%) =

$$\{\text{total sugars (\%)} - \text{reducing sugars (\%)}\}$$

### **Where:**

Titre = (Sample - blank).

### **3-3-3: Ash content:**

The ash content was determined according to the method described by the(AOAC,2003).

Principle: the inorganic materials which are varying in concentration and composition are customary determined as a residue after being ignited at a specified heat degree.

### **Procedure:**

A sample of  $5 \pm 0.001$  g was weight into a pre-heated, cooled, weighed and tarred porcelain crucible and placed into a muffle furnace (No.20.301870, Carbolite, England ) at 600 C until a white gray ash was obtained. The crucible was transferred to a desiccators, allowed to cool to room temperature and weight. After that, the ash content was calculated as a percentage based on the initial weight of the sample.

### **Calculation:**

Ash (%) =  $\frac{\{(Wt\ of\ crucible+ \ Ash) - (Wt\ of\ empty\ crucible)\}}{Sample\ weight(g)} 100\%$

### **3-3-4: Total soluble solids (TSS):-**

Total soluble solids (TSS) of honey bees were measured with hand- type Refractometer (0-50% Brix) at 20 C° it was expressed (%) or degree Brix according to (A.O.A.C., 1990).

### **3-3-5: pH Value:-**

The pH of the honey bee was measured with glass electrode pH meter (Model: HANNA instruments 8521) at ambient temperature.

### **3-3-6: Total titrable acidity:**

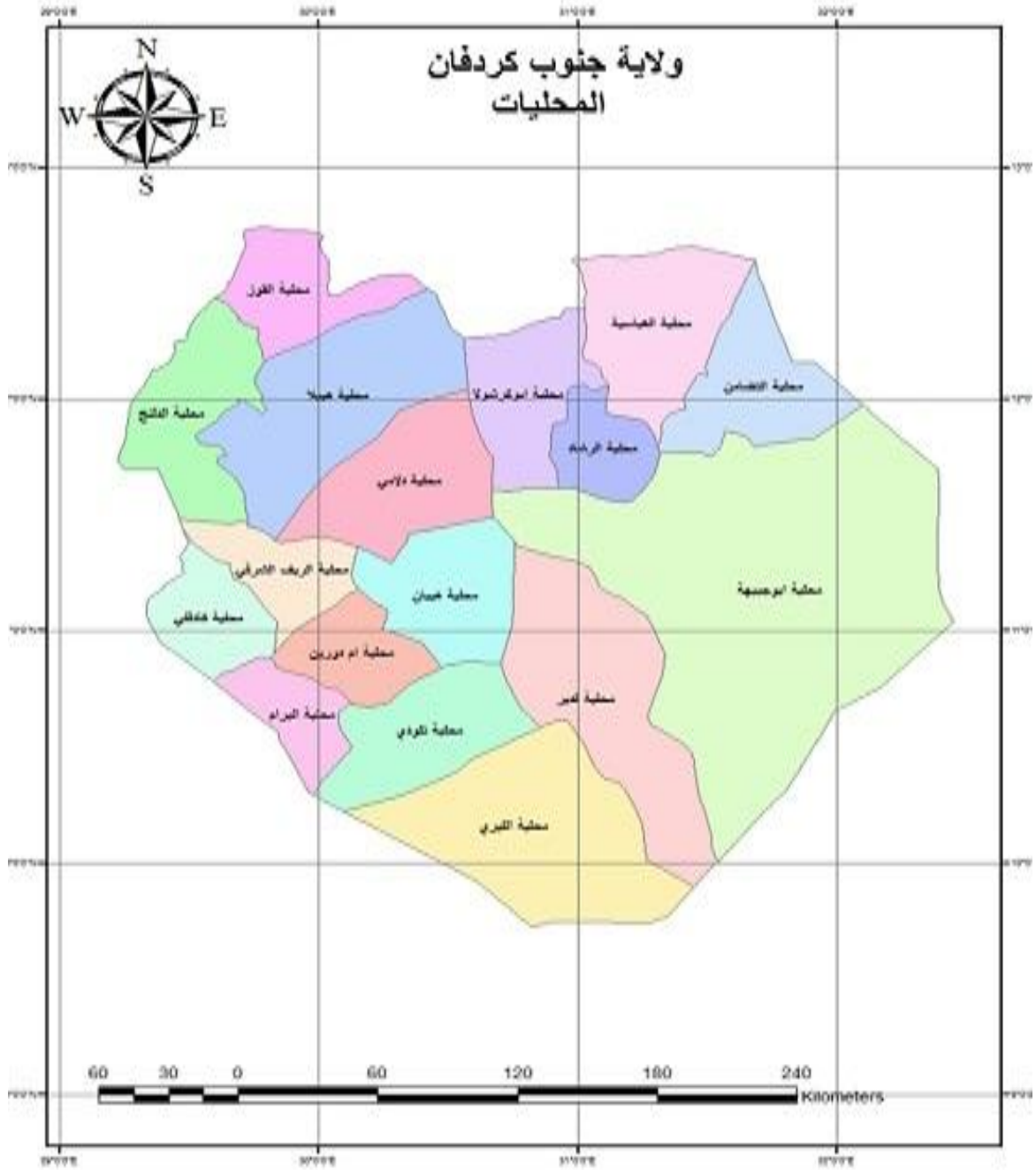
The Total titrable acidity was calculated according to Board Method (1988). Ten grams of honey bees were weighted into a 250 ml Beaker , diluted with 90 ml of distilled water and titrated against 0.1 N NaOH to

pH 8.0 using phenolphthalein as an indicator and it was calculated as follows :-

Total acidity (mg/100g) expressed as citric acid =

Titer (ml) x N (NaOH) x dilution x equivalent weight x 100

Weight of the sample taken x volume taken for estimation



**(A): Area of the Study- South Kordofan State**



**(B) Villages of the Study- South Kordofan State**

**Plate(1): Area of Study (A-B)**



**(A):**Refractometer**(B):**pH meter



**(C):**Burritte



**(D): Sensitive balance****(E): Petri dish**



**(F): Oven**

**Plate(2): Laboratory Equipments(A-F).**



(A):Taleh(B):Alseddir



(C):Algarad( el-sunt)(D):Samokhalluban





(E): Elkhubiesh



(F) Homaid



(G):Tebaldi



(H): Om sienanna



(I): Kharob

**Plate(3): different plant honey sources from South Kordofan State(A-I)**

# CHAPTER: FOUR

## RESULTS

### **4-1: Results of Chemical analysis of Natural Bee Honey Samples of South Kordofan State:-**

Chemical analysis of Natural Bee Honey samples of South Kordofan State i.e. (Moisture content - Total solid - TSS - Titrable acidity - pH- Total Ash - Total sugar - Reducing sugar - Non reducing sugar) was conducted in **JICA** laboratory in College of Agriculture Studies, Sudan University of Science and Technology.

#### **4-1-1: Result of Moisture Content(%) and Total Solid(%):**

- Result of moisture content of sample1 Namma(17.24%), sample2 Abo lekri(16.43%), sample3Aldebab(15.55%).
- Result of total solid% of sample1Namma(82.77%), sample2 Abo lekri(83.52%), sample3Aldebab(84.45%).

#### **4-1-2: Result of Total Soluble Solids(%) and Titrable Acidity(%):**

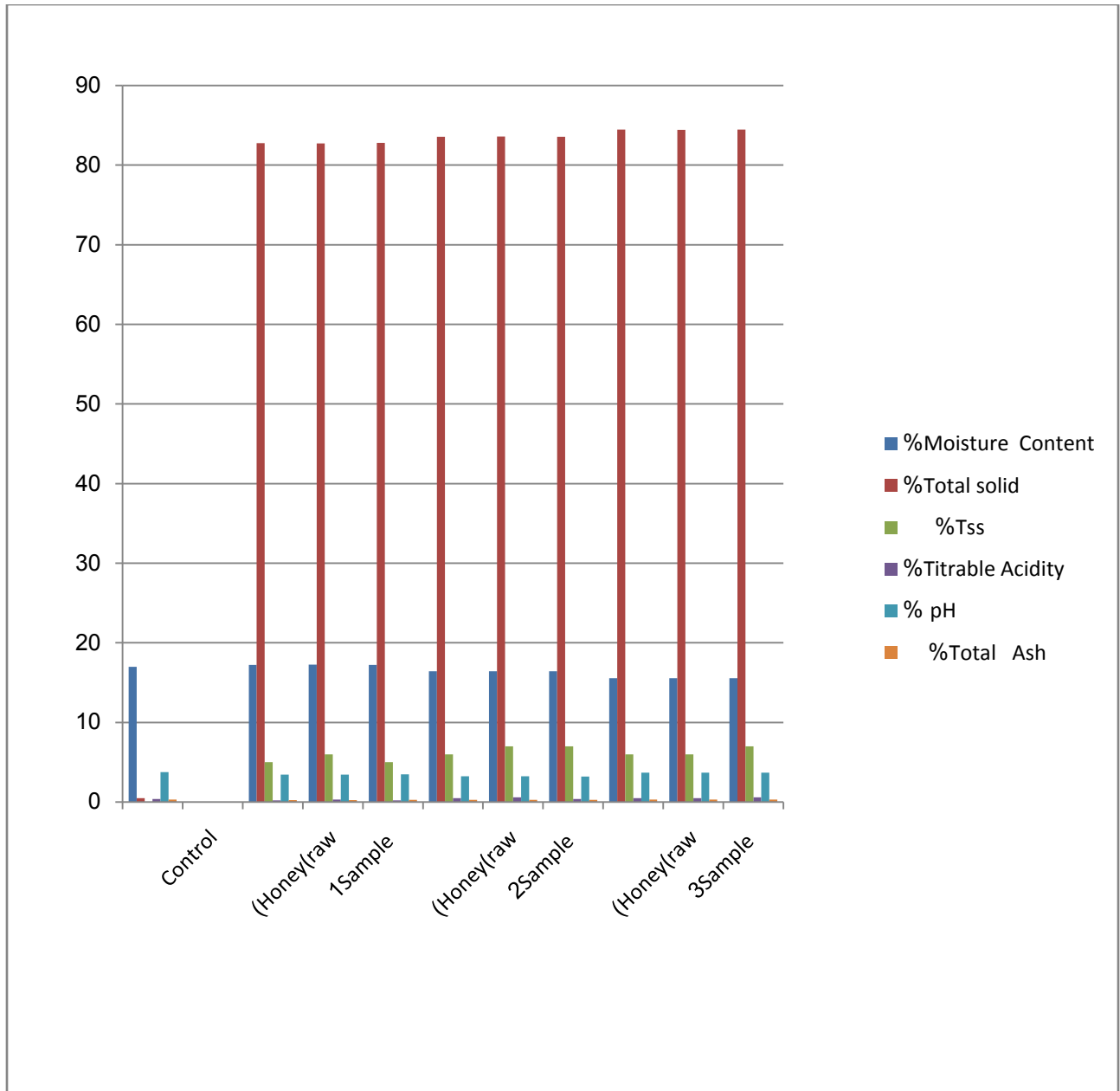
- Result of TSS% of sample1Namma(5.3%), sample2 Abo lekri(6.6%), sample3Aldebab(6.3%).
- Result of Titrable acidity% of sample1Namma(0.23%), sample2 Abo lekri(0.5%), sample3Aldebab(0.5%).

### **4-1-3: Result of pH(%) and Total Ash(%):**

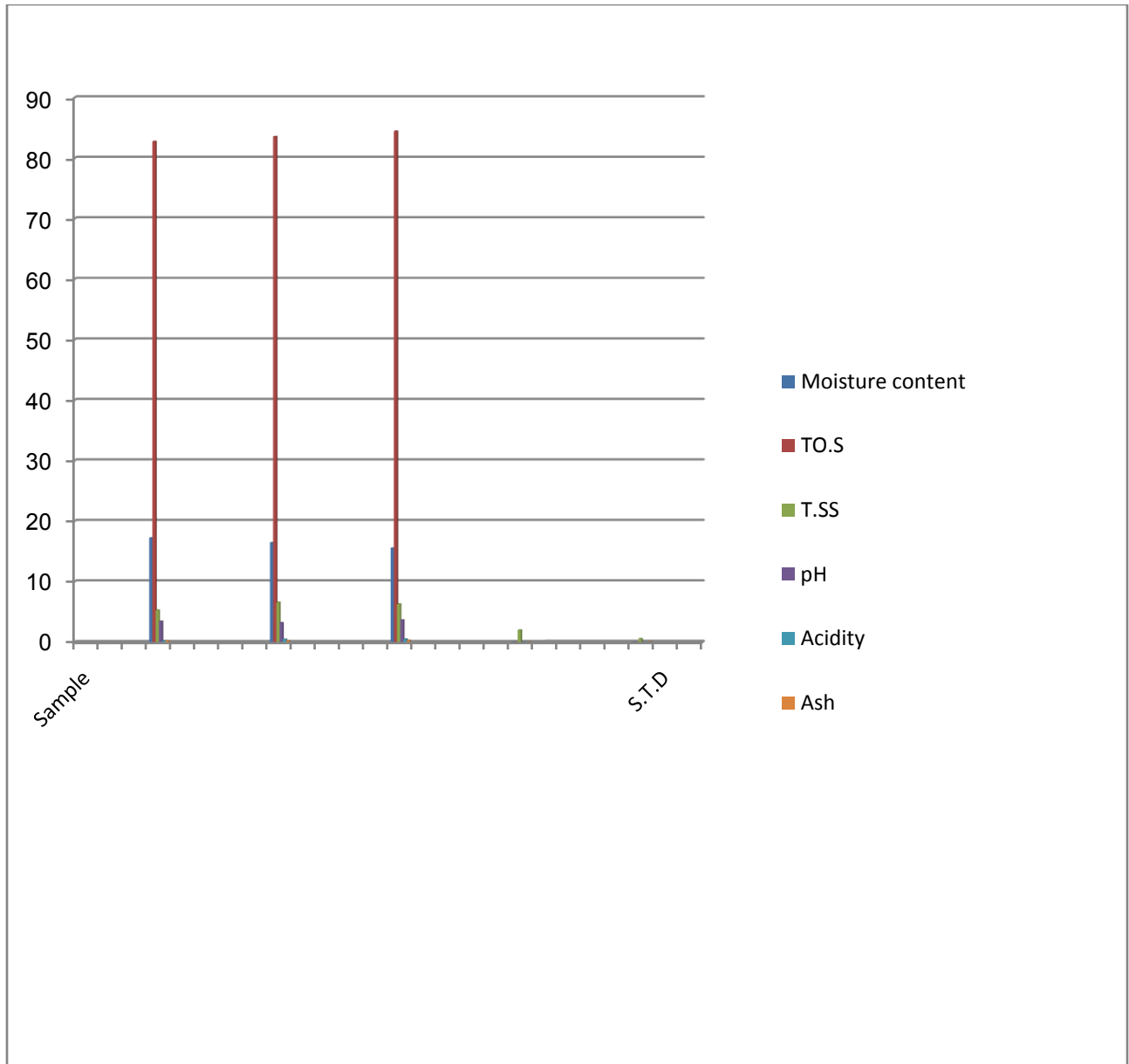
- Result of Ph% of sample1Namma is (3.46%),sample2 Abo lekri(3.22%), sample3Aldebab(3.69%).
- Result of total Ash% of sample1Namma(0.26%), sample2 Abo lekri(0.28%), sample3Aldebab(0.31%).Table(1).

**Table(1) Results of chemical and Statistical analysis of honey samples of southKordofan State:-**

Parameter Sample	Moisture Content %	Total solid%	Tss%	Titration Acidity %	pH %	Total Ash%
<b>Contro l</b>	17	84.33	-	0.4	3.75	0.3
<b>Honey Sample 1</b>	17.24	82.76	5	0.2	3.46	0.26
	17.26	82.74	6	0.3	3.46	0.25
	17.22	82.78	5	0.2	3.47	0.27
<b>Honey Sample 2</b>	16.44	83.56	6	0.5	3.22	0.29
	16.42	83.58	7	0.6	3.23	0.28
	16.43	83.57	7	0.4	3.21	0.29
<b>Honey Sample 3</b>	15.55	84.45	6	0.5	3.68	0.31
	15.56	84.44	6	0.5	3.70	0.32
	15.54	84.46	7	0.6	3.69	0.30
<b>SE</b>	0.0021	0.0021	2	0.00047	0.00047	0.03
<b>LSD</b>	0.01410	0.0141	0.5774	0.00882	0.00882	0.0745



**Figure (1): Results of chemical analysis of honey samples of southKordofan State.**



**Figure(2): Statistical analysis of research results**

#### **4-1-4:Result of Total Sugar%, Reducing Sugar% and Non-reducing Sugar%:**

- Result of total sugar of sample1Namma (85.32%), sample2 Abo lekri(88.88%), sample3Aldebab (96.72%).
- Result of Reducing sugar of sample1Namma(69.23%), sample2 Abo lekri(86.43%), sample3Aldebab(93.89%).
- Result of Non reducing sugar% of sample1Namma(5.60%), sample2 Abo lekri(2.44%), sample3Aldebab(2.83%).Table(2)

**Table(2) Result of Chemical and Statistical analysis of the Total Sugars content(Reducing and Non-reducing) of natural honey samples from SouthKordofan State:-**

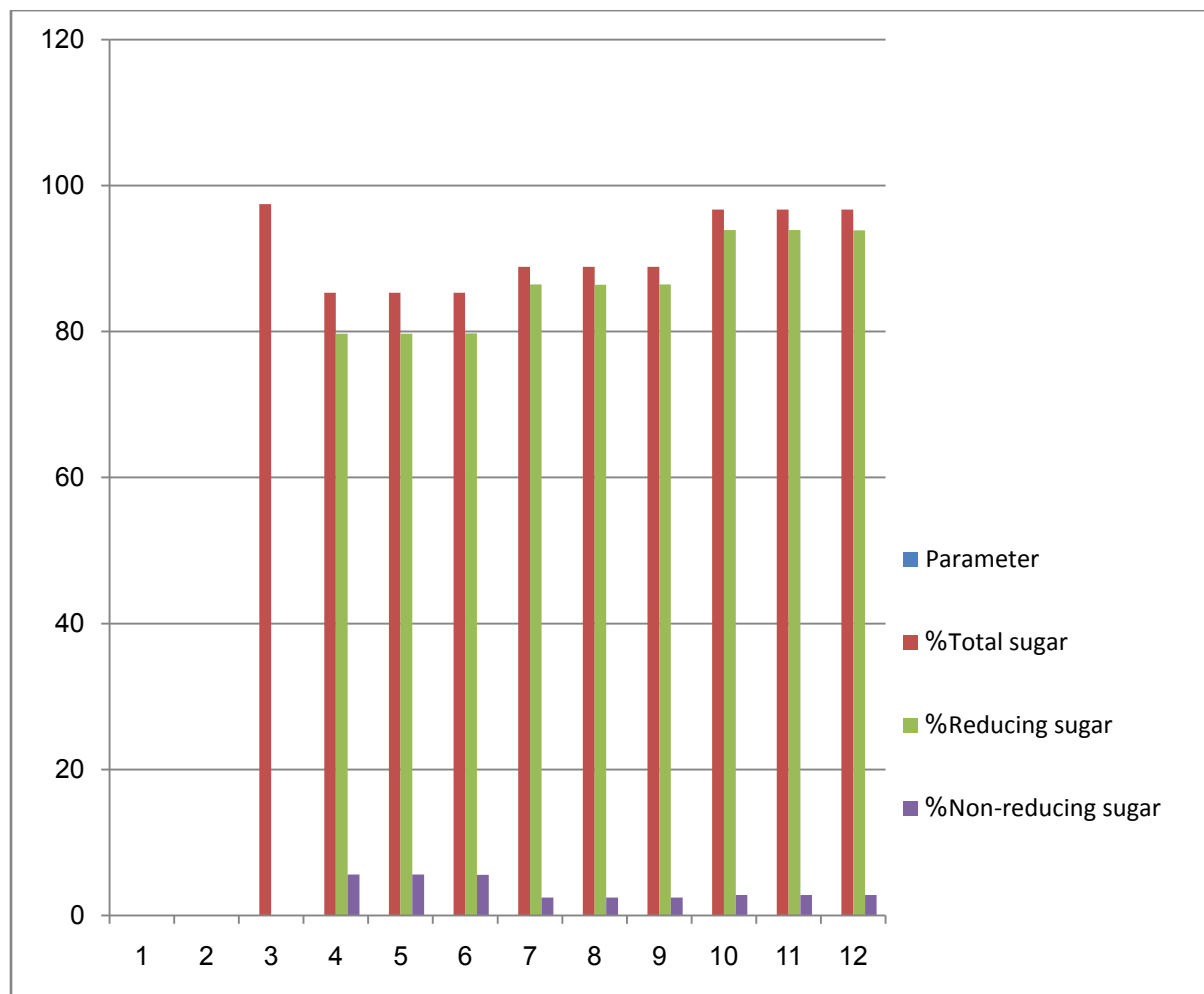
<b>Parameter Sample</b>	<b>Total sugar%</b>	<b>Reducing sugar%</b>	<b>Non- reducing sugar%</b>
<b>Control</b>	97.45		
<b>Honey Sample 1</b>	85.32	79.71	5.61
	85.32	79.72	5.60
	85.33	79.74	5.59
<b>Honey Sample 2</b>	88.89	86.44	2.45
	88.88	86.43	2.45
	88.88	86.44	2.44
<b>Honey Sample 3</b>	96.72	93.91	2.82
	96.74	93.92	2.82
	96.72	93.86	2.82
<b>SE</b>	0.0004	0.0026	0.0017
<b>LSD</b>	0.0082	0.02	0.0167

**Keys:**

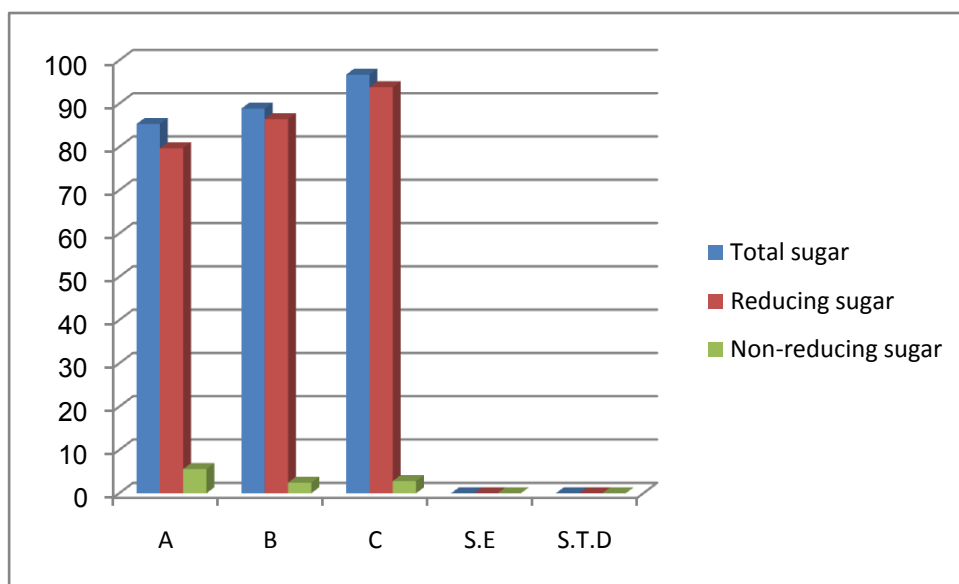
SE= Standard error

LSD= Least Significant differences





**Figure (3): Result of analysis of the Total Sugar(Reducing and Non-reducing) of natural honey samples from SouthKordofan State.**



**Figure(4):Statistical analysis of research results**

## **CHAPTER: FIVE**

### **5-1: Discussion:**

Sample 1Namma gave the best result of moisture(17.24)%, sample 3Aldebab gave lower result of moisture(15.55)% , sample 3 Aldebabgave highest result of sugar (96.72)%, sample 1Namma gave lowerresult of Sugar(85.32)% sample 3Aldebab gave the best result of Total Solids (84.45)% ,sample 1Namma has lower result of Total Solids(82.77)% also sample 1Namma gave a low pH result(3.46%), sample 3Aldebab gave high result of pH(3.69)%, and sample 1Namma gave little content of Total Ash(0.26)%, sample 3Aldebab gave a lot of Total Ash(0.31)% either acidity, sample 1Namma is the level close to the control 3.46%.

### **5-2: Conclusions:**

In this study the best result of Analytical Study of Natural Bee Honey of South Kordofan State is Sample (1) Namma honey Comparing with Standard Specifications.

### **5-3: Recommendation**

We recommended to be Continuous of this research in Future Studies due to the existence of a large diversity and the spread of natural honey production in the regions and localities of South Kordofan State. The wide spread of these sources and diversity affects the chemical and physical properties of honey production, and we recommend conducting similar Studies to cover the research area.

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[www.portalsks.gov.sd](http://www.portalsks.gov.sd)> about state.

[www.na7la.com](http://www.na7la.com).

Wikipedia- honey.

**3(1):Statistical analysis of research result of Results of chemical analysis of honey samples of south Kordofan State:-**

Sample	Moisture content	TO.S	T.SS	pH	Acidity	Ash
A	17.24 <sup>a</sup>	82.76 <sup>a</sup>	5.3 <sup>a</sup>	3.46 <sup>a</sup>	0.23 <sup>a</sup>	0.26 <sup>a</sup>
B	16.43 <sup>b</sup>	83.57 <sup>b</sup>	6.6 <sup>ab</sup>	3.22 <sup>b</sup>	0.5 <sup>b</sup>	0.28 <sup>b</sup>
C	15.55 <sup>c</sup>	84.45 <sup>c</sup>	6.3 <sup>ab</sup>	3.69 <sup>c</sup>	0.53 <sup>b</sup>	0.31 <sup>ab</sup>

**Appendix(2):Statistical analysis of research result of Result of Chemical analysis of the Total Sugars content(Reducing and Non-reducing) of natural honey samples from South Kordofan State:-**

Sample	Total sugar	Reducing sugar	Non-reducing sugar
A	85.32 <sup>a</sup>	79.72 <sup>a</sup>	5.6 <sup>a</sup>
B	88.88 <sup>b</sup>	86.44 <sup>b</sup>	2.45 <sup>b</sup>
C	96.73 <sup>c</sup>	93.81 <sup>c</sup>	2.83 <sup>c</sup>