Chapter One

Introduction

1.1 Introduction

Honey is the natural sweet substance produced by honey bees from the Nectar of blossoms or from secretions of living parts of plants or excretions of Plant sucking insects on the living parts of plants, which honey bees, collect, Transform and combine with specific substances of their own, store and leave In the honey comb to ripen and mature (Codex Alimentations Commission, 1994). Honey consists essentially of different sugars, predominantly glucose and Fructose. The color of honey varies from nearly colorless to dark brown. The consistency can be fluid, viscous or partly to entirely crystallized. The Flavor and aroma vary, but usually derive from the plant origin (CodexAlimentations Commission 1994). In a few cases the geographical origin can be established by the presence of characteristic pollens which are limited to a certain region. More often the Presence of certain pollen combinations (honey types) allows a determination of the region in which the honey was produced. The pollen spectrum of a Honey is a result of the floral, agricultural and forest conditions of the region in which the honey was produced (Foveaux *et al,* 1978). The determination of the botanical origin of bee honey is based on the identification of the pollen Grains and other constituents of the sediment and on the frequencies of the different microscopic elements (Foveaux *et al.*, 1978).

Honey may be designated according to floral or plant source if it comes wholly or mainly from that particular source and has the oregano lactic, Physiochemical and microscopic properties corresponding with that origin. Honey consists fundamentally of different sugars (such as fructose and glucose), proteins, minerals, organic acids, enzymes as well as other substances and solid particles derived from honey collection. Bee honey is a valuable food that contains a combination of necessary nutrients. The honey types produced in a certain country or area represent the floral or nectar sources in that place, whose presence solely depends on the climate, topography and agricultural pattern of that area. Different kinds of bee honey vary considerably in their physical, chemical and oregano lactic properties (Mohammed, 2006).

1.2 Research Problem

The field of laser matter interaction may be with metal, tissue or food this research study the effect of laser in honey properties of physics and chemical.

1.3 Literature review

Abdelgadir Taha Abdelgadir Elsheikh (2003**)** the objective of this study was to compare the physiochemical properties of bee honey with those of sugarcane honey. Four samples of bee honey and two of sugarcane honey were collected. The bee honey samples differed in their plant source; these were Helianthus annulus, Acacia militia var. militia, Sisyphus spina-christi and Azadirachta indicia. The sources of sugarcane honey were a local product and an imported one. The six samples were analyzed for total reducing sugar, fructose, glucose, sucrose, moisture, protein, ash, minerals and PH the physical and functional properties, e.g., free acidity, refractive index, opticalactivity, Hydroxymethylfurfural (HMF) and diastase number were determined. The results showed that the reducing sugars were higher in the bee honey than in the sugarcane only. Similarly, fructose was higher in the bee honey and relatively low in the sugarcane honey. However, sucrose was higher (27.79- .74%) in the sugarcane honey and relatively low (1.15-0.60%) in the bee honey. The moisture content for all samples of honey was in the range 19.05- 17.00%. Protein content was markedly high in bee honey (1.05-

0.70%) while it was low (0.35-0.25%) in sugarcane honey. The ash in bee honey was in the range of 0.50-0.15%. All honey samples were slightly acidic and gave pH values of 5.95-4.88. The Diastase number (DN) for bee honey was in the range of 5.93-3.4 DN being highest in *Helianthus annulus* bee honey and lowest in *Azadirachta indicia* bee honey, while the sugarcane honey was free of diastase. Hydroxymethylfurfural (HMF) showed a lot of variation among the honey samples with a wide range of 101.50-4.60mg/kg. The bee honey contained relatively high amounts of Na and K in the ranges 660 to 150 and 1968 to 319 ppm, respectively, while Fe was in the range 80.65-30.65 ppm. Bee honey showed refractive indices in the 1.490-1.461 while sugarcane honey had a refractive index 1.493 for both samples. Bee honey samples were laevorotatory except the bee honey of Sisyphus spina-christi which is dextrorotatory, while both sugarcane honey samples were dextrorotatory.

Sumaya Ibrahim Mohammed Ham ad (2007) used this investigation was carried out to determine the phenol contents and antioxidant activity of Sudanese honey. Seven samples of Sudanese honey were tested for phenol content, antioxidant activity and other parameters such as moisture, pH, refractive index, ash, total soluble solids, protein, electrical conductivity and color intensity. Results of analysis demonstrated that there is a good amount of

Phenol content and antioxidant activity in Sudanese honey. It ranged from 4.4 to 201.1 mg/TAE/100 g honey for phenol content. The highest amount of total phenol content was found in the *Acacia militia* honey (Snit) 201.1 mg/TAE/100 g honey followed by the *Banalities aegyptiaca* honey (Haggling) 146.38 mg/TAE/100 g honey and then came *Acacia seal* honey (Talia) 67.11 mg/TAE/100 g honey. Honey from Two types of*Ziziphus spina-christi* (Seder of mountain and Seder) showed similar values 21.98 and 20.15 mg/TAE/100 g honey respectively , while honey of *Azadirachta indicia* (Neem) was found to contain 17.15 mg/TAE/100 g honey and honey from *Cucurbit a maxima* Dutch. (Pumpkin) was found to contain 4.44 mg/TAE/100 g honey. For antioxidant activity, it ranged from 3177 to 6247µg for dry weight sample cause 50% inhibition, which indicates antioxidant activity. The maximum antioxidant effect was found in *Azadirachta indicia* honey (Neem) 3177 µg followed by *Banalities aegyptiaca* honey (Haggling) 4045 µg, then *Sisyphus spina-christi* honey (Seder) 4068 µg, and *Acacia seal*

Honey (Talia) 4679 µg, while *Sisyphus spina-christi* honey (Seder of mountain) was 5125 µg. The minimum antioxidant effect was observed in *Acacia militia* honey (Snit) 6247 µg, followed by *Cucurbit maxima* Dutch. Honey (Pumpkin) 5323 µg. Results of this study showed highly significant differences ($P<0.01$) in phenol contents of different honey samples. There was no correlation ($r = 0.441$) between antioxidant activity and total phenol content. Percent of inhibition increased with increasing the concentration. There was highly positive Correlation between concentrations (5, 25 and 50µl) of diluted honey samples and the percent of inhibition, which indicates the antioxidant activity. Results of parameters such as protein, ؛Bricks and electrical conductivity are within the standard levels and they ranged from 0.200- 0.286, 75.2-79.0 and 0.20-0.80 for protein, ؛Bricks and electrical Conductivity, respectively. Highly significant differences ($P<0.01$) were observed for other parameters such as moisture, pH, refractive index and ash, with Values ranging from 16.20-21.27%, 3.70-4.80%, 1.4833- 1.4960% and 0.1207-1.205% , respectively. The Bricks in honey showed significantly high negative correlation ($P<0.05$) ($r=-0.869$) with moisture content. Color of honey samples was measured by using Minolta chromameter and the values of L*, a* and b* were obtained and the values of chrome, hue angle, and browning index were calculated. The ranges of 24.47-59.44, -1.26-8.41 and 2.40-22.02 for L*, a* and b*, respectively, while the calculated ranges of 2.70-22.30, 62.68-89.51 and 11.76-82.35 were obtained for chrome, hue angle and browning index, respectively .

ALIKUKU Gaddoum (2007) used this study investigated the biology and honey production of a honeybee hybrid (F1) (*Apes milliner Carnica* × *Apes milliner Lamarckian*), which was imported to three different areas in Sudan characterized by different type of forest trees, at altitude 13^{o} North. These areas are the Dander area, *Sisyphus spinal Christi* (Seder), Kostas area, *Acacia militia* (Snit), and Umrowaba area; *Acacia seal* (Tale) 2 km^2 for each area. In the beginning of the study field survey was conducted among the farmers, the questionnaire included the beekeeping practices, purposes of using hives, percentage of modern hives, whether they practiced traditional or modern hives, average yield/hive during one extraction of honey and whether the production done annually, biannually or perennially and the percentage of people using beekeeping. Secondly: The life cycle was studied using 3 hives in each of the 3 areas, the duration of the egg, larva, pupa and adult was calculated for each queen, worker and drones in the nine hives, and the average values were obtained, the mean duration was as follows: (a) Queen: eggs hatch in 3 days, larva duration 8-days, pupa duration was 12-days and adult 16-days, (b) worker eggs hatch in 3-days, larva 8-days, pupa 15-days and adult 21-days, (c) drones eggs hatch in 3-days, larva duration 9 days, pupa duration 16-days and the adult duration was 24 days. Thirdly: Honey production was investigated using 6 hives in each of the 3 areas. The average honey yield was taken at the end of each flowering season for the 3 different areas. The yield of the six hives at Dander, which were taken in November was 3 kg in (Seder) and the six hives at Kostas, which was taken in

October yield 2.7 kg in (Snit) and that at Umrowaba which taken in January yielded 2.6 kg in (Tale). Statistical analysis showed that in Seder the production of honey was significantly higher than the other two areas (Kostas, Snit) and (Umrowaba, Tale) using complete randomized design (C.R.D).

Amel Abdurrahman Mohammed ALabas August (2011) used this study was aimed to investigate physiochemical properties of honey bee. Three samples of honey bee from Tlody (sample (1)), Umdafog (sample (2)), and Nubba mountain (sample (3)) were investigated. The investigated physical properties were surface tension, density, refractive index, conductivity, and dynamic viscosity. The density of samples 1, 2 and 3 was 1.373, 1.3842, and 1.3932g\cm3 respectively, whereas, the respective viscosity of the samples was 2.356, 8.912, and 6.893pa.s. For the same samples, the surface tension was found to be 59.6133, 62.799, and 66.413dyne/cm, respectively, the conductivity was found to be 0.1516, 0.10394, 0.12395mS cm-1, respectively whereas, the refractive index was found to be 1.48, 1.493, and 1.493, respectively. The investigated chemical properties were cationic contents, sugars contents. The concentration of Ca, Na, K, Pb, and Fe %w/w in the honey samples was as follow: sample (1) (50, 112, 360, 0.4407, 6.9357), sample (2) (60, 164, 61, 0.016267, 36.652), and for sample (3) it was (30, 4.6, 960, 0.0116, 18.675), respectively. The percentages of fructose, glucose, maltose and sucrose sugars in the samples were found to be as follow: (13.12, 28.42, 0, 0) for sample (1), (26.4885, 35.253, 0.30204, 1.9208) for sample (2), and (39.745, 32.924, 0.3595, 0) for sample (3). The purity of honey bee was also tested with two quick methods, physical and chemical methods. According to these methods all three honey samples were considered pure honey bee.

Mohammed Yusuf Musa Yagoub July (2013) Nine types of honey (2 imported, 7 commercial) samples were collected from different locations in Sudan were analyzed to evaluate their physicochemical and microbiological characterteristics. Physicochemical Properties adopted by the Codex Alimintarius such as: moisture content (%), acidity (%) ,pH, specific gravity , viscosity, total sugar(%),reducing sugar(%),sucrose(%) , glucose(%) and fructose(%) were used. These Physicochemical parameters were determined using standard methods recommended by the AOAC (1990). The results were statistically analyzed .The mean moisture content of the 9 honey samples 18.2 ± 0.434, acidity 0.54 ± 0.330, pH 3.60 ± 0.114 specific gravity 1.25 ± 0.017 , viscosity 120.7 ± 0.434 ,total sugars 70.4 ± 0.425 , reducing sugars 65.1 ± 0.490 , sucrose 5.6 ±0.418 , glucose 32.9 ±565 and the fructose 32.1 ±0.439. The microbiological analysis ensured the presence of yeast cells and pathogenic bacteria *Salmonella, Staphylococcus aureus, and Clostridium botulinum* in both honey types. Were Sample (B) showed pathogenic bacteria: *Salmonella, Staphylococcus aurous, and Clostridium botulinum*, where sample (G) showed *Staphylococcus aurous and Clostridium Botulinum* and sample (I) showed *Salmonella*. The results revealed that commercial honeys confine with the Codex (minimum and maximum) range. On the other hand the study indicated that Sudanese honey confines with some international specifications and different with some others. It is recommended that following, local specifications of Sudanese honey and development methods of production, collection and safety handling of honey avoid contamination honey by pathogenic microorganisms.

Munhall Abu baker Ahmed Elrufaie(2014) used The aim of this research was to determine the percentage of conventional sugars (glucose, fructose, sucrose and maltose) in three honey samples collected from South Sudan, Al Fisher and Al Gadarif. The values of refractive index, pH, and water content were also measured. The refractive indexes were 1.490, 1.490 and 1.489 the pH values were 4.26, 4.37and 4.32 and the water contents were 18, 18.1and 15.4 respectively. The percentage of glucose, fructose, sucrose determined by classical methods (Lane-Etymon and audiometric titration) were 36.2, 37.48 and 2.35 in South Sudan sample, 33.9, 36.5and 3.9 in Al Fishier sample, 40.00, 19. 66 and 11.36 in Al Gadarif sample, respectively The percentage of glucose, fructose, sucrose, and also maltose determined by HPLC were 31.98, 38.41 ,0.423and 1.294 in South Sudan sample; 35.32, 37.41, 0.702and0.790 in Al Fishier sample and 35.80, 33.40, 15.71and 0.٠ in Al Gadarif sample respectively. The results obtained by HPLC were usually more accurate, because the technique is more sensitive compared with classical methods. The F/G (fructose/glucose) ratio of the honey of South Sudan and Al Fishier were seemly more genuine than that of Gadarif that might be adulterated with other sweeteners, most likely cane honey or molasses (artificial honey)

1.4 The objective of this work:

a- The main target of this research is to study the effect of laser on honey**.**

b- Determine honey properties before and after exposing by laser.

c- Exposing the sample to different output powers of laser for fixed time, five minutes.

1.5 Thesis Layout

This thesis is consist of four chapters, chapter one Introduction and Literature Review ,and chapter tow consist Basic Concepts of laser and milk, and Light interaction with matter**,** chapter three consist Experimental Part (The materials and device and method), chapter four consist Results and Discussion and Conclusion, Recommendations and finally References.

Chapter Two

Basic Concepts

2.1 Laser

Definition of laser: Laser is the acronym for light Amplification by stimulated Emission of Radiation .Laser is a device that can amplify light and produce a highly direction, intense, monochromatic and coherent beam.

2.1.1 Properties of laser

The main characteristics of laser are:

(a) Coherence: is a measure of the ability of different a wave fronts or part of wave fronts, to interfere or intermingle with each other, when the wave fronts are combined, as in interferometer.

(b)Brightness and intensity:

Laser beam are the brightest of sources .They are extremely intense too. It is recorded that, on one night, American Satellite Scientists tried to pick up New the region are on, it could give a picture to the camera.

(c) Directionality:

All waves, including light waves, undergo the phenomenon of diffraction .light, falling on a surface, having a hole or aperture, diverges after passing through the hole.the angle of divergence is affection of spatial coherence of light.

(d) Monochromaticity:

One of special characteristics of abeam having temporal coherence is spectral purity or monochromaticity .The high spectral purity of laser is due to the ability of the optical resonator to oscillate only Avery small number of resonant modes.

(e) Focus ability

Owing to the property of spatial coherence in laser, it is possible to focus laser beam to an extremely fine spot. (K.R. Nambiar, 2004**).**

2.1.2Laser construction

A laser system is constructed from three main parts**:-**

A. Pumping source

Pumping source is providing energy to the laser system for example electrical discharge, flash lamp, light from another laser, chemical reactions and even explosive devices. The type of pumping source uses principally depends on the gain medium, and this also determines how the energy is transmitted to the medium.

B. Laser Gain medium

Calls lasing medium results from stimulated emission of electronic or molecular transition from higher to lower energy state populated by a pump source.

C. The optical resonator or optical cavity

The Optical Resonator is two parallel mirrors placed around the gain medium which provide feedback of the light. Cavity designed to internally reflect infrared, visible, ultra -violet. It can be contain gases, liquids or solids. Cavity materials can determine the wavelength of the output. Figure 2.1 shows the components of laser system. (Orazio Svelto, 2002)**.**

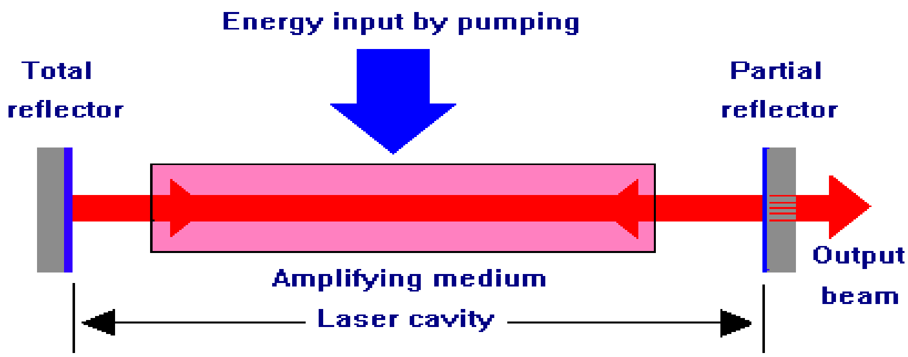


Figure (2.1) Element of Laser

2.1.3 Laser types

Different type of laser can be classified into solid, liquid, gas and semiconductor lasers. This classification is based on the laser medium that is chosen.

(a) Solid state lasers: A solid state laser was the first one to come into the laser world .solid state laser is part of the laser system involving high-density gain media.

(b) Gas lasers: Gas laser fall in category of lasers involving low – density gain media. The gas media are used in almost half of the commercial lasers that are currently available. With the advent of solid state laser which are more which are more compact and with better potential, some of the gas lasers may vanish from the scene in future.

(c) Semiconductor lasers: Semiconductors have electrical conductivities lying between those of insulation and conductors. The properties of semiconductor, energy level, excitation mechanisms and semiconductor laser structures.

(d) Liquid lasers: It is difficult to grow good laser crystal with perfect quality and they are also expensive. Liquid laser are those in which the active medium is formed by solutions of certain organic dyes dissolved in liquids such as alcohols. (K.R.Nambiar, 2004).

2.1.4 Laser applications

Lasers range in size from microscopic diode lasers (top) with numerous applications, to football field sized neodymium glass lasers (bottom) used for inertial confinement fusion, nuclear weapons research and other high energy density physics experiments.

Main article: List of applications for lasers

When lasers were invented in 1960, they were called "a solution looking for a problem"(Charles H. Townes ,2003) Since then, they have become ubiquitous, finding utility in thousands of highly varied applications in every section of modern society, including consumer electronics, information technology, science, medicine, industry, law enforcement, entertainment, and the military. Fiber-optic communication using lasers is a key technology in modern communications, allowing services such as the Internet.

The first use of lasers in the daily lives of the general population was the supermarket barcode scanner, introduced in 1974. The laserdisc player, introduced in 1978, was the first successful consumer product to include a laser but the compact disc player was the first laser-equipped device to become common, beginning in 1982 followed shortly by laser printers.

Some other uses are:

- Medicine: Bloodless surgery, laser healing, surgical treatment, kidney stone treatment, eye surgery, ophthalmoscopes, dentistry.
- Industry: Cutting, welding, material heat treatment, marking parts, non-contact measurement of parts.
- Military: Marking targets, guiding munitions, missile defense, electro-optical countermeasures (EOCM), alternative to radar, blinding troops.
- Law enforcement: used for latent fingerprint detection in the forensic identification field (Dalrymple B. E., Duff J. M., Menzel E. R, 1977) (Dalrymple B. E, 1983).
- Research: Spectroscopy, laser ablation, laser annealing, laser scattering, laser interferometer, lieder, laser capture micro dissection, fluorescence microscopy, metrology.
- Product development/commercial: laser printers, optical discs (e.g. CDs and the like), barcode scanners, thermometers, laser pointers, holograms, Bubbblegrams.
- Laser lighting displays: Laser light shows.

- Cosmetic skin treatments: acne treatment, cellulite and striate reduction, and hair removal.

In 2004, excluding diode lasers, approximately 131,000 lasers were sold with a value of US$2.19 billion(*Kincade, Kathy; Anderson, Stephen*,2005) In the same year, approximately 733 million diode lasers, valued at $3.20 billion, were sold(Steele, Robert V,2005).

2.2 Honey

Honey is a sugary food substance produced and stored by certain hymenopter insects. (Crane E, 190). It is produced from the sugary secretions of plants or insects, such as floral nectar or aphid honeydew, through regurgitation, enzymatic activity, and water evaporation. (*Crane E, 1990*). (*Crane, E., Walker, P*., & Day, R., 1984). The variety of honey produced by honey bees the genus *Apis*) is the most well-known, due to its worldwide commercial production and human consumption (Crane, Ethel Eva, 1999).

2.2.1 Composition of Honey

By far, the largest portion of the dry matter in honey consists of the sugars. This very concentrated solution of several sugars results in the characteristic physical properties of honey – high viscosity; "stickiness," high density, granulation tendencies, tendency to absorb moisture from the air, and immunity room some types of spoilage. Because of its unique character and its considerable difference from other sweeteners, chemists have long been interested in its composition and food technologists sometimes have been frustrated in attempts to include honey in prepared food formulas or products. Limitations of methods vailable to earlier researchers made their results only approximate in regard to the true sugar composition of honey. Although recent research has greatly improved analytical procedures for sugars, even now some compromises are required to make possible accurate analysis of large numbers of honey samples for sugars.

An analytical survey of U.S. honey is reported in *Composition of American Honeys*, Technical Bulletin 1261, published by the U.S. Department of Agriculture in 1962. In this survey, considerable effort was made to obtain honey samples from all over the United States and to include enough samples of the commercially significant floral types that the results, averaged by floral type, would be useful to the beekeeper and packer and also to the food technologist. In addition to providing tables of composition of U.S. honeys, some general conclusions were reached in the bulletin on various factors affected by honey composition.

Where comparisons were made of the composition of the same types of honey from 2 crop years, relatively small or no differences were found. The same was true for the same type of honey from various locations. As previously known, dark honey is higher than light honey in ash (mineral) and nitrogen content. Averaging results by regions showed that eastern and southern honeys were darker than average, whereas north-central and intermountain honeys were lighter. The north-central honey was higher than average in moisture, and the intermountain honey was more heavy bodied. Honey from the South Atlantic States showed the least tendency to granulate, whereas the intermountain honey had the greatest tendency.

The technical bulletin includes complete analyses of 490 samples of U.S. floral honey and 14 samples of honeydew honey gathered from 47 of the 50 States and representing 82 “single” floral types and 93 blends of “known” composition. For the more common honey types, many samples were available and averages were calculated by computer for many floral types and plant families. Also given in this bulletin are the average honey composition for each State and region and detailed discussions of the effects of crop year, storage, area of production, granulation, and color on composition. Some of the tabular data are included in this handbook. **(**By J. W. WHITE, JR. AND LANDIS W. DONER, 1980*)*

2.2.2 Physical characteristics of honey

2.2.2.1Viscosity

Freshly extracted honey is a viscous liquid. Its viscosity depends on a large variety of substances and therefore varies with its composition and particularly with its water content (Table 2.1 and 2.2). Viscosity is an important technical parameter during honey processing, because it reduces honey flow during extraction, pumping, settling, filtration, mixing and bottling. Raising the temperature of honey lowers its viscosity (Table 2.3) a phenomenon widely exploited during industrial honey processing. Some honeys, however, show different characteristics in regard to viscosity: Heather (Calling vulgarisms) Manual (Leptospermum solarium) and Car via callous are described as thyrotrophic which means they are gel-like (extremely viscous) when standing still and turn liquid when agitated or stirred. By contrast a number of Eucalyptus honeys show the opposite characteristics. Their viscosity increases with agitation.

Table 2.1: Variation of the viscosity of honey at 25^{0}C, containing 16.5% water, cording to the botanical origin and therefore the composition of the honey (Munro, 1943).

Type	Viscosity (poise)
Sage	115
White clover	94
Sweet clover	87

Table 2.2: Variation of the viscosity of white clover honey at 250 C according to its water content (Munro, 1943).

Water content (%)	Viscosity (poise)
13.7	420
15.5	138
18.2	48
20.2	20

Table 2.3: Viscosity of sweet clover honey containing 16.1% water according to temperature (Munro, 1943).

Temperature (°C)	Viscosity (poise)
13.7	600.0
20.6	189.6
29.0	68.4
39.4	21.4
48.1	10.7
71.1	2.6

2.2.2.2 Density

Another physical characteristic of practical importance is density. Honey density, expressed as specific gravity in Table 2.4, is greater than water density, but it also depends on the water content of the honey (Table 2.4). Because of the variation in density it is sometimes possible to observe distinct stratification of honey in large storage tanks. The high water content (less dense) honey settles above the denser, drier honey. Such inconvenient separation can be avoided by more thorough mixing.

2.2.2.3 Hygroscopicity

The strongly hygroscopic character of honey is important both in processing and for final use. In end products containing honey this tendency to absorb and hold moisture is often a desired effect such as, for example, in pastry and bread. During processing or storage however, the same hygroscopicity can become problematic, causing difficulties in preservation and storage due to excessive water content. From Table *2.5* it can be readily seen that normal honey with a water content of 18.3 % or less will absorb moisture from the air at a relative humidity of above 60%.

Table 2.4 Approximate equilibrium between relative humidity (RH) of ambient air and water content of a clover honey (White, 1975a).

Air (%RH)	Honey (% water content)
50	15.9
55	16.8
60	18.3
65	20.9
70	24.2
75	28.3
80	33.1

2.2.2.4 Surface Tension

It is the low surface tension of honey that makes it excellent humectants in cosmetic products the surface tension varies with the origin of the honey and is probably due to colloidal substances. Together with high viscosity, it is responsible for the foaming characteristics of honey (Value-added products from beekeeping. Chapter 2. Fao.org, 2011).

2.2.2.5 Electrical Conductivity

The conductivity measurement is easy and fast and need only inexpensive instrumentation. It is very widely used for discrimination between honeydew and blossom honeys and also for the characterization of unifloral honeys. Conductivity is a good criterion of botanical origin of honey and today it is determined in routine honey control instead of the ash content. This measurement depends on the ash and acid content of honey; the higher their content, the higher the resulting conductivity (Vorwohl, 1964). There is a linear relationship between the ash content and electrical conductivity (Piazza *et al.*, 1991)

2.2.2.6 Refractive index

The refractive index of a substance is the ratio of the velocity of light in the substance to that in air (White, 1975). The primary interest in this property of honey is to provide rapid, accurate and simple methods of determining the moisture content of honey. By using the refract meter, moisture in honey can be determined with ease, compared with other method. Chat away (1935) Table which was modified by Wetmore (1955) can be used; the Table relates the refractive index value of honey measured at (20 °C) to its corresponding moisture content values.

2.2.3 Chemical properties of bee honeys

Honey is basically composed of carbohydrates like monosaccharide's and oligosaccharides (60-85%) which vary in regular forms with moisture content (12-23%), low proportions of inorganic and organic materials, such as proteins and polysaccharides, and high floral pollen contents (White, 1969). Moisture content has an influence on honey color, viscosity, flavor, density and refractive index and it is one of the most important physicochemical parameters for the analysis, conservation and stability of foods in general (Mateo and Bosch-Rig, 1997; Rancho *et al*., 1991).

2.2.3.1 Carbohydrates

More than 95% of the solids of floral and honeydew honeys are carbohydrate in nature, largely simple sugars (monosaccharides) fructose and glucose are the major constituents (White, 1992). In nearly all honey types, fructose predominates and only a few honeys, such as rape (*Brescia nap us*), dandelion (*Traaxacum officinal*) and blue curls (*Trichostema lanceolatum*) appear to contain more glucose than fructose. These two sugars together represent for 85–95% of honey carbohydrates (White, 1979). Surveys of oral honey composition have established at fructose and glucose is the major carbohydrates, ranging from 65 to 80% of his total soluble solids (Costa *et al*., 1999; Donner, 1977; Siddiqui, 1970). Besides these sugars, other minor carbohydrates chiefly did- and disaccharides containing glucose and fructose residues, have been identified (Low & Spurns, 1988; Siddiqui & Frugal, 1967; Swallow & Low, 1990). The contents of sucrose and isomailtose were broad, ranging from mean values of 0.07and 0.18 % respectively. The mean values for maltose were in the range 1.58 to 3.77%. The level of turnsole (0.78%) was similar to that of inverse (1.11%) Low amounts of meli-biose (0.05%) and anise (0.03%) were found in Brazilian honeys. Maltotriose, melezitose and ramose, were present with mean values of 0.24, 0.21and 0.10%, respectively. (Acosta *et al*., 2000). Some studies have been carried out in order to investigate the origin of the honey oligosaccharides. Maurizio (1975) and Percival (1961), studying the carbohydrates of nectar of the majority of plant families visited by honeybees, noted that variable amounts of sucrose, glucose and fructose were present therein.

Other sugars, such as farinose and melezitose, were mainly found in honeydew, a sweet liquid secreted by some species of plant sucking insects, which is gathered by bees during periods of low nectar availability (Loom-bard *et al.*, 1984; Maurizio, 1975b). Low and Spurns (1988) and Mateo and Bosch-Rig (1997) have emphasized that the complex mixture of oligosaccharides in honey may be useful in determining the oral type.

2.2.3.2 Moisture Content

The moisture content of honey is an important factor contributing to its stability against fermentation and granulation during storage. Moisture content was affected by climate, season and moisture content of original plant nectar. Honey moisture is the quality criterion that determines the capability of honey to remain stable and to resist spoilage by yeast fermentation: the higher the moisture, the higher the probability that honey will ferment upon storage. The water content is that value determined from the refractive index of the honey by reference to a standard Table.

(White *et al*., 1962) reported that the moisture content of 490 American bee honey samples ranged from 13.4-22.9% and averaged 17.2%. While Al-sarong (1977) reported that the moisture content of seven Sudanese bee honey samples ranged from 14.8-27.0%. Ibrahim (1985) reported that the moisture content of Sudanese bee honey samples ranged from 13.01-26.08% and averaged 19.09%.

2.2.3.3 Protein Content

In spite of their low concentrations they are important constituents because they influence many properties of honey (Paine et al, 1934). Protein content of honey has been used as a test for adulteration (Lee and Kim, 1984). (White *et al*., 1962) reported that the nitrogen content in American bee honeys ranged from 0-

0.138 and averaged 0.041%. Ibrahim (1985) reported a range of 0.077-1.378% and an average of 0.53% protein in Sudanese bee honeys.

2.2.3.4 Amino Acids in Honey

European Community food laws establish compositional and quality parameters for honey, such as Hydroxymethylfurfural content, humidity, enzymatic activities, and pesticide levels, but such parameters have no relationship to geographical or botanical origin of honey. Pollen recognition has been the raditional method to determine the floral origin of the honey, but this technique is tedious and has some limitations. Many studies have sought analytical markers of botanical origin for honey, based on aroma compounds, sugar profile, falconoid pattern, non-falconoid phenolics, organic acids, isotopic relations, and protein domino acid compositions (Ankles, 1998). Proteins and amino acids in honeys are attributable both to animal and vegetal sources, the major of these being pollen. Amino acids account for 1% (w/w), and praline is the major contributor with 50–85% of the total amino acids. Beside praline, there are 26 amino acids in honeys, their relative proportions depending on the honey origin (nectar or honeydew). Since pollen is the main source of honey amino acids, the amino acid profile of a honey could be characteristic of their botanical origin. Free amino acid omposition is more likely than protein composition to determine the botanical source of a honey. It has also been proposed that better and more useful information can be provided by increasing the number of analyzed samples, by combination of these and other analytical data, and by statistical treatment of the results (Sanlam, 1998). However, the determination of the botanical origin of a honey is a hard task, due to the complexity of the matrix, and because composition is affected by many factors, including climatic or soil conditions (Shuel, 1975). (Davies ,1976) found that the ratios between certain honey amino acids were different, depending on geographical origin, and that these differences increased when comparing honeys from the same region but of different floral origins. Krell (1996) reported that the following free amino acids exist in honey: praline, lysine, histamine, argentine, aspartic acid, heroine, serine, glutei acid, glucose, almandine, cosine, valance, methionine, isoleucine, Lucien, tyrosine, phenylalanine and tryptophan. (Coalmine, 1960) and (Maeda *et al*., 1962) reported that praline is the predominant amino acid in honey. (Coalmine, 1960) reported the preponderance of praline (45% in finish honey 80% in an imported honey) of the overall amino acids content. The next most abundant amino acid reported in the finish honey was glutei acid and in the imported honey was Lucien. Bergner and Korma (1968) reported that stores from sugar feeding of bees contained the same 19 amino acids found in mixed samples of honey.

2.2.3.5 Proline content

The honey Proline content is a criterion of honey ripeness and in some cases, also of sugar adulteration (Von Deer Ohe *et al.,* 1991). A minimum value for genuine honey of 180 mg\kg is accepted in honey control laboratories. However, it should be taken into account that there is considerable Proline variation, depending on the type (Bosi and Battaglini, 1978).

2.2.3.6 Ash and minerals content

The aim of element determination is to study the contamination of Agricultural products ground and air. One might explain the significant differences in mineral content as owing to the different botanical origins of honey. However, other factors such as geographical conditions are also expected to affect the mineral content. Similar results in other types of honey at different locations were observed by several workers (Salinas *et al.,* 1994; Frias *et al.,* 1997**)** with increasing world interest in honey characterization various studies have been carried out relating physicochemical parameters to botanical and geographical origins. Ash content is one of these parameters that have been associated with floral sources of honey samples. However, little attention has been given to the determination of how much of the variability in ash contents is caused by contributions of different floral sources or honey samplings Compared to the variations caused by analytical errors. The average ash of American bee honeys as found by (White et al, 1962) was 0.17% and ranged from 0.02, 1.028%. Ismaeil (1972) found that the average ash content of Egyptian honeys he analyzed was 0.17%. Iron content was 0.82 mg/kg and calcium content was 6.6 mg/kg. McClelland (1975) mentioned that Ca, Mg, K, and Na were found in honey samples, K was found in higher amounts compared to the other minerals. While Ibrahim (1985) reported a range of (0.088-1.975%) and an average ash content of 0.374% in Sudanese honeys. Ibrahim (1985) reported the following range of values for minerals in bee honey (ppm): Na (73-697), K (25- 1987), Zn (1-103), Cu (0-85), Fe (35-544), and Pb (0-37).

2.2.3.7 Acidity and pH

Acidity is an important quality criterion. Honey fermentation causes an increase of acidity and because of this a maximum acidity value has proven useful, although there is a considerable natural variation. The old standard fixed a minimum of 40 miliequivelants / kg, which has been increased to 50 miliequivelants / kg in codex draft, as there are some honeys, which have a higher natural acidity (Horn and Lullmann, 1992). The acidity of honey is due to the presence of organic acids, particularly the glycolic acid, in equilibrium with their lactones or esters and inorganic ions such as phosphate and chloride (Echingo and Takenaka, 1974). The variation in acidity among different honey types may be attributed to variation in these constituents due to extraction season (Perez-

Arquillue *et al.,* 1994). (White *et al*., 1962) reported an average pH value of 3.91 and a range of (3.42-6.10) for American honey samples. While Ismaeil (1972) reported an average pH value of 3.9 for Egyptian honey samples he analyzed. Ibrahim (1985) mentioned a range of (3.3-4.3) and an average of (3.8) for the pH value of Sudanese honey samples.

2.2.3.8 Enzymes

Honey is a complex mixture of sugars, enzymes, wax and lipid along with minute quantities of minerals, amino acids, organic acids, vitamins, ash, pollen and porpoise (White, 1975). Sugars present in honey are laevulose and dextrose besides sucrose and maltose in minor quantities. The major enzymes present in honey are inverts, amylase (diastase) and glucose oxides along with minute quantities of catalos and acid phosphates (White, 1975). Diastase and inverts are nutritionally important enzymes present in honey. Diastase hydrolyses carbohydrates for easy digestibility while inverts hydrolyse sucrose and maltose (White, 1975). Glucose an oxide is another important enzyme in honeys which catalyses glucose to form glycolic acid and hydrogen peroxide (White, 1975). Heating of honey motivates the loss of thermo labile, aromatic substances. Losses are proportional to temperature and heating time. Damages caused by heating can be evidenced by measuring quality control parameters, such as diastase activity and Hydroxymethylfurfural (HMF) (5- (hydroxymetyl-) furan- 2-carbaldehyde) content (Bodganov *et al.,* 1997). Diastase activity is a honey quality parameter used to determine if honey has been extensively heated during processing. Honey heating effect on the diastase activity was studied in two steps. Honey diastase activity is a quality factor, influenced by honey storage and heating and thus an indicator of honey freshness and honey heating. Although there is large natural variation of diastase, the present standard of a minimum diastase number (DN) value of 8 has proven to be useful. (Renaldo *et al*, 1973) and (Ammon ,1949) reported that the source of diastase is the bee in contrast with other workers who considered it to be of pollen or nectar, or from pollen, nectar and bees.(White *et al.*, 962) reported an average value of (20.8) for the diastase number and arrange of (2.1-61.2).

2.2.3.9 Hydroxymethylfurfuraldehyde HMF

HMF (5-hydroxymethylfurfuraldehyde) measurement is used to evaluate the Quality of honey; generally not present in fresh honey, its content increases during conditioning and storage.(According to Singh *et al.*,1988) honey processing, requires heating both to reduce viscosity, and to prevent crystallization or fermentation. In air ventilated chambers, at 45–50 °C for 4-7 days or by immersion of honey drums in hot water. Heating of unifloral honey leads to different HMF levels in honey (Fallico *et al.*, 2004). This compound which may be formed by the decomposition of fructose in the presence of and acid was originally thought to be not a constituent of honey in the hive (White, 1979). There are three methods that can be used for the determination of HMF (Codex Alimentations Standard for Honey, 1993; Jeuring and Kippers, 1980; White, 1979). These methods were tested collaboratively by the International Honey Commission with three honey samples to cover the main range of determination (Bogdanov *et al.*, 1999).

2.2.3.10 Vitamins

Honey also contains a wide range of vitamins like A, B, C, D, E and K. To process such a complex mixture for consistent product quality, retaining most of the nutritional value and imparting a better product appeal, is a real challenge for the processing industries. Studies on honey proved its wide spread usage other than its nutritional value (Lagrange, 1991)**.**

2.2.3.11 Phenolic Compounds of Honey

The quality of honey is judged by the botanical or floral origin and chemical composition (Cherchi *et al.*, 1994). The price of honey is based on its quality and, hence, its floral origin (Andrade *et al.*, 1997). Traditionally, the floral source of a honey has been identified by the analysis of bee pollens present in the honey. (However, Tan *et al.,* 1989) suggested that chemical approaches might be more ccurate and easily undertaken in the characterization of the floral source of a honey. The use of Phenolic compound analysis, including flavonoids, in the identification of honeys has been suggested by (Amiot *et al.*, 1989) and has since been used as a tool for studying the floral and geographical origins of honeys. Analysis of Phenolic compounds has been regarded as a very promising technique for studying the floral and geographical origins of honeys (Ferreres *et al.*, 1992).

2.3 Laser Matter Interaction

When light strikes the surface of a material, a portion will be reflected from the interface due to the discontinuity in the real index of refraction and the rest will be transmitted into the material. The fraction of the incident power that is reflected from the surface (R) depends on the polarization and angle of incidence (θ_i) of the light as well as the index of refraction of the atmosphere (n_1) and the material (n_2). The reflection coefficients (R) are related to the transmission coefficients through T= 1- R, for the case of normally incident light on a flat surface.

$$R = \left(\frac{n_1 - n_2}{n_1 + n_2} \right)^2 \quad \text{……………..(2.13)}$$

The reflectivity of a given material will depend on the frequency of the light source through the dispersion relation of its index of refraction. Also depend on the temperature of the material through changes in the permittivity, band structure, plasma oscillations, or material phase.

Once inside the material, absorption causes the intensity of the light to decay with depth at a rate determined by the material's absorption coefficient (α). In general, (α) is a function of wavelength and temperature, but for constant (α), intensity (I) decays exponentially with depth (z) according to the Beer–Lambert law.

$$I(z) = I_0 e^{-\alpha z} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots \text{(2.14)}$$

Where I_0 is the intensity just inside the surface after considering reflection loss.

It is convenient to define the optical penetration or absorption depth, $\delta = 1/\alpha$ which is the depth at which the intensity of the transmitted light drops to (1/e) of its initial value at the interface. Absorption depths are short relative to bulk material dimensions.

When dealing with Crow nanosecond duration laser pulses, it is typically assumed that most of the absorption is due to single photon interactions. However, for picoseconds (ps) and femtosecond (fs) lasers, the extremely high instantaneous intensity enables phenomena such as optical breakdown and multiphoton absorption which can significantly decrease absorption depths (Pveducation, 2015).

Chapter Three

Experimental Part

3.1 Introduction

This chapter includes the materials used in this work and the following methods (sample preparation and setup) and the procedure**.**

3.2 Materials

3.2.1 Honey

Honey Seder was brought from Cabom region South Darfur its weight in one Kilo grams and was divided into four samples weight of sample per 250 grams.

Figure (3.1) photo of jar of honey (250 gram)

3.3 Devices

3.3.1Helium – Neon Laser

The first successful demonstration of age's laser was done by Ali Gavan and his colleagues in the bell Telephone laboratory in 1961, using admixture of helium and neon .This laser has Avery long lifetime of operation and is generally trouble-free.

This laser operates in mixture of helium and neon; at low pressure .The laser transitions take place within the neutral atomic species. The wave length, generally, is in the red region of the spectrum at 632.8 nm.

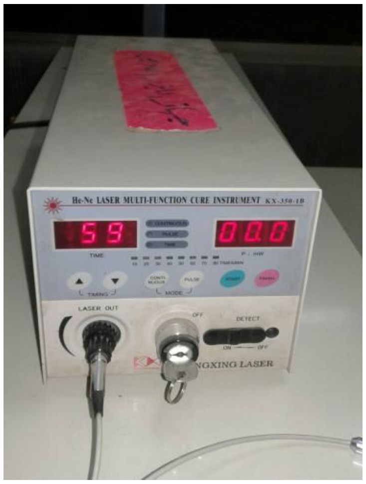


Figure (3.2) He Ne laser

3.3.2 Viscometer

The HAAKE Viscometer 6 plus and 7 plus instruments are classic rotational viscometers for the fast determination of viscosity as defined in ISO 2555 and more ASTM standards. This viscometer works on the same principle as all other Rotational viscometers; i.e. a cylinder or a disk is submerged in the substance to be tested and the force which is necessary to overcome the viscosity resistance against the rotation or flow is measured. A spring is connected between the cylinder (and disk/spindle) and the motor shaft which is rotating with a certain speed. The eviation angle of the spindle against the measuring spring is measured electronically; the result is a torque value. The torque value measured with the viscometer is calculated based on the speed and the geometry of the spindle; the Result is a direct reading of the viscosity value in maps.

Figure (3.3) photo of the HAAKE Viscometer 6plus

3.3.3 Atomic Absorption

The Perkin-Elmer2380 Atomic Absorption Spectrum Photometer is a double-beam, microcomputer-controlled atomic absorption spectrophotometer. The 2380 uses a high-dispersion monochromatic with a dual-blazed grating and high-performance photomultiplier for maximum energy throughput over the wavelength range from 190 to 870nm, Two sets of sills (Normal and Alternate) provide optimum performance with both flame and flame-less techniques**.**

Figure (3.4) photo of the Atomic Absorption

3.3.4 Refract meter

Is a laboratory or field device for the measurement of an index of refraction (refract meter). The index of refraction is calculated from Snell's law while for mixtures, the index of refraction can be calculated from the composition of the material using several mixing rules such as the Gladstone–Dale relation and Lorentz–Lorenz equation.

Figure (3.5) photo of the Refract meter

3.3.5 DiST4

He DiST meters are reliable, pocket sized instruments that will give you quick and accurate readings. The casing of the popular DiST meters has been redesigned for increased strength, to better fit your hand and also offer a much larger LCD for easier viewing. The graphite sensors provide better repeatability since they do not oxidize. The probe is user replaceable. In fact, the whole PCB modules slides out and can be replaced. The casing has been shaped in such a way as to ease air bubble out. The temperature sensor is exposed and provides faster response time.

Figure (3.6) photo of the DiST4

3.3.6 CARBOLITE

The CWF range of general purpose laboratory chamber furnaces is bench mounted. Models are available in five sizes with a maximum operating temperature up to 1300 °C. His airflow in the CWF-B furnaces is enhanced by the addition of air inlet holes in the door and a tall chimney which rapidly removes the fumes from the furnace. The CWF-BAL furnace with integral balance can be used for thermo gravimetric analysis (TGA) and loss on ignition (LOI) applications, where weight change of the sample must be monitored during the heating process. This is required, for example, in the determination of inorganic matter content in materials such as cement, lime, calculated bauxite and refractoriness. For applications involving organic matter content, please refer to the AAF-BAL.

Figure (3.7) photo of CARBOLITE

2.3.7 ACCU- meter

is a scientific instrument that measures the hydrogen-ion concentration (or pH) in a solution, indicating its acidity or alkalinity. The pH meter measures the difference in electrical potential between a pH electrode and a reference electrode. It usually has a glass electrode plus a calomel reference, or a combination electrode in addition to measuring the pH of liquids, a special probe is sometimes used to measure the pH of semi-solid substances, model JENWAY.UK 3505.

Figure (3.8) photo of ACCU- meter

3.4 Method

3.4.1 The irradiate

The first Honey was divided into four samples of equal weight of 250 grams for each sample, the first sample was not exposed to laser as control, the sample (2) was exposed to laser with power 1mw, sample (3) the laser's power by 2 mw. Was exposed to a laser power of 1.5mw and sample (4) was knows to the laser's ability by 2mw.

Figure (3.9) Experimental Setup

3.4.2 Viscosity

Put the 50 ml of the sample of honey in kais and offer on viscosity out fit growing is evolved with in hundred rpm where there the device measuring the resistance with the sample and calculated viscosity on the basis.

3.4.3 Density

Explain the honey, 1bottle intensity that nine 25 deal where Yusuf honey with the bottle.

Density = weight of honey /size of honey or weight of honey /size of water

3.4.4 Conductivity

Report on the device where the planting of the device inside the sample honey where the device to read.

3.4.5 Refractive index

Read the coefficient of the refracting device of measuring the coefficient of refracting where to be read directly on the lens of the device.

3.4.6 Wax

Weighed ten grams of sample the honey adds to her water dripped cool and well mixed where the nomination of the sample on a paper by information weight and dry paper and store after hours with an oven temperature of 1 00 degrees centigrade.

3.4.7 Ashes

Is used furnace device. Actuating device in temperature at 0 – 1200 degree hundred then put the honey in tea cup on delicate balance mass of honey 2.2 gram and then bur of honey first burn to disposal from steam after that put honey in furnace for hours.

3.4.8 Monocular Sugar

Calculated in a manner lane and anon where weigh gram of sample honey and add to it distilled water and be sized to 250 deals. Equivalent to sample honey against talig A+B in people and the end point the end point the color of the red bricks and the amount of sugar 1have custom tables does not.

3.4.9 Total sugar

Take of mobile for operations mounsaturated 50 deals and add to it 6.5 ml Hcl center and put 1have a water bathe Dare percentile for goanna last 5 minutes. Come sample Na OH with the point of the guide fen puffs crooks and size to 100 ml distilled water and standard iced honey solution , when a solution of talig and determines the amount of sugar 1have tables allocated to them .

3.4.10 Sucrose

Improves the sucrose values are the following:

Sucrose = Total sugar – Monocular sugar

3.4.11 Fructose

Improve the fructose values are the following:

Fructose = Monocular sugar – Glucose

3.4.12 Acidity

Noosa 5 grams of sample honey in the role of it and add to it 100 ml distilled water and standardized against N0.1 Na OH with point s that vine puffs crooks end –point the pink color.

3.4.13 Metal

Weighed three grams of the sample is burned in the smelter and incineration process have temperature 550 – 600 degrees centigrade for two hours, cool and add to it 10% Hcl and put me a water bath for an hour to nominate and be sized to 100% of the reading on the device atomic .

Chapter Four

Results and Discussion

4.1 Introduction

This chapter summarizes results obtained during the work. Results include photographs, figures and tables as shown below. Data fitting of experimental results was also shown, discussion and conclusion

4.2 Results and Discussion

Table 4.1 and figures 4.1 – 4.15 show the results of the physical and chemical properties of the honey sample control (Reference) and those irradiated by He.Ne laser with different powers.

Table 4.1 Results of physical and chemical properties of honey

Properties	S_1(Reference)	S_2	S_3	S_4
Conductivity Ms/cm	0.0143	0.0211333	0.042666	0.058433
Refractive Index	1.42265	1.4303166	1.43065333	1.4394333
Density g/cm^3	1.32366	1.444666	1.337666	1.265333
Viscosity Pa.s	400.47	400.76	400.5	400.3033333
Ashes %	0.28666	0.22	0.1933333	0.18333
Moisture %	18.48333	18.41333	19.00333	18.196666
Wax%	0.060666	0.0746666	0.048	0.027333

Sugars Monocular%	**69.226666**	**69.65**	**70.176666**	**70.95333**
Total sugars%	**72.7133333**	**70.56**	**71.0833**	**72.63666**
Glucose %	**32.1**	**32.606666**	**32.8333**	**34.67666**
Fructose %	**37.35**	**39.143333**	**37.21333**	**38.31666**
Sucrose %	**3.4866666**	**1.5033**	**0.9066**	**1.6833**
Maltose %	**7.31**	**6.97333**	**6.9733**	**7.15**
Na/ ppm	**4.593333**	**4.48**	**4.70333**	**5.43**
Ca /ppm	**6.493333**	**6.163**	**4.95**	**4.74**
K /ppm	**61.39**	**60.503333**	**59.69333**	**57.68333**
Fe/ ppm	**0.3933**	**0.41**	**0.42666**	**0.3833333**
Mg/ ppm	**2.303333**	**2.056666**	**2.05**	**2.19**
Acidity	**36.61666**	**36.91333**	**35.78**	**36.02**

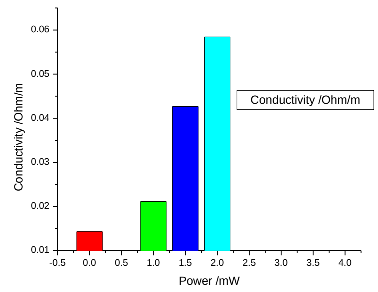
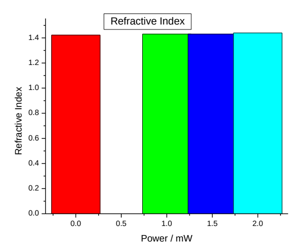


Figure (4.1) Variation of honey conductivity versus laser output irradiated powers

Figure (4.1) illustrates the variation of honey conductivity versus laser output irradiated power; it shows that the conductivity of the as obtained honey (control or reference sample) is 0.0143 ms/cm, while the irradiated samples conductivity increase proportional to the output laser irradiated powers from 0.0211333 ms/cm to 0.058433 ms/cm, this increase might be due to photo electric effect.



Figure(4.2)Variation of honey refractive index versus laser output irradiated powers

Figure(4.2) illustrates the variation of honey Refractive index versus laser output irradiated power; it shows that the Refractive index of the as obtained honey (control or reference) sample is 1.42265, while there is no significant changes in the irradiated samples refractive indices compare with the reference sample.

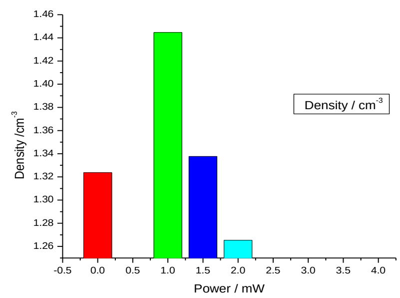


Figure (4.3) Variation of honey density versus laser output irradiated powers.

Figure (4.3) illustrates the variation of honey density versus laser output irradiated power; it shows that the obtained honey (control or reference sample) density is 1.32366 g/cm^3 and the irradiated samples densities is increase in the low dose sample to1.444666 g/cm^3, then it decrease in the other samples to 1.337666 g/cm^3 and1.265333g/cm^3 .

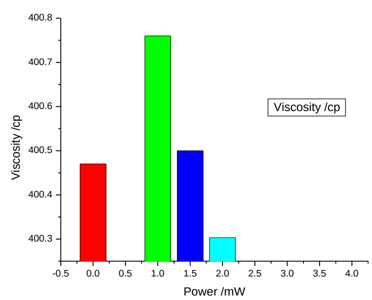


Figure (4.4) Variation of honey viscosity versus laser output irradiated powers.

Figure (4.4) illustrates the variation of honey viscosity versus laser output irradiated power; it shows that the obtained honey (control or reference sample) viscosity is 400.47 Pa.s and the irradiated samples viscosity is 400.76 Pa.s, 400.5 Pa**.s** and 400.3033333 Pa.s , there is no significant changes in the irradiated samples viscosity compare with the reference sample.

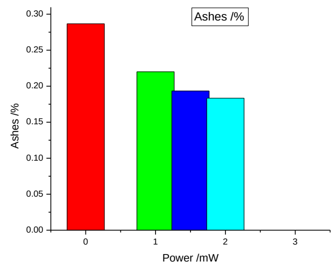


Figure (4.5) Variation of honey ashes versus laser output irradiated powers

Figure (4.5) illustrates the variation of honey ashes versus laser output irradiated power; it shows that the ashes of the as obtained honey (control or reference sample) is 0.28666 % ,while the irradiated samples ashes decrease proportional to the output laser irradiated powers, the irradiated samples ashes is 0.22 %, 0.1933333 % and 0.18333 % .

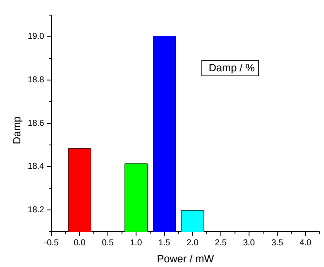


Figure (4.6) Variation of honey Moisture versus laser output irradiated powers

Figure (4.6) illustrates the variation of honey versus Moisture laser output irradiated power; it shows that the obtained honey (control or reference sample) Moisture is 18.48333% and the irradiated samples damp is 18.41333%, 19.00333% and 18.196666 %, there is no significant changes in the irradiated samples damp compare with the reference sample.

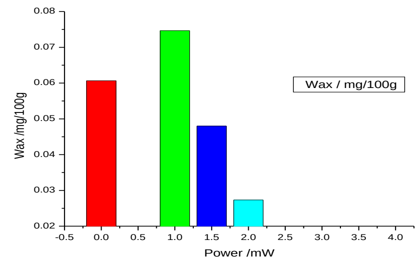


Figure (4.7) Variation of honey wax versus laser output irradiated powers

Figure (4.7) illustrates the variation of honey wax versus laser output irradiated power; it shows that the wax of the as obtained honey (control or reference sample) is 0.060666 %, while the irradiated samples wax increase by the low power greater than the control wax, then it decrease proportional to the output laser irradiated powers, the irradiated samples wax is 0.0746666 %, 0.048 % and 0.027333 %.

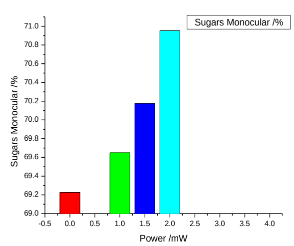


Figure (4.8) Variation of honey monocular sugars versus laser output irradiated powers

Figure (4.8) illustrates the variation of honey monocular sugars versus laser output irradiated power; it shows that the monocular sugars of the as obtained honey (control or reference sample) is 69.226666 %, while the irradiated samples monocular sugars slightly increase proportional to the output laser irradiated powers from 69.65% to 70.95333%. This may be due to the breakup of the total sugar.

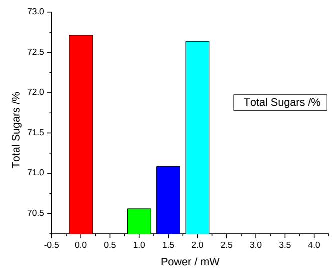


Figure (4.9) Variation of honey total sugar versus laser output irradiated powers

Figure (4.9) illustrates the variation of honey total sugar versus laser output irradiated power; it shows that the obtained honey (control or reference sample) total sugar is 72.713333 % and the irradiated samples total sugar is 70.56 % , 71.0833% and 72.63666 %, there is no significant changes in the irradiated samples total sugar compare with the reference sample.

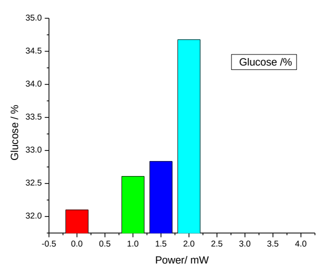


Figure (4.10) Variation of honey glucose versus laser output irradiated powers

Figure (4.10) illustrates the variation of honey glucose versus laser output irradiated power; it shows that the glucose of the as obtained honey (control or reference sample) is 32.1%, while the irradiated samples glucose increase proportional to the output laser irradiated powers from 32.606666 % to 34.67666 %.

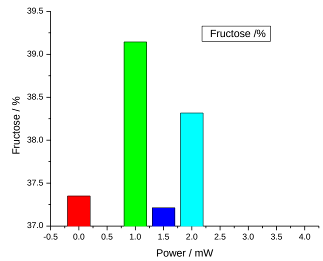


Figure (4.11) Variation of honey fructose versus laser output irradiated powers

Figure (4.11) illustrates the variation of honey fructose versus laser output irradiated power; it shows that the obtained honey (control or reference sample) fructose is 37.35 % and the irradiated samples fructose is 39.143333 %, 37.21333% and 38.316666 %, there is no significant changes in the irradiated samples fructose compare with the reference sample.

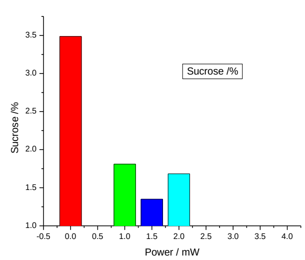


Figure (4.12) Variation of honey sucrose versus laser output irradiated powers

Figure (4.12) illustrates the variation of honey sucrose versus laser output irradiated power; it shows that the sucrose of the as obtained honey (control or reference sample) is 3.4866666 %, while the irradiated samples sucrose decrease less than the control sample, the irradiated samples sucrose is 1.5033 %, 0.9066 % and 1.6833 %

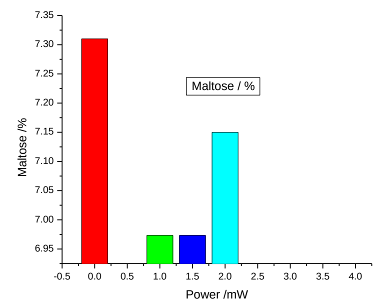


Figure (4.13) Variation of honey maltose versus laser output irradiated power

Figure (4.13) illustrates the variation of honey maltose versus laser output irradiated power; it shows that the obtained honey (control or reference sample) maltose is 7.31% and the irradiated samples maltose is 6.97333 %, 6.9733 % and 7.15 %, there is no significant changes in the irradiated samples maltose compare with the reference sample.

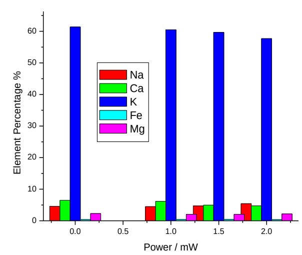


Figure4.14 Variation of honey elements versus laser output irradiated powers

Figure (4.14) illustrates the amount of sodium honey element (Na) in the different samples; it shows that the amount of the Na as obtained honey (control or reference sample) is 4.593333 %, while in the irradiated samples element(Na) slightly increase proportional to the output laser irradiated powers from 4.48 % to 5.43 %.

It also illustrates the amount of sodium honey element (Ca) in the different samples; it shows that the amount of the Ca as obtained honey (control or reference sample) is 6.493333 %, while the irradiated samples wax increase by the low power greater than the control element (Ca) , then it decrease proportional to the output laser irradiated powers, the irradiated samples wax is 6.163 %, 4.95 % and 4.74 %.

It also illustrates the amount of potassium honey element (K) in the different samples; it shows that the amount of the K as obtained honey (control or reference sample) is 61.39 %, while the irradiated samples sucrose decrease less than the control sample, the irradiated samples element (K) is 60.503333 %, 59.69333 % and 57.68333 %.

It also illustrates the amount of Iron honey element (Fe) in the different samples; it shows that the amount of the Fe as obtained honey (control or reference sample) is 0.3933 % and the irradiated samples element (Fe) is 0.41 %, 0.42666 % and 0.3833333 %, there is no significant changes in the irradiated samples element (Fe) compare with the reference sample.

It also illustrates the amount of magnesium honey element (Mg) in the different samples; it shows that the amount of the Mg as obtained honey (control or reference sample) is 2.303333 % and the irradiated samples element (Mg) is 2.056666 %, 2.05 % and 2.19 %, there is no significant changes in the irradiated samples element (Mg) compare with the reference sample.

In general K amount is the highest amount and (Fe) Iron amount is the lowest amount in all samples with no significant changes in all elements.

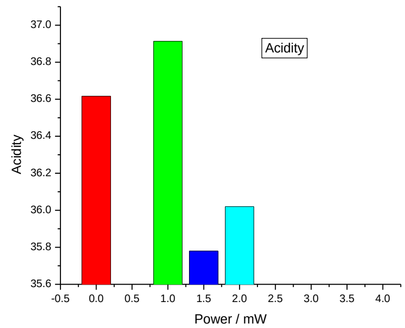


Figure4.15 Variation of honey Acidity versus laser output irradiated powers

Figure (4.15) illustrates the variation of honey Acidity versus laser output irradiated power; it shows that the obtained honey (control or reference sample) Acidity is 36.61666 and the irradiated samples Acidity is 36.91333, 35.78 and 36.02, there is no significant changes in the irradiated samples Acidity compare with the reference sample.

4.3 Conclusions

As conclusion four honey bee samples were collected from Cabom region South Darfur. Three of them were irradiated by differ output power of He.Ne laser in the same time 5 minutes.

These samples were subjected to some physical and chemical test to investigate. The investigated properties were electrical conductivity, refractive index, density, viscosity, Moisture, Ashes, Wax, Monocular Sugars, Total sugars, Glucose, Fructose, Maltose, Sucrose and acidity; it also included estimation of some elements like Na, Ca, K, Fe, and Mg.

The results of irradiation of honey by He-Ne Laser effect on some physical and chemical properties by increasing like conductivity, monocular sugar, glucose, density and it affect in other properties by decreasing like ashes, wax, sucrose, density and it didn't affect in some properties like refractive index, viscosity, moisture, total sugar, fructose, maltose and some elements like Na, Ca, K, Fe, Mg.

4.4 Recommendations

The following can be suggested as a future work:

1- Study of the effect of other lasers on honey properties.

2- Study of the effect of other lasers on other types of honey properties.

REFRENCES

Abdelgadir Taha**,** 2003**,** "Physicochemical Properties of Bee Honey Floral Origins Compared to Those of Sugarcane Honey"**.**

Alcarria Honey, 1994, a study of their Botanical Origin's Lebsonm Unters. Forsch.: 139–143.

Ali Kuku Gaddoum, 2007, "Study on the biology and honey production bee hybrid (F1) Apis mellifera carnica × Apis mellifera lamarckii".

Al-Sarrag, M. S., 1977, Morph metrical and Biological Studies on Sudanese honey bee Apis mellifera L. (Hymenoptera: Apidae). Ph. Ditheists. Cairo University.

Amel Abdurrahman**,** 2011, "The Physicochemical Properties of Honey Bee in kurdufan, Sudan".

Ammon, R., 1949, Der Ursprung Der Diastase des Bienenhonigs. Biochem. Z.319: 295-299.

Amoit, M. J.; Aubert, S.; Gonnet, M. and Tacchini, M., 1989, the Phenolic Compounds in Honeys: Preliminary Study upon Identification and Family Quantification. Apidologie, 20(2): 115–125.

Andrade, P.; Ferreres, F.; Gil, M. I. and Toma´ s-Barbera´ n, F. A., 1997, .Determination of Phenolic Compounds in Honeys with Different Floral Origin by Capillary Zone Electrophoresis. Food Chemistry. 60(1): 79–84.

Anklam, E., 1998, .A review of the Analytical Methods to Determine the Geographical and Botanical Origin of Honey. Food Chemistry. 63(4): 549–562.

Shuel, R. W., 1975, the Production of Nectar. In C. P. Dad ant (Ed.), The Hive and the Honeybee (pp. 265–282). Illinois: Hamilton.

Bodganov, S.: Martin, P. and Lullmann, C., 1997,. Harmonised Methods of the European Honey Commission. Apidologie (pp. 1–59). France: Elsevier.

Bogdanov, S.; Lu¨llman, C.; Martin, P.; Von der Ohe, W.; Russmann, H. and Vorwohl, G., 1999, Honey quality methods of analysis and international regulatory standards: Review of the work of the International honey Commission.Mitteilungen Gerbeite Lebensmittel, 108-125.

Bosi, G. and Battaglini, M., 1978, Gas Chromatographic Analysis of Free and Protein Amino Acids in Some Unifloral Honeys. Journal of Apiculture Research,17(3): 152–166.

Charles H. Townes , 2003,. "In the first laser ". Laura Garwin; Tim Lincoln. An entry of Nature: Twenty-One Discoveries that Changed Science and the World. University of Chicago Press. pp. 107–12. ISBN 0-226-28413-1. Retrieved February 2, 2008.

Cherchi, A.; Spanedda, L.; Tuberoso, C. and Cabras, P., 1994, Solid phase Extraction and High Performance Liquid Chromatographic Determination of Organic Acids in Honey. Journal of Chromatography A. 669: 59–64.

Christiana Honsberg and Stuart Bowde, 2015, Surface *Texturing*. [Online] available from: http://www.pveducation.org/pvcdrom/design/surface-texturing. [[Accessed: 27th july2015]

Clinical Methods Section Determination of oligosaccharides in Brazilian honeys of

Codex Alimentarius Commission, 1993, Standard for Honey, Ref. Nr. CL 1993/14-SH, FAO and WHO, Rome

Codex Alimentarius Commission, 1994, codex Standard for Honey. 11:21 – 24. Comprehensive survey (pp. 157–206). London: Heinemann.

Compounds of Different Botanical Origin Brazilian Honeys. Food Chemistry. 65:347-352.

Costa, L. S. M.; Albuquerque, M. L. S.; Trugo, L. C.; Quinteiro, L. M. C.; Barth, O. M.; Ribeiro, M. and De Maria, C. A. B. ,1999, Determination of Non-Volatile

Crane E , 1990, *"*Honey from honeybees and other insects*"*. Ethnology Ecology & Evolution. ***3*** (sup1): 100–105. Doi: 10.1080/03949370.1991.10721919.

Crane, E., Walker, P., & Day, R., 1984, Directory of important world honey sources. International Bee Research Association. ISBN 086098141X.

Crane, Ethel Eva, 1999, the World History of Beekeeping and Honey Hunting *Rutledge*. ISBN 9781136746703.

Dad Costa, J.M.; Leite, A. J. M.; Trugo, B. L. C.; Costa, A. L.; Quinteiro, C. L.; Barth, D. O.; Dutra, D. V. and De Maria, A. C, 2000, Analytical, Nutritional and

Dalrymple B. E. "Visible and infrared luminescence in documents: excitation by laser". Journal of Forensic Sciences, 28(3), 1983, 692–696.

Dalrymple B. E., Duff J. M., Menzel E. R. "Inherent fingerprint luminescence – election by laser". Journal of Forensic Sciences, 22(1), 1977, 106–115.

Davies, A. M. C, 1976, the Application of Amino Acid Analysis to the Determination of the Geographical Origin of Honey. Journal of Food Technology. 11: 515–523.

Different botanical origin. Food Chemistry 70: 93-98.

Echingo, T. and Takenaka, T., 1974, Production of Organic Acids in Honey by Honey Bees. Journal of Agriculture Chemical Society Japan. 48: 225–230.

Fallico, B.; Zappal, _A. M.; Arena, E. and Verzera, A, 2004, Effects of Heating Process on Chemical Composition and HMF Levels in Sicilian Monofloral Honeys. Food Chemistry. 85: 305–313

Ferreres, F.; Ortiz, A.; Silva, C. and Garcia-Viguera, C, 1992, Flavonoids of ‘‘La

Frias, I.; Hardisson, A.; Gonzalez, T.; Munoz, V. and Espinar, M, 1997, the Mineral Content of Honey in Tenerife (the Canary Islands). Apicata, 32: 21–23.

From New Zealand Unifloral Honeys. 2. Degraded Carotenoids and Other

Horn, H. and Lullmann, C, 1992, Das Grosse Honigbuch, Herewith, Munched.
Ibrahim, A. O, 1985, Studies on Sudanese Honeys. M. Sc. Thesis. University of Khartoum.
Islam Mohammed (2015) “Calibration and Measurement the Spectral Rang of Laser Goggles” .

J. W. White, JR. AND Landis W. Doner, 1980, Research leader and research chemist, respectively, Science and Education Administration, Eastern Regional Research Center, Philadelphia, Pa. 19118.

Jeuring, J. and Kuppers, F, 1980, High Performance Liquid Chromatography of Furfural and Hydroxymethylfurfural in Spirits and Honey. Journal of the Association of Official Analytical Chemists, 63:1215-1218.
K.R.Nammbiar Professor and head Department of Electronics, 2004, "Lasers principle and Applications", AJ college of science and Technology.
Kincade, Kathy; Anderson, Stephen January 1, 2005, "Laser Marketplace Consumer applications boost laser sales 10%". Laser Focus World. Vol. 41 no. 1.
Komamine, A., 1960, Amino Acids in Honey. Act. Chem. Fem. B 33: 185-187.
Krell, R., 1996, Value Added Products from Beekeeping. FAO Agricultural Services Bulletin. No. 124. Rome.
Lagrange, V., 1991, Ultrafiltration of honey. American Bee Journal, 131, 453.
Lee, C. Y. and Kime, R. W., 1984, the Use of Honey for Clarifying Apple Juice. Journal of Apicultural Research. 23(1): 45-49.
Lombard, A.; Buffa, A.; Manino, A. and Patetta, A, 1984, Identification of farinose in Honeydew. Experiential, 40, 178-180.
Louveaux, J; Maurizio, A. and Vorwhol, G, 1978, Methods of Melissopalynology. Bee World. 59: 125-138.

Low, N. H. and Sporns, P, 1988, Analysis and Quantitation of Minor Di- and Trisaccharides in Honey, Using Capillary Gas Chromatography. Journal of Food Science. 53: 558-561.

Maeda, S.; Mukai, A.; Kosugi, N.; Okada, Y, 1962, the Flavor Components of Honey. Journal of food Science and Technology. 9(7): 179-180.

Mateo, R., and Bosch Reig, F, 1997, Sugar Profiles of Spanish Unifloral Honeys. Food Chemistry. 60(1): 33–41.

Mateo, R., and Bosch Reig, F, 1997, Sugar Profiles of Spanish Unifloral Honeys. Food Chemistry. 60(1): 33–41.

Maurizio, A, 1975, How Bees Make Honey. In E. Crane, Honey, a Comprehensive Survey (1st end) (pp. 77-105). London, UK: Heine-mann (inCooperation with the International Bee Research Association).

Mclellan, A. R., 1975, Calcium, Magnesium, Potassium and Sodium in Honey and in nectar secretion. Journal of Apicultural Research. 14 (2): 57-61.

Mohammed Yusuf**,** 2013**,** “PHYSIOCHEMICAL AND MICROBIAL Characteristics Of Different Type OF Sudanes Honey”.

Mohammed, H. M. E., 2006, Chemical properties and Antibacterial Activities of Different Kinds of Floral Bee Honeys. M. Sc. Thesis. University of Khartoum.

Munhall Abu baker Ahmed Elrufaie, 2014, Determination of conventional sugars in some Sudanese honey samples

Orazio Svelto, Marko H.Niemz, 2007,"Laser-Tissue Interaction fundamentals and Application", Germany.

Paine, H. S. Gertler, S. I. and Lothrop, R. E., 1934, Colloidal Constituents of Honey. Influence on Properties and Commercial Value. Ind. Eng. Chem. 26: 73-81. Cited in: White, J. W. Jr., 1979, Composition of Honey. In Crane, E. (ed.)

Honey: A comprehensive Survey.2nd edition. Heinemann in cooperation with IBRA. London.

Percival, M., 1961, Types of Nectars in Angiosperm. New Physiology. 60: 235-281.

Perez-Arquillue, C.; Conchello, P.; Arino, A.; Juan, T. and Herresa, A., 1994, Quality Evaluation of Spanish Rosemary (Rosomarinus officinalis) Honey. Food Chemistry. 51: 207–210.

Piazza, M. G.; Accorti, M. and Persano, L, 1991, Electrical Conductivity, Ash, Color and Specific Rotatory Power in Italian Unifloral Honeys. Apicoltura. 7: 51-63.

Rinaudo, M. T.; Ponzetto, C.; Vidano, C. and Marlerro, F, 1973, the Origin of Honey Amylase. Comp. Biochem. Physiol. 46 B (2): 253-256.

Salinas, F.; Montero De Espinosa, V., Osorio, E., and Lozano, M., 1994, Determination of Mineral Elements in Honey from Different Floral Origins by Flow Injection Analysis Coupled to Atomic Spectroscopy. Revista Espanola deciencia y Tecnolgia de Alimentos, 34, 441–449.

Sancho, M. T.; Muniategui, S. B.; Huidobro, J. F. and Simal, 1999, Mieles del pais Vasco. III: ague y azucares. *Anal*. Bromatol. XLIII-1: 101-112.

Steele, Robert V. February 1, 2005, "Diode-laser market grows at a slower rate". Laser Focus World. *Vol. 41 no. 2*

Substances from Heather Honey. Journal of Agricultural and Food Chemistry.37 (5): 1217–1221.

Sumaya Ibrahim, 2007**,** “Phenolic Contents And Antiox Indent Activity Of Sudanes Honey”.

Tan, S. T.; Wilkins, A. L.; Holland, P. T. and McGhie, T. K, 1989, Extractives

Value-added products from beekeeping, 2011, Chapter 2. Fao.org. Retrieved on 14 April.

Von der Ohe, W.; Dustmann, J. H. and Von der Ohe, K., 1991, Prolin also kriterium der reif des honigs. Deutsche Lebensmittel-Rundschau, 87(12): 383–386.

White, J. W., 1969, Moisture in honey: Review of chemical and physical methods. J. AOAC. 52(4), 729}737.

White, J. W., 1975, Composition of Honey. In C. Eva (Ed.), Honey a comprehensive survey (pp. 157–206). London: Heinemann.

White, J. W. Jar, 1979, Composition of honey. In E. Crane (Ed.), Honey. Acomprehensive survey (pp. 162). London: Heinemann.

White, J. W. Jar, 1992, Honey in the hive and the honey bee. In J. M. Graham (pp. 873). Hamilton, IL: Dad ant and Sons.

White, J. W. Jr., 1979, Composition of Honey. In Crane, E. (ed.) Honey: Acomprehensive Survey.2nd edition. Heinemann in cooperationwith IBRA. London.

White, J. W. Jr.; Riethof, M. H. and Kushnir, I, 1962, Composition of American Honeys. United States Department of Agriculture Technical Bulletin. 1261:124.