Sudan University of Science and Technology
College of Graduate Studies

Effect of Helium-Neon Laser (632.8 nm) and Diode Laser (532 nm) on Powder Milk

تأثير ليزر الهليوم – نيون (632.8 nm) وليزر الثنائي (532 nm) على الحليب المجفف

A Thesis Submitted as Partial Fulfillment of the Requirements for the Degree of Master of Science in Physics.

By:
Sami Abdalla Ahmed Abdalla

Supervisor:
Dr. Ali Abdel Rahman Saeed Marouf

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الآيـــــــة :

قال تعالى:

(وَإِنَّ لَكُمْ فِي الْأَنْعَامِ لَعِبْرَةً ۖ نُسْقِيكُمْ مِمَّا فِي بُطُونِهِ مِنْ بَيْنِ فَرْثٍ وَدَمٍ لَبَنًا خَالِصًا سَائِغًا لِلشَّارِبِينَ)

صدق الله العظيم س

سورة النحل الايه (66)

Dedication

To

My father

My mother

My family

My Friends

Acknowledgment

First of all, I would like to thanks Allah for giving me the strength to finish this study.

Special thanks Dr Ali Abdel Rahman Saeed Marouf, supervisor of my thesis for his guidance and assistance throughout the progress of this thesis . My thanks extend to staff of Institute of Laser-Sudan University of Science and Technology and My thanks extend to staff of Institute research of Technology.

ABSTRACT

In this study two types of laser (He-Ne and Green Diode) are used to radiate a sample of a powder milk from available on local markets for a difference durations of times, some of chemical parameters analysis were done (rate of Moisture , the measure of pH value and Ash%) on sample of powder milk .

When use (He-Ne) laser it was found that a decrease in Moisture when we use it for short duration of time, but increased Moisture when used it for long duration ,also He-Ne laser decreased Ash and pH .

When use green diode laser it was found that no affect on Moisture, but we found increase on Ash and decrease on pH value.

المستخلص

في هده الدراسة تم استخدام نوعين من الليزر (هيليوم – نيون وليزر الثنائي) لتشعيع عينة من اللبن المجفف المتوفر في الاسواق المحليه لفترات زمنية مختلفة, ومن ثم تم اجراء بعض التحاليل الكيميائيه (نسبة الرطوبه,تقدير الرماد و قياس الحموضه) على عينات اللبن المجفف .

حيث وجد ان ليزر الهيليوم –نيون يؤدي الي خفض نسبة الرطوبه عند استخدامه لفترات قصيره بينما يؤدي لزيادتها عند استخدامه لفترات طويله,ويخفض نسبة الرماد ,كما يخفض الحموضة.

أما ليزر الدايود الاخضر فقد وجد انه لايؤثر على نسبة الرطوبة ,بينما ادى لرفع نسبة الرماد وخفض الحموضة.

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CHAPTER ONE

Introduction and Literature Review

1.1 Introduction

Many scientific studies contradict the conventional wisdom that milk and dairy consumption help reduce osteoporotic fractures. Surprisingly, studies demonstrating that milk and dairy products actually fail to protect bones from fractures outnumber studies that prove otherwise. Even drinking milk from a young age does not protect against future fracture risk but actually increases it. Shattering the "savings account" calcium theory, Cumming and Kline berg report their study findings as follows.

This research studies the effect of laser on

1.2 Research Problem:

This research focus on evaluation and improves some chemical parameters by using tow source of laser (He-Ne 632.8 nm and diode Laser 512nm).

1.3 Literature review

In This chapter demonstrate some above study where high light there results.

Milk contains all the essential nutrients for all physiological function of the body system. According to Byron *et al* (1974) the average composition of milk is water 87.20%, dry matter 12.80% (fat 3.70%, Protein 3.50%, Lactose 4.90% and Ash 0.70%). Milk is also good source of calcium, phosphorus and fat soluble vitamins (A, D, E and K). For this reason it is the nature's most nearly perfect food. Milk is highly perishable agricultural product because its support to luxuriant growth of almost all kinds of microbes.

surplus milk which could be utilized by converting it into various milk products such as ghee, butter, yoghurt (Dahi), powdered milk, cheese, cream, condensed milk and various other fermented dairy products should be taken into consideration.

Dry milk or powder milk is a product obtained by the removal of water and fat from whole milk, usually fat percent of whole milk powder is minimum 26% and maximum 40%, for partially skimmed milk powder minimum 1.5% and maximum 2.5%. For all types of powder milk water content ranges from 3-5% (Edgar Spreer , 1995). Under any circumstances water percent of dry milk should not exceed 5%. The removal of water from the milk takes place in two stages. The first stage is concentration by vacuum evaporation and the second stage is drying. Ninety percent of the water in the milk is removed in the evaporator and only ten percent in the spray dryer (Robinson, 1994a). The two principal processes for the manufacture of milk powder are the roller or the drum process and the spray process. Other systems are the form mat process and the freeze drying process. More recently, equipment in which combinations of these fundamental processes are found has been developed (FAO/WHO, 1973).

Powder milk has a much longer keeping quality and can be held in un-refrigerated storage condition. Much less storage space is required per unit of solids. Distribution is possible to the countries particularly those with unfavorable conditions of the perishable dairy products to be impractical. Consequently, dry milk has superiority both in economy and convenience. Powder milk is advantages for its concentrated source of many essential nutrients (Hall and Hendrick, 1966).

Powder milk (whole and non fat) are used in manufacturing ice cream, infant foods, bakery goods, confections and sausages and they are utilized by flour millers, and cheese processors. In Bangladesh whole milk and half-cream powder milk available in tin containers are mainly used as baby food. These are also used for convalescents and in the preparation of many other sweetmeats.

Nandakumar et al, (2006) were used Visible light lasers as bactericidal agents to remove bacterial bio-films Nandakumar et al, (2006). Recently, Hamblin et al. (2005) also showed that high intensity visible light could kill Helicobacter pylori in the stomach of humans. Therefore, in some instances, the use of visible light as a bactericidal agent might prove to be cost effective and cause fewer side effects than anti-bacterial drugs. However, as in the case for UV, insufficient wavelength dependent dose information is available documenting the bactericidal effects of visible light. Escherichia coli is an indigenous member of the intestinal flora of healthy humans and warm-blooded animals, and comprises about 1% of the total.

Tallon, Van Houdt, Michiels et al (2005) UV disinfection is becoming more popular in drinking/waste water treatment as well as in clinical and industrial facilities; it is of interest to examine the bactericidal effects of UV and visible light on this bacterial species.

(Leclerc et al., 2001).Although only some E. coli strains are pathogenic to humans, certain pathogenic serotypes, such as E. coli O157:H7, have caused numerous outbreaks associated with food and drinking water (Betts, 2000; Kuhnert et al., 2000; Rasmussen and Casey, 2001; Swerdlow et al., 1992). Because E. coli is ubiquitous in the fecal materials of humans and warm-blooded animals and the presence of fecal contamination correlates well with the presence of many fecal-borne human pathogens (Leclerc et al., 2001), this bacterial species has been used as a standard fecal contamination indicator to assess the cleanliness and safety of drinking water and commercial food.

Ultraviolet light (UV) has been used extensively for disinfection at waste and drinking water treatment and clinical and industrial facilities (Decho, 2000;Wilson, 1994).For most UV disinfection equipment, either the mercury 254 nm UV line or the UV–visible light bands from a xenon arc lamp is used as the UV source (Hockberger, 2002). However, with the creation of new UV diodes and lasers that emit radiation between 280 and 400 nm, applications of these devices to the production of bactericidal UV light systems can be anticipated once lethal dose information is available visible light.

More recently, it has been suggested that high-power lasers, such as the Nd:YAG laser, may be useful for destroying bacteria, presumably by a thermal effect. The bactericidal action of a high-power Nd:YAG laser on a suspension of E.coli was studied. In a thermocouple equipped cuvette, a temperature rise up to 50 C was observed after the use of laser with a power output of 100 W for 23 s. this resulted in more than 90% loss of viability of E.coli. As a comparison, a suspension of E.coli was heated up to 50C in a water path. In this case there was only a minimal loss of viability of E.coli. It was concluded that" thermal" response because of just heating the suspension fluid is not a sufficient explanation for the killing of E.coli. Therefore, other process involved during exposure to the Nd:YAG laser. However, using a different in "vitro" model in which agar plates (inoculated with bacteria) where exposed to laser light, temperature close to 100C where major immediately after radiation. This indicates that theAntimicrobial effect within this particular model is probably caused by a photo-thermal effect rather than by photo-chemical effects of the laser light itself as suggested by Gro¨nquist et al. (20). Meral et al. (19) evaluated the minimal energy levels necessary to have a bactericidal effect on a bacterial suspension of various oral microorganisms. Instead of submerging the tip in the suspension, they observed a distance of 10 mm. Within this laboratory setting, they concluded that the addition of a dye(E.g. sheep blood) enhanced the absorption of the laser light. The efficacy of the Nd:YAG lasers has also been evaluated for the photo-thermal disinfection of root canals studied by Bergman's et al. (21). Although a different indication, the 'in vitro' models used bare resemblance to the present investigation. Laser irradiation was performed in wet root canals that had been inoculated with a bacterial suspension of Enterococcus facials (a relatively heat-resistant bacterium). The laser application was found to be safe and to have a potential disinfection capacity (99.7% kill). In a comparable study by Wang et al. (21), the Er,Cr:YSGG laser was compared with the Nd:YAG laser. Both laser systems had a significant bactericidal effect on infected root canals, but the Nd:YAG was more effective resulting in 98% kill. In a more basic 'in vitro' endodontic model, laser radiation was delivered to 12 E. facials broth cultures in small capillary tubes. For specimens that received a total energy of ‡60 J, no viable bacteria were detected following laser treatment (Rooney et al 1994).

"Consumption of dairy products, particularly at age 20 years, was associated with an increased risk of hip fracture in old age. ("Case-Control Study of Risk Factors for Hip Fractures in the Elderly". American Journal of Epidemiology. Vol. 139, No. 5, 1994).

Some researcher reported that *n*-3 PUFA enriched supplemental fat resulted in a decrease in feed consumption, milk yield and milk fat depression in cows (Or-Rashid et al., 2008), however, in goats, others reported no effect (Zhang et al., 2006). While *n*-6 enriched diet (such as sunflower) unmodified or increased the milk composition in both species (Dai et al.,

1.5 The objective of this thesis:

The main goal of this research is use laser to interaction with powder milk and the study of the impact on the physical and chemical properties of powder milk.

1.6 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 Definition of laser:

The word (laser) is an acronym derived from Light Amplification by Stimulated Emission of Radiation. The light emitted by laser is different from that produced by more conventional light sources. laser is a device that generates or amplifies coherent radiation at frequencies in the infrared, visible or ultraviolet and other regions of the electromagnetic spectrum.

Lasers are distinguished from other light sources by their coherence. Spatial coherence is typically expressed through the output being an arrow beam which is diffraction-limited, often a so-called "pencil beam." Laser beams can be focused to very tiny spots, achieving a very high irradiance, or they can be launched into beams of very low divergence in order to concentrate their power at large distance.

Temporal (or longitudinal) coherence implies a polarized wave at a single frequency whose phase is correlated over a relatively large distance (the coherence length) along the beam. a beam produced by thermal or other incoherent light source has an instantaneous amplitude and phase which vary randomly with respect to time and position, and thus a very short coherence length.

Most so-called "single wavelength “lasers actually produce radiation in several modes having slightly different frequencies (wavelengths), often not in a single polarization ,and although temporal coherence implies monochromaticity, there are even lasers that emit broad spectrum of light, or emit different wavelengths of light simultaneously. there are some lasers which are not single spatial mode and consequently their light beams diverge more than required by the diffraction limit. However all such devices are classified as "lasers" based on their method of producing that light: stimulated emission, lasers are employed in applications where light of the required spatial or temporal coherence could not be produced using simpler technologies.

2.1.1 Properties of laser:

Laser radiation shows as extremely high degree of monochromaticity ,coherence , directionality and brightness as compared to other no coherent light sources.

2.1.1.1Monochromaticity:

The Mono chromaticity of laser radiation is a unique property of laser light, results from the circumstance that light oscillation sets in at one resonance frequency of the optical cavity, and owing to the balance between gain and loss in CW operation the line width ΔvL of the oscillating mode is ultimately limited by quantum noise.

2.1.1.2Coherence:

The coherence of the laser radiation refers to the time period Δt in which the phase undergoes random changes , and the coherence length is a measure of the propagation distance over which the beam stays coherence .

2.1.1.3 Directionality:

The directionality of the laser beam is due to the fact that the gain medium is placed inside an open optical resonator .

2.1.1.4 Brightness:

The brightness of laser radiation is closely related to the directionality and stems from the capability of a laser oscillator to emit a high optical power in a small solid angle of space .

2.1.2Elements of laser:

A laser generally requires three components for its operation:

(a) an active medium in the form of a laser rod, with energy levels that can be selectively populated;

(b) a pumping process to produce population inversion between some of these energy levels;

(c) a resonant cavity containing the active medium which serves to store the emitted radiation and provides feedback to maintain the coherence of the radiation.

The main problem in designing a laser is to involve produce a sufficiently high population of atoms in the excited state. For this, many ingenious ways fully all have been evolved. The most common method of center excitation is by sending an intense beam of light from a flash lamp or a continuous source of light through the material in the form of a cylindrical rod or a container tube with a suitable gas. Only those materials which can be pumped to achieve population inversion, are used to give laser radiation.

The existence of states whose mean life times are relatively long so as to help pile up considerable energy in the excited levels, is necessary. Long life time of a level and the sharpness of the spectrum lines usually go together, and so, the materials that can be best used to give laser radiation are crystals with sharp lines, and gases at low pressure. An important aspect of the laser operation involves the design of a resonator cavity to maximize the process of stimulated emission. Two carefully aligned mirrors, one having more than 99 percent reflectivity and the other having less reflectivity, are placed at either end of the cavity containing the laser rod and the flash lamp. The stimulated radiation multiplies by bouncing back and forth many times between the two mirrors and passing through the laser medium. And, when it exceeds a certain limit, the laser light comes out citation in the form of a narrow pencil beam through the semi-transparent mirror .

2.1.3 Laser construction:

A laser system is constructed from three main parts:

2.1.3 .1 Pumping source:

It can provide 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.

2.1.3.2 Laser gain medium:

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

2.1.3.3The optical resonator or optical cavity:

In its simplest form 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 contains gases, liquids and solids, Cavity materials can determine the wavelength of the output.

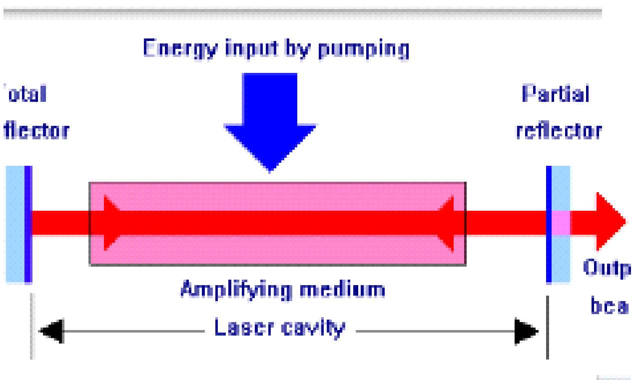


Figure (2.1) elements of laser

2.1.4 Laser types

The various laser types developed so far display a wide range of physical and operating parameters. Indeed, if lasers are characterized according to the physical state of the active material, we call them solid-state, liquid, or gas lasers. A rather special case is where the active material consists of free electrons at relativistic velocities passing through a spatially periodic magnetic field free electron lasers. If lasers are characterized by the wavelength of emitted radiation, one refers to infrared lasers, visible lasers, and ultraviolet (UV) and x-ray lasers.

2.1.4.1 Gas lasers:

A gas laser contains atoms or molecules. Stimulated transitions occur in atoms between electronic states and in molecules between rotational, vibration, or electronic states. We describe various gas discharge lasers: helium–neon laser; metal vapor laser; argon ion laser; exciter laser; nitrogen laser; CO2 laser; optically pumped gas lasers .

Helium-Neon Laser:

The helium-neon (He Ne) laser can emit several lines in the visible and infrared range, but most commercially available lasers are based on the red line at632.8 nm, with a power of several milli watts. He Ne lasers have exceptionally low gain and efficiency, and their *cw* output does not exceed 100 mW. Their applications are limited to low-power tasks.

The active medium of a helium-neon laser is a mixture of helium and neon gases(usually 10:1). The pumping energy is provided by high-voltage dc (direct current)electric discharge at about 10 kV to the bore of a gas-filled tube of length between10 cm and 2 m, containing gas under a pressure of several torr . The more numerous helium atoms absorb more energy from collisions with electrons produced from the electric discharge than do neon atoms, and they are preferentially excited to higher electronic levels. Then, the helium atoms transfer the excess energy to neon atoms, raising them through resonant collisions to a meta stable state, which has an energy nearly identical to that of the excited helium atoms. Then, the excited neon atoms return to the ground state, producing stimulated emission once population-inversionis reached. Generally, several laser transitions are possible, but most He Ne lasers are designed to favor 632.8nm emission.

The transitions in the infrared region at wavelengths of 1523.5 nm and 3392nm are not usually used in mass production ,owing to the higher prices of special optics in IR. However, they do have several specific uses. For example, the 1523.5 nm line is used successfully for testing silicon glass optical fibers, owing to the minimal losses in this spectral area.

Although laser diodes provide an alternative to helium-neon lasers, they are still used in alignment , inter ferometry, metrology, medical diagnosis such as flow-cytometry, in holography ,and in shops to read product codes, because of their good beam coherence and quality. They are also used to determine the position of patients under X-ray irradiation. They serve in industrial alignment to determine straight lines with the laser beam in the construction of buildings, tunnels, and sewer pipes. The compact laser diodes, however, have partially superseded the helium-neon lasers in hand-held barcode readers, but they are still dominant in industrial code readers because of their divergence.

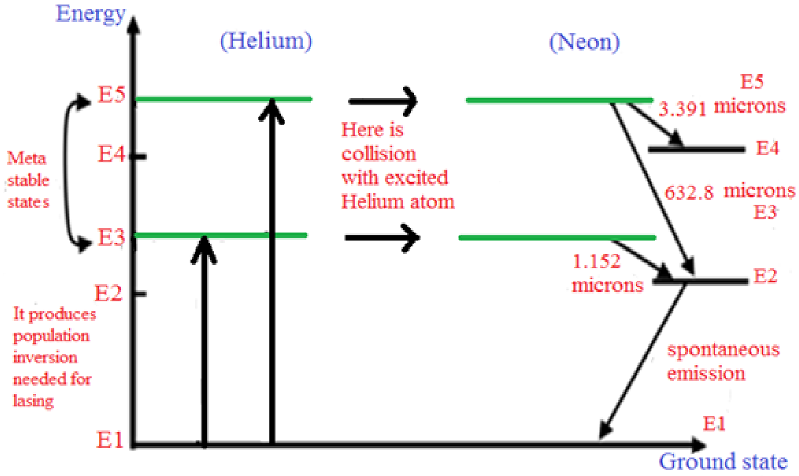


Figure (2.2) energy state of He-Ne laser

2.1.4.2 Solid laser:

We discuss solid state lasers that make use of electronic states of impurity ions in dielectric crystals or in glasses — other types of solid state lasers, namely semiconductor lasers that are based on electrons in energy bands of semiconductors. It consists the ruby laser, the titanium–sapphire laser, neodymium-doped YAG laser, of other neodymium lasers, and of other YAG lasers.

2.1.4.3 Semiconductor lasers:

Semiconductor lasers represent one of the most important class of lasers in use today, not only because of the large variety of direct applications in which they are involved, but also because they have found a widespread use as pumps for solid-state lasers. These lasers will therefore be considered at some length . For the active medium, semiconductor lasers require a direct-gap material, so normal elemental semiconductors (e.g., Si or Ga) cannot be used. The majority of semiconductor laser materials are based on a combination of elements in the third group of the Periodic Table (such as AI, Ga, In) and the fifth group (such as N, P, As, Sb) hence referred to as 1II-V compounds [4].

2.1.4.4 Liquid Dye lasers

Liquid Dye Lasers use a solution of complex dye material as the active medium. The dyes are large organic molecules, with molecular weights of several hundred. The dye material is dissolved in an organic solvent, like methyl alcohol. Thus the active medium is a liquid.

Dye lasers are the only types of liquid lasers which have reached a well developed status.

One of the most important features that dye lasers offer is tenability, that is, the color of the output beam can be varied by adjusting the inter cavity tuning element and also by changing the type of the that is used. The monochromatic output of available dye lasers can be turned over a broad range, from the ultraviolet, to the near infrared. Liquid dye lasers that can be tuned to any visible wavelength, and to portions of the infrared and ultraviolet, are commercially available in both pulsed and continuous models. Dye lasers are chosen for applications, like spectroscopy, in which tenability is important

2.1.5 Laser applications:

Lasers are employed over a wide range of applications from scientific research, biomedicine, and environmental sciences to industrial material process, microelectronics and entertainment.

Some applications are: Industrial application like cutting , welding ,drilling by using CO2 laser, ruby laser, argon ion laser , pulse N d:YAG laser.

Medical application like phototherapy of eye , tissue surgery , using (CO2 laser, N d: YAG laser ,argon ion laser, and dye laser).Military applications include range finders and beam weapons , by (CO2 laser, N d:YAG laser, chemical laser, semiconductor laser). Other applications include Communication , information processing , super market scanners , printers ,reading device for compact disc player ,holography and spectroscopy .

2.1.5.1Scientific Research:

Lasers have opened new fields of investigation in science and technology. It has given physics a versatile tool for the study of interaction of light and matter. The powerful beam of laser has become an important tool for spectroscopic analysis. A laser system, known as microprobe, is used for exciting emission from solid samples for spectrographic analysis. In 1928, Prof. CV Raman discovered a new phenomenon, known as Raman Effect. by which molecular structures of different substances can be investigated by passing monochromatic light through them. He found that when light passes through a transparent substance, it is scattered and emerges with a change of frequency caused due to the vibration of molecules in the substance. This produces additional lines (known as Raman lines) in the scattered light spectrum. The discovery of laser is a great boon for recording the Raman spectra. The use of lasers has enabled recording of Raman lines within seconds, which otherwise would require long exposure times of or few hours using ordinary light sources. The analysis of Raman lines gives the fundamental properties of the substances. Similarly, lasers can also be used for analyzing liquids. A laser beam, when passed through a liquid, gives several colures (wavelengths) and the process is called fluorescence. The study of the fluorescence spectra thus obtained gives the properties of the liquids. Lasers offer attractive possibilities in terms of the exploration of molecular structure and determination of nature of chemical reactions. A laser beam can initiate and hasten a chemical reaction. Since different reactions require different wavelengths of light, a 'tunable' laser (i.e., a source whose wavelength can be altered as in radio tuning) is of immense help to a chemist. Tunable lasers, particularly dye lasers, now cover the entire visible spectrum and have revolutionized optical spectroscopy. In photochemistry, lasers with short duration pulses are highly useful for inducing and monitoring ultrafast chemical reactions more efficiently than by any conventional method. Laser also finds application in biological research. Using laser techniques, biological studies have been carried out in enzymes, proteins, cellular components and isolated cells, microorganisms, tissue culture, isolated physiological systems individual organs, etc. Using a ruby laser coupled with a microscope, single cells have been irradiated with laser beams focused on to a spot of the order of one micron to destroy individual chromosomes, thus making available a highly delicate instrument for genetic studies. It is also possible to produce laser beams as narrow as the diameter of a protein molecule and use it to alter genetic properties of living organisms.

2.2 Milk

Milk is an emulsion of butterfat globules within a water-based fluid that contains dissolved carbohydrates and protein aggregates with minerals, Because it is produced as a food source for the young, all of its contents provide benefits for growth. The principal requirements are energy (lipids, lactose, and protein), biosynthesis of non-essential amino acids supplied by proteins (essential amino acids and amino groups), essential fatty acids, vitamins and inorganic elements, and water.

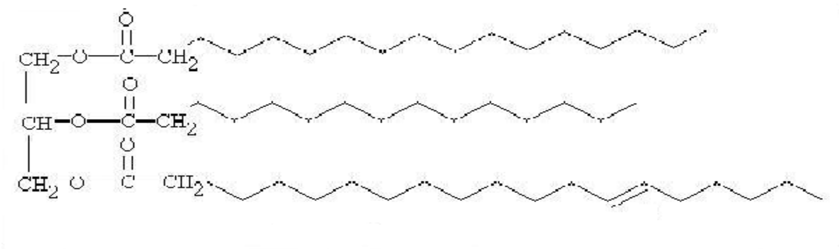


Figure (2.3) chemical bond of milk

Milk is a nutrient-dense food. This means that it provides a high level of essential nutrients compared to its calories. In fact, each serving of milk provides 10% or more of the recommended daily intake for calcium, vitamin D (if fortified), protein, potassium, vitamin A, vitamin B, riboflavin and phosphorus.

Milk is an excellent source of calcium. Regardless of its fat content, milk provides about 300 milligrams (mg) of calcium per serving (8 fluid oz). The chart below provides information on the calcium content of fluid milk products per serving. An adequate intake of calcium helps to reduce the risk of osteoporosis, high blood pressure and colon cancer. It is difficult to obtain enough calcium without consuming milk (or other dairy foods). To help meet calcium needs, the following number of servings of milk (or its equivalent) is recommended each day.

2.2.1 Physical and chemical properties of milk:

Milk is an emulsion or colloid of butterfat globules within a water-based fluid that contains dissolved carbohydrates and protein aggregates with minerals. Because it is produced as a food source for the young, all of its contents provide benefits for growth. The principal requirements are energy (lipids, lactose, and protein), biosynthesis of non-essential amino acids supplied by proteins (essential amino acids and amino groups), essential fatty acids, vitamins and inorganic elements, and water.

We will cover the following physical properties.

- Density
- Viscosity
- Freezing Point

Density:

The density of milk and milk products is used for the following;

- to convert volume into mass and vice versa
- to estimate the solids content
- to calculate other physical properties (e.g. kinematic viscosity)

Density, the mass of a certain quantity of material divided by its volume, is dependent on the following:

- temperature at the time of measurement
- temperature history of the material
- composition of the material (especially the fat content)
- inclusion of air (a complication with more viscous products)

With all of this in mind, the density of milk varies within the range of 1027 to 1033 kg /m3 at 20° C .The following table gives the density of various fluid dairy products as a function of fat and solids-not-fat (SNF) composition:

Viscosity:

Viscosity of milk and milk products is important in determining the following:

- the rate of creaming
- rates of mass and heat transfer
- the flow conditions in dairy processes

Milk has long been a popular beverage, not only for its flavor, but because of its unique nutritional package. Milk is one of the best sources of calcium in the American diet. It also provides high-quality protein, vitamins and other minerals. Milk and skim milk, excepting cooled raw milk, exhibit Newtonian behavior, in which the viscosity is independent of the rate of shear. The viscosity of these products depends on the following:

- Temperature:
- cooler temperatures increase viscosity due to the increased voluminosity of casein micelles
- temperatures above 65° C increase viscosity due to the denaturation of whey proteins
- pH: an increase or decrease in pH of milk also causes an increase in casein micelle voluminosity.
- **pH Meter**:

pH 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.

2.3 Light interaction with matter:

When optical radiation interacts with matter, it may be reflected, absorbed, or transmitted.

2.3.1Absorption:

If a light wave of a given frequency strikes a material with electrons having the same vibration frequencies, then those electrons will absorb the energy of the light wave and transform it into vibration motion. During its vibration, the electrons interact with neighboring atoms in such a manner as to convert its vibration energy into thermal energy. Subsequently, the light wave with that given frequency is absorbed by the object .It is the transformation of radiant power to another type of energy, usually heat, by interaction with matter. In physics, absorption of electromagnetic radiation is the way in which the energy of a photon is taken up by matter, typically the electrons of an atom. Thus, the electromagnetic energy is transformed into internal energy of the absorber, for example thermal energy. The reduction in intensity of a light wave propagating through a medium by absorption of a part of its photons is often called attenuation. Usually, the absorption of waves does not depend on their intensity (linear absorption), although in certain conditions (usually, in optics), the medium changes its transparency dependently on the intensity of waves going through, and satiable absorption (or nonlinear absorption)occurs.The absorbance of an object quantifies how much of the incident light is absorbed by it. This may be related to other properties of the object through the Beer–Lambert law. The absorption coefficient determines how far into a material light of a particular wavelength can penetrate before it is absorbed. In a material with a low absorption coefficient, light is only poorly absorbed, and if the material is thin enough, it will appear transparent to that wavelength. The absorption coefficient depends on thematerial and also on the wavelength of light which is being absorbed. Semiconductor materials have a sharp edge in their absorption coefficient, since light which has energy below the band gap does not have sufficient energy to excite an electron into the conduction band from the valence band.

2.3.2Reflection:

Reflection is the process by which electromagnetic radiation is returned either at the boundary between two media (surface reflection) or at the interior o amedium(volume reflection) .it is the change in direction of a wave front at an interface between two different media so that the wave front returns into the medium from which it originated. Common examples include the reflection of light, sound and water waves. The law of reflection says that for secular reflection the angle at which the wave is incident on the surface equals the angle at which it is reflected. Mirrors exhibit seculars reflection. Reflection of light is either seculars (mirror-like) or diffuse depending on the nature of the interface. In specula reflection the phase of the reflected waves depends on the choice of the origin of coordinates. (Wikipedia,2015).

Diffuse reflection happen when light strikes the surface of a (non-metallic) material it bounces off in all directions due to multiple reflections by the microscopic irregularities inside the material and by its surface, if it is rough. Thus, an 'image' is not formed. This is called diffuse reflection. The exact form of the reflection depends on the structure of the material. Reflection and transmission of light waves occur because the frequencies of the light waves do not match the natural frequencies of vibration of the objects.

2.3.3Transmission:

It is the passage of electromagnetic radiation through a medium .The transmittance of a material is the proportion of the incident (approaching) light that moves all the way through to the other side. For example, let's say you're shining a flashlight on a semi-transparent glass block.

You start off with 100% of your incident light. The first thing that happens is that30% of that light is reflected off the outer surface of the glass. That leaves you with70% to continue through the glass block. Another 50% of the light is absorbed by the molecules inside the glass block itself. That leaves you with 20% that immerges from the opposite side. So you could say that the glass block has a transmittance of 20%.

The transmittance of a material depends on its thickness, but it also depends on the type of 'light' (or electromagnetic waves) you are using. A material might have a different transmittance for visible light than it does for infrared, or x-rays. This is why hospital x-rays go through your skin until they reach the bones, even though visible light does not.

2.3.4Lightscattering:

Light scattering can be thought of as the deflection of a ray from a straight path ,for example by irregularities in the propagation medium, particles, or in the interface between two media. Deviations from the law of reflection due to irregularities on a surface are also usually considered to be a form of scattering. Most objects that one sees are visible due to light scattering from their surfaces (Kerker,M.1969)(Mandelstam ,L.I.1928). Indeed, scattering of light depends on the wavelength or frequency of the light being scattered. Since visible light has wavelength on the order of a nanometer, objects much smaller than this cannot be seen, even with the aid of a microscope. (VandeHulst .H.C 1981) (Bohren, C.F and Huffman, D.R 1983).

2.4 Spectroscopy:

Spectroscopy means study of the interaction between matter and radiated energy and it used to refer to the measurement of radiation intensity as a function of wavelength .Spectroscopy is basically an experimental subject and is concerned with the absorption, emission or scattering of electromagnetic radiation by atoms or molecules.

Electromagnetic radiation covers a wide wavelength range, from radio waves to great importance in surface chemistry, adsorbed on a solid surface. Ultraviolet (UV) and visible radiation comprise only a small part of the electromagnetic spectrum, which includes such other forms of radiation as radio ,infrared (IR), cosmic, and X rays.

The energy associated with electromagnetic radiation is defined by the following equation:

$$\boldsymbol{E = hv} \qquad \textbf{(2.1)}$$

Where **E** is energy (in joules), **h** is Planck's constant (6.62×10^{-34} Js), and **v**isfrequency. Electromagnetic radiation can be considered a combination of alternating electric and magnetic fields that travel through space with a wave motion. Because radiation acts as a wave, it can be classified in terms of either wavelength or frequency, which are related by the following equation:

$$\boldsymbol{v = c/\lambda} \qquad \textbf{(2.2)}$$

Where ν is frequency (in seconds), c is the speed of light (3 × 108 ms-1), and λ is wavelength (in meters).

In UV-visible spectroscopy, wavelength usually is expressed in nanometers (1 nm =10-9 m). It follows from the above equations that radiation with shorter wavelength has higher energy.

In UV-visible spectroscopy, the low-wavelength UV light has the highest energy. In some cases, this energy is sufficient to cause unwanted photo chemical reactions when measuring sample spectra (remember, it is the UV component of light that causes sunburn).

When radiation interacts with matter, a number of processes can occur, including reflection, scattering, absorbance, fluorescence/phosphorescence (absorption and reemission), and photochemical reaction (absorbance and bond breaking). In general, when measuring UV-visible spectra, we want only absorbance to occur. Because light is a form of energy, absorption of light by matter causes the energy content of the molecules (or atoms) to increase. The total potential energy of a molecule generally is represented as the sum of its electronic, vibration, and rotational energies.

The amount of energy a molecule possesses in each form is not a continuum but a series of discrete levels or states.

CHAPTER THREE

Basic Concepts

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 The powder Milk

Powder milk Samples were obtained from powder milk available at local market in Sudan has long been a popular beverage, not only for its flavor, but because of its unique nutritional package. Milk is one of the best sources of calcium in the American diet. It also provides high-quality protein, vitamins and other minerals.

3.2.2 The devices:

3.2.2.1 He-Ne laser:

He-Ne lasers are pumping Energy provided by high –voltage Dc(direct current)electric . These are one of the most common types of laser, and are used for many different applications.

He-Ne laser typically emit light with a wavelength of 632.8 nm, and constant power 1 ml Watt.

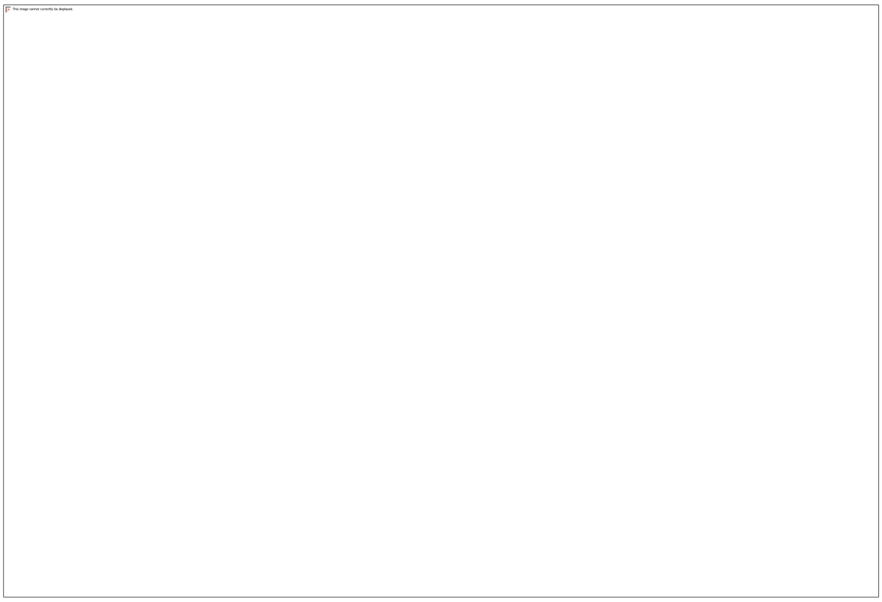


Figure (3.1) He-Ne Gas Laser(632.8nm)

3.2.2.2 Diode Laser

Green Diode lasers are pumping Energy provided by high –voltage Ac(Indirect current)electric . These are one of the most common types of laser, and are used for many different applications.

Diode laser typically emit light with a wavelength of 532 nm, and constant power 1000 ml Watt.

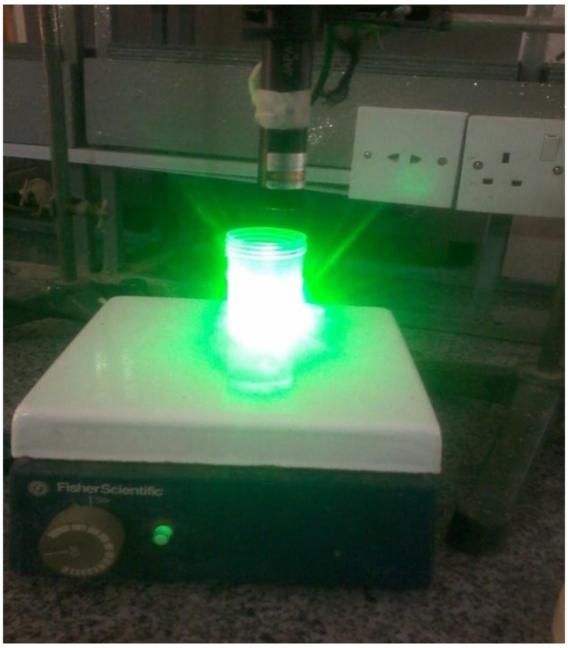


Figure (3.2) Green Diode Laser (532nm)

3.2.2.3 The magnetic stirrer

The magnetic stirrer device is used to make homogenous solution by mixing the powder milk compound with He-Ne laser radiation .A rotation fieldOf magnetic force is employed to induce variable speed a stirring action within either closed or opened vessels .The stirring is accomplished with the aid of small permanent magnets sealed in Pyrex glass. This device was manufactured by Scott science and healthcare limited it speed 60 to 1500 pm.

Figure (3.3) Magnetic stirrer

3.2.2.4 pH Meter

pH 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 electrode, 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.

Figure (3.4) pH meter

3.3 Methods

The present experiment was conducted in National Center research –institute research & Technology and Sudan University of Science and Technology-institute of Laser.

Four samples of powder milk was irradiated by different laser dosages pass constant power (1mw) by He-Ne laser 632.8 nm, and other four samples of powder milk was irradiated by different laser dosages power (1000mw) by Diode green laser (532 nm) for different time (0 ,15 ,30 ,45) minutes for all eight samples. then some chemical parameters were evaluated.

Figure (3.5) Powder Milk Samples

3.3.1. Moisture content

The moisture content was determined according to the standard method of the Association of Official Analytical Chemists (AOAC, 2003).and it was as follow:

Procedure:

A sample of 0.5 gm will be weighed into a pre-dried and tarred dish. Then, the sample will be placed into an oven (Kat-NR.2851, Elektrohelios, Sweden) Figure.3.4 and left to dry at 105±1Cº until a constant weight is reached . After drying, the covered sample will be transferred to a desiccators and cooled to room temperature before reweighing. Triplicate sample will be used.

Figure(3.6) Oven (Moisture ELAEZER)

Calculation:

$$\text{Moisture content } [\%] = \frac{[m2-m3]}{[m2-m1]} \times 100$$

Where:

m1 = mass of dish + cover

m2 = mass of dish + cover + sample before drying

m3 = mass of dish + cover + sample after drying

3.3.2 Ash content

The standard analytical method of A.O.A.C, (2003) will be used for determination of ash content in the samples.

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 2 gm will be weighed into a pre- heated, cooled weighed and tarred porcelain crucible. Before ashing, the sample was pre-washed on an electrical pre-asher and placed into a muffle furnace (Carbolite, Sheffeild, England) at 525 to 600 C ^{o}until a constant weight was obtained. The weight of the residue after Ashing was defined as ash content and expressed as a percentage based on the dry matter content in the ground sample.

Calculation:

$$\textbf{Ash content} = W_1 / W_0 \text{ X } 100 \%$$

Where

W_1= Weight of ash

W_0= Weight of sample

Figure (3.7) Furnace

Figure (3.8) Sample after ashing

3.3.3pH-value

The pH of the milk samples was measured by using a recalibrated pH meter model (HI 8521 microprocessor bench pH/ MV/ Cº meter) Figure (3.4). This will be calibrated with two standard buffers (PH6.8 and 4.0).

Figure (3.9) Sample pH value

CHAPTER FOUR

Results and Discussion

4.1 Introduction:

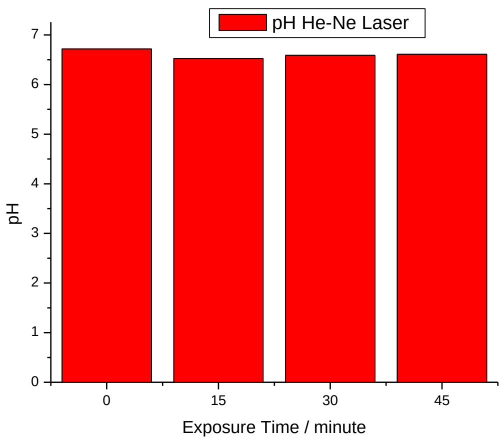
This chapter summarize results obtained during the work. Results include photographs, figures and tables as shown below. Data fitting of experimental results wasalso shown, discussion and conclusion .

4.2 Results and Discussion:

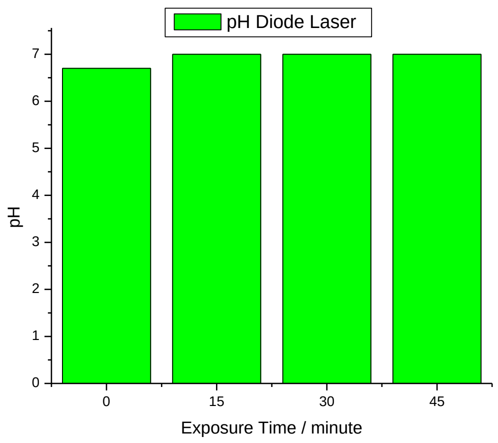
4.2.1 The pH of the powder milk samples

Table (4.1) pH of powder milk

Sample	Control	15 minutes	30 minutes	45 minutes
He-Ne laser	6.72	6.525	6.59	6.61
Diode laser	6.7	7.00	7.00	7.00



(a)He-Ne (632.8nm)



(b)Green Diode(512nm)

Figure (4 .1) pH value

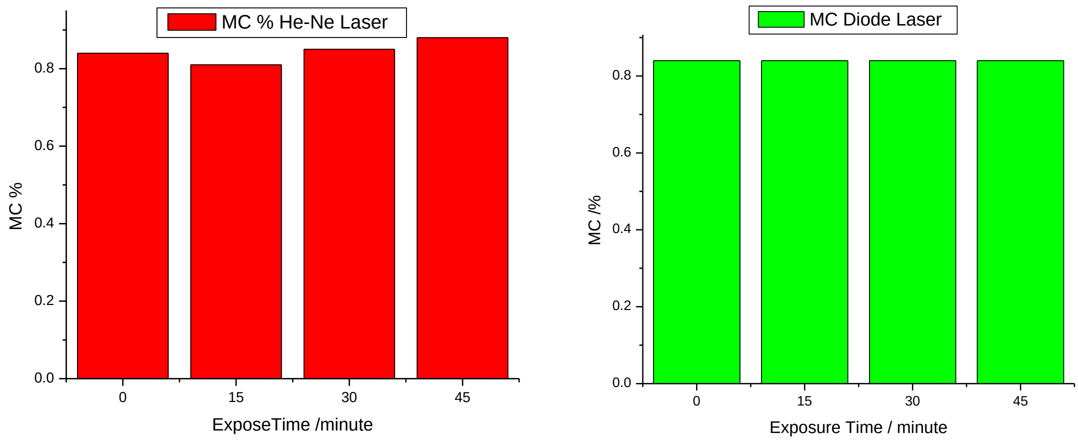
The results indicated that the pH of the powder milk samples dropped from 6.72 for the control samples treated with 1 mw beams(He-Ne632.8nm)and 6.525 for the second sample (Exposure time 15 **minutes**) the pH is decrease. And 6.59 for the three sample (Exposure time 30 minutes) , **6.61**(Exposure time 45 minutes) the pH increased .The results revealed the as the power of the light beams increased the pH of the powder milk samples decrease this probably due to the effect of the light beams on the buffering capacity and the milk components not on the acidity.

The pH of the powder milk samples dropped from 6.7 for the control samples treated with 1000 mw beams(Green Diode 512 nm)and 7.00 for the second sample (Exposure time 15 minutes) the pH is increased but pH-value constant for the sample(Exposure time 15, 30 and 45 minutes) .

4.2. 2 Moisture content

Sample	Control	15 minutes	30 minutes	45 minutes
He-Ne laser	**3.8397**	**3.81**	**3.85**	**3.88**
Diode laser	**3.84**	**3.84**	**3.84**	**3.84**

Table (4.2) MC of powder milk



(a)He-Ne(632.8nm) **(b)Green Diode(512nm)**

Figure (4 .2) MC%

The results indicated that the Moisture content of the powder milk samples dropped from 3.8397% for the control samples treated with 1 mw beams(He-Ne632.8nm)and 3.81% for the second sample (Exposure time 15 minutes) the MC% is decrease. And 3.85% for the three sample (Exposure time 30 minutes) , 3.88% (Exposure time 45 minutes) the MC% increased The results revealed the as the power of the light beams increased the MC% of the powder milk samples increased this probably due to the effect of the light beams on the Powder milk components.

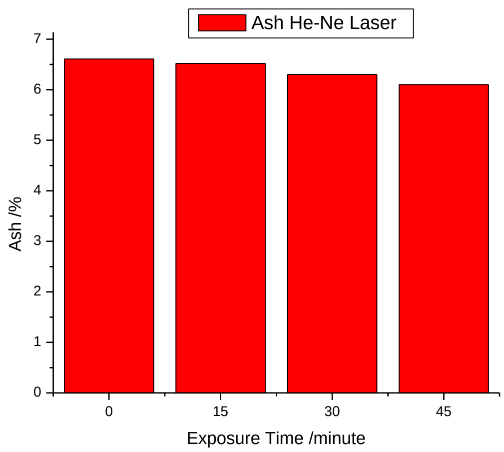
The MC% of the powder milk samples dropped from 3.84% for the control samples treated with 1000 mw beams(Green Diode 532 nm)and but the Moisture content constant

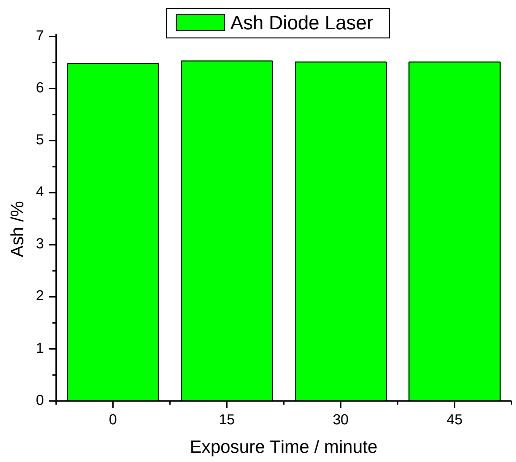
(3.84%) for the sample(Exposure time 15, 30 and 45 minutes) .The results revealed the as the power of the light beams increased the MC% of the powder milk samples increased this probably due to the effect of the light beams on the Powder milk components.

4.2.3 Ash content

Table (4.3) Ash of powder milk

Sample	**Control**	**15 minutes**	**30 minutes**	**45 minutes**
He-Ne laser	**6.61**	**6.52**	**6.30**	**6.10**
Diode laser	**6.48**	**6.53**	**6.51**	**6.51**





(a) He-Ne (632.8nm) **(b)Green Diode(512nm)**

Figure(4.3) Ash%

The results indicated that the Ash content of the powder milk samples dropped from 6.61% for the control samples treated with 1 mw beams(He-Ne632.8nm)and 6.52 for the second sample (Exposure time 15 **minutes**) the Ash% is decreased. And 6.3% for the three sample (Exposure time 30 minutes), **6.1%** (Exposure time 45 minutes) the Ash% decreased. The results revealed the as the power of the light beams increased the Ash% of the powder milk samples decrease.

The Ash% of the powder milk samples dropped from 6.48% for the control samples treated with 1000 mw beams (Green Diode Laser 532 nm) and 6.53% for the second sample (Exposure time 15 minutes) the Ash% is increased but Ash% constant for the sample(Exposure time 15, 30 and 45 minutes) .The results revealed the as the power of the light beams increased the Ash% of the powder milk samples increased .

4.3 CONCLUSION:

From the obtained results the following conclusion is drawn:

- Results confirmed that the laser effect on the chemical composition of the powder milk.
- Results showed a decrease in the moisture content, Ash content and pH value when use He-Ne laser (Red light) whose wave length is about 632.8nm and out power 1mw .
- Results showed an increased in the Ash content and pH value, no impact on moisture content when use Diode laser (Green light) whose wave length is about 512nm and out power 1000 mw .

4.4 RECOMMENDATIONS:

Further research on:

- ❖ the effect of laser on the chemical composition of the milk by use some types of laser is required.
- ❖ The effect of laser and evaluation some chemical parameters by using many source of laser .
- ❖ The effect on the laser of powder milk by characterize of milk.

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WILLIAM S. C. CHANG Professor Emeritus Department of Electrical Engineering and Computer Science University of California San Diego “PRINCIPLES OF LASERS AND OPTICS” (2005)
WILLIAM S. C. CHANG Professor EmeritusDepartment of Electrical Engineering and Computer ScienceUniversity of California San Diego“PRINCIPLES OF LASERS AND OPTICS” (2005)