Sudan University of Science And Technology

College of Graduate Studies

Effects of Some Food Supplements and Containers on PH, Conductivity, Ionization and light Absorption of Water

تأثيرات بعض المكملات الغذائية والأواني على الأس الايدروجيني والموصلية والتأين والامتصاص للماء

A Thesis Submitted in Fulfillment for the Requirement of Doctor Degree (PhD) in Physics

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الآيـــــة

بسم الله الرحمن الرحيم

قال تعالى

(اقْرَأْ بِاسْمِ رَبِّكَ الَّذِي خَلَقَ (1) خَلَقَ الْإِنْسَانَ مِنْ عَلَقٍ (2) اقْرَأْ وَرَبُّكَ الْأَكْرَمُ (3) الَّذِي عَلَّمَ بِالْقَلَمِ (4)عَلَّمَ الْإِنْسَانَ مَا لَمْ يَعْلَمْ (5))

صدق الله العظيم

سورة العلق (الآية1-5)

Dedication

I dedicate this thesis to my father, mother, and my family

Acknowledgment

I would like to express may gratitude to Sudan university of science and Technology, Graduate College, Faculty of Science, Department of physics for allowing doing this work and for encouragements .Special thanks to my supervision professor Mubarak Dirar AbdAllaYagoub for valuable guidance and fruitful suggestions. I also thanks Dr. Ali Suleiman for his invaluable help Thanks extends also to my father, mother and family for encouragements and moral support.

Abstract

Water plays a central role in human life. Thus its physical properties affects human health directly .Thus the aim of this work is to study the effect of water containers and food supplements on the physical properties of water. This is done by examining the water conductivity, ionization degree, PH and light absorption using conductivity, ionization, PH and ultraviolet (UV) spectrometer devices respectively. Water was poured are put inside pride, steel, glass and plastic containers. The food supplements added to water for different concentrations are mint, ginger, lemon, cinnom and fenugreek respectively. The conductivity results shows no considerable changes upon increasing food supplements concentrations or changing the container. This may be attributed to the very low sensitivity of the conductivity device. Fortunately the ionization degree increase with concentration linearly. This may be related to the use of very sensitive ammeter on the scale of μA . The PH for all food supplements decreases upon increasing their concentrations, except ginger which increases his PH with concentration. The effect of the container on the water PH shows that only pride container increases water PH with time where it attains a maximum value of 7.17 after about 60 minutes. The UV test shows that the absorption coefficient of water in pride container increases with time. This means that pride containers are the best ones that make water healthy.

المستخلص

يلعب الماء دورا مهما في حياة الإنسان. لذا فان خواصه الفيزيائية تؤثر على صحته مباشرة. لهذا السبب هدفت هذه الدراسة للتعرف على تأثير نوع الإناء الحاوي للماء ونوع المكمل الغذائي المضاف آلية على خواصه الفيزيائية. وقد تم عمل ذلك باختبار الموصلية ودرجه التأين والأس الايدروجيني وامتصاص الضوء بأجهزة قياس الموصلية ودرجة التأين والأس الايدروجيني ومطياف الأشعة فوق البنفسجية بالترتيب . تم سكب الماء ووضعه في آنية في الفخار والاستيل والزجاج والبلاستيك. أما المكملات الغذائية التيأضيفت بتركيزات مختلفة فهي النعناع و الزنجبيل والليمون والقرفة والحلبة. بينت نتائج الموصلية عدم تغير الموصلية بصورة ملحوظة عند زيادة تركيز المكملات الغذائية أو عند استبدال الإناء. وهذا يعزى لضعف حساسية جهاز قياس الموصلية. ولحسن الحظ زادت درجة التأين خطيا مع زيادة تركيز المكملات الغذائية . وهذه لها علاقة باستخدام اميتر حساس جدا في مدى المايكرو أمبير وسجل الأس الايدروجيني نقصانا مع زيادة تركيز كل المكملات الغذائية ما عدا الزنجبيل الذى زاد اسه الايدروجيني مع زيادة التركيز . أما تأثير نوع الوعاء على الأس الايدروجيني للماء فقد أظهر أن الفخار وحده هو الذي يزيد الأس الايدروجيني بصورة واضحة حيث يبلغ أقصى قيمة له وهي بعد مضي 50 دقيقة. وقد بينت اختبارات الطيف الفوق البنفسجي زيادة الامتصاصية للماء داخل إناء الفخار مع الزمن. وهذا يعني أن الآنية الفخارية هي أفضل من يجعل المياه صحية.

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Chapter One

Introduction

1.1Water

Water is very important to us. It is widely used for our life as well as the life of plants and all living organisms. The physical properties of water is thus very important to human health. Water is sued for drinking, since most of human cells contains water [1]. Mild and oil are used in food. The PH, conductivity and ionization plays an important role in penetration rate of these fluids inside the cells, where it gives them the important and compounds that activate these cells [2, 3].

This encourages many scientists to see how one can improve the quality of water. Some scientists design magnetic equipment that can change these physical properties to activate human and other organisms cells [4, 5]. These magnetic equipment where shown to change some physical properties of water, milk and oil, in a manner which gives cells more energy, besides increasing their electromagnetic activity [6, 7, 8].

On the other hand researches made by MasaroImo to shows the effect of container material type on the crystal structure and type of water [9, 10]. Some researchers also shows that the addition of silver or titanium to water change some of their physical properties [11, 12].

1.2Water And Religion

Water is considered a purifier in most religions. Faiths that incorporate ritual washing (ablution) include Christianity, Hinduism, Islam, Judaism, the Rastafarian movement, Shinto, Taoism, and Wicca. Immersion (or aspersion or affusion) of a person in water is a central sacrament of Christianity (where it is called baptism); it is also a part of the practice of other religions, including Islam (Ghusl), Judaism (mikvah) and Sikhism (AmritSanskar). In addition, a ritual bath in pure water is performed for the dead in many religions including Islam and Judaism. In Islam, the five daily prayers can be done in most cases after completing washing certain parts of the body using clean water (wudu), unless water is unavailable (see Tayammum). In Shinto, water is used in almost all rituals to cleanse a person or an area (e.g., in the ritual of misogi)[13].

In Christianity, holy water is water that has been sanctified by a priest for the purpose of baptism, the blessing of persons, places, and objects, or as a means of repelling evil. In Zoroastrianism, water (āb) is respected as the source of life. Philosophy The Ancient Greek philosopher Empedocles held that water is one of the four classical elements along with fire, earth and air, and was regarded as the ylem, or basic substance of the universe. Thales, who was portrayed by Aristotle as an astronomer and an engineer, theorized that the earth, which is denser than water, emerged from the water. Thales, a monist, believed further that all things are made from water. Plato believed the shape of water is an icosahedron which accounts for why it is able to flow easily compared to the cube-shaped earth. In the theory of the four bodily humors, water was associated with phlegm, as being cold and moist. The classical element of water was also one of the five elements in traditional Chinese philosophy, along with earth, fire, wood, and metal[14].

Water is also taken as a role model in some parts of traditional and popular Asian philosophy. James Legge's 1891 translation of the Dao De Jing states, "The highest excellence is like (that of) water. The excellence of water appears in its benefiting all things, and in its occupying, without striving (to the contrary), the low place which all men dislike. Hence (its way) is near to (that of) the Tao" and "There is nothing in the world more soft and weak than water, and yet for attacking things that are firm and strong there is nothing that can take precedence of it—for there is nothing (so effectual) for which it can be changed." Guanzi in the "Shuidi" chapter further elaborates on the symbolism of water, proclaiming that "man is water" and attributing natural qualities of the people of different Chinese regions to the character of local water resources.[Dihydrogen monoxide parody.

Water is a major component of all living things. It is anomalous in many of its physical and chemical properties. Some are essential for life while others have profound effects on the size and shape of living organisms, how they work, and the constraints within which they must operate. Many of water's basic physical properties can now be explained, at least semi quantitatively, in molecular and structural terms, although in spite of intense studyitrem[15].

1.3WaterFor Life

Every day, diarrhoeal diseases from easily preventable causes claim the lives of approximately 5000 young children throughout the world. Sufficient and better quality drinking water and basic sanitation can cut this toll dramatically, and simple, low-cost household water treatment has the potential to save further lives. As we enter the International Decade for Action, this report makes clear that achieving the target of the Millennium Development Goals (MDGs) for access to safe drinking water and basic sanitation will bring a payback worth many times the investment involved.

It will also bring health, dignity and transformed lives to many millions of the world's poorest people. The humanitarian case for action is blindingly apparent. The economic case is just as strong. Improved water and sanitation will speed the achievement of all eight MDGs, helping to: eradicate extreme poverty and hunger; achieve universal primary education; promote gender equality and empower women; reduce child mortality; improve maternal health; combat HIV/AIDS, malaria and other diseases; ensure environmental sustainability; and develop a global partnership for development.

At US$11.3 billion a year, the dollar costs of achieving the MDG drinking water and sanitation target are affordable; the human costs of failing to do so are not .The International Decade for Action provides the incentive for coordinated efforts to prevent the daily disaster of unnecessary deaths [16,15].

1.4Research Problem

Water for people are forced to pass through plastic pipes, which affect their physical properties severally and affect the human health. Many recent researches indicates that human health is highly effected by the physical properties of water. Some attempts were made to improve the quality of water and the physical properties using bio-disc or magnetic equipment to improve water physical properties, but they are expensive.

1.5 Aim of The Work

The aim of this work is to improve the quality as well as the physical properties of water by using some vessels like clay and by adding some natural products.

1.6 Thesis Lay Out

The thesis consists of five chapters. Chapters one and two are the introductions and theoretical background. Chapters three and four are devoted for literature review and materials and methods. Chapter five is concerned with results discussion and conclusion.

Chapter Two

Theoretical Background and Previous Studies

2.1 Introduction

Water is important for human life. Therefore this chapter is concerned with studying their physical properties.

2.2 Forms Of water

Water – with its formula H_2O – is the only inorganic compound existing in its solid, liquid and gaseous physical state under natural conditions. Water serves as a medium or the transformation of highly complex organic molecules that form the basis for life processes. The reason for many of liquid water's special properties originates from the water molecules consisting of dipoles that associate through hinter molecular hydrogen bonds in its condensed phase [17].

2.3 The Phenomenon Of Hydrogen Bonding

This type of bond is of fundamental significance for the development of life and life processes. The uniqueness of water compared to other – also hydrogen bonded – liquids is the existence of a three dimensional network. This causes particularly strong intermolecular interactions between water molecules in their condensed phase. Among all bond types, Linus Pauling ascribes the greatest significance in physiology to the hydrogen bond. A hydrogen bond can form if two atoms X and Y – in general very electronegative elements like fluorine, oxygen or nitrogen – are connected to a group X–H•••Y through a hydrogen atom. In this arrangement, the hydrogen atom is located asymmetrically and bound stronger by one of the atoms, e.g. X, instead of being situated half way between both other atoms [18].

The hydrogen atom, however, does penetrate the electron cloud of the atom Y to a certain degree. Typical bond energies of hydrogen bonds are 20 kJ/mol – about a quarter of the bond energy of a covalent bond – and bond distances are between 0.25 and0.3 nm. In the case of hydrogen bonds in water, different experimental methods have yielded bond energies between 19and 22 kJ/mol. As such, the almost linear O^{-}H•••O arrangement of a water dimmer, as it exists in ice (shown inFig2.1), is also energetically very favorable in the liquid phase [19,17].

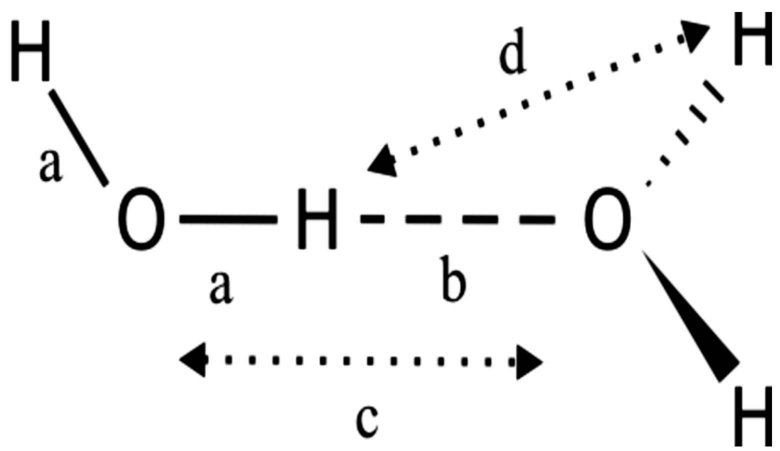

Figure 2.1: Geometry of the water molecule and energetically favored configuration of two molecules in condensed phase.

2.4 Physicochemical Characteristics

Various anomalies of water at temperature ranges of up to 100 °C are a result of hydrogen bonding. When comparing these properties to those of atomic or non-hydrogen bonded molecular liquids of similar molecular size some particularities are noteworthy:

• The melting point of ice is exceptionally high if compared to the decrease in melting points with decreasing atomic number among the hydrides of the sixth main group. Water shares this behavior with various hydrides and halogen ides of the 4th, 5th, 6th, and 7th group. Among these groups, the first elements show extremely high melting and boiling points.

• During the melting of ice at atmospheric pressure, the volume contracts by 8.2%. This anomalous contraction of volume – most substances expand during melting – leads to a decrease in freezing point with increasing pressure: »ice melts under pressure«. At 0 °C the freezing point is decreased by 1 °C with a pressure of 1.33×107 Pa.

• The dependence of liquid water's molar volume on pressure and temperature exhibits extremes. The density of liquid water has a maximum at 3.98 °C[20,18].

• The thermal expansion coefficient a of liquid water is one order of magnitude smaller compared to other molecular liquids. The isothermal compressibility cT shows that for a molecular liquid water is rather incompressible.

• The dynamic viscosity of water is higher than that of comparable, non-hydrogen bonded liquids. Furthermore, the pressure dependence of the viscosity is anomalous: the viscosity decreases with pressure and reaches a minimum at about 60 MP a (this pressure is equivalent to a water column of 6 km).

• Water's surface tension is higher than that of other liquids, including most other hydrogen bonded liquids.

• Within a temperature range of up to 130 °C, liquid water's thermal conductivity increases with increasing temperature.

• Liquid water possesses a high specific heat capacity at constant pressure, which changes only slightly up to 100 °C.

• The enthalpy evaporation D*vap h* of water is anomalously high. Similar to the specific heat capacity, D*vap h* is almost four times as high as those for other comparable, non-hydrogen bonded liquids. This difference is ascribed to the hydrogen bond. In addition, the enthalpy of evaporation of water is very high compared to its enthalpy of melting. The fact that water expands while freezing has led, amongst other consequences, to our familiar picture of nature, e.g.: Water easily penetrates rock crevices. When it freezes, the rock is further disrupted, physical and chemical weathering occurs, and, ultimately, soil is formed. The fact that water exhibits its highest density at 4 °C, but not at its freezing point, is essential for the thermal stratification and the circulation of lakes. This leads to the freezing of water bodies from their surface towards the ground. Not only is this of importance for aquatic life of inland waters, but it is also crucial for the oceans. If the colder regions of the oceans were to freeze from the bottom to the top, energy received by the sun's radiation during summer would only be sufficient to thaw the uppermost layers. Thus, the cycling of energy and matter which relies on the circulation of the oceans would cease partially or even completely.

The enormous specific heat capacity of water is responsible for its ability to store vast amounts of energy. In this way, water currents, as for example the Gulf Stream, carry gigantic amounts of heat from warmer climate zones into colder ones. Thus, the oceans work as huge thermostats. Not only the Earth's climate, but also the heat regulation of organisms depends on the high heat capacity of water. It contributes, for example, to the maintenance of a constant body temperature in warm-blooded organisms[21,19].

Additionally, the relatively high thermal conductivity of water prevents serious local temperature fluctuations. Very pure water has an electric conductivity of0.03 µS/cm. This is due to the auto proteolysis of water .

The electric conductivity measured on real water bodies, however, is significantly higher, which is mainly due to dissolved ionic water ingredients. Water, being a strong dielectric – water's dielectric constant is one of the highest known for liquids – is an excellent solvent for salts and gases, which are capable of solvolys is with subsequent dissociation(e.g. CO_2).Another feature of water which is important for the hydrological cycle is its enthalpy of evaporation. Closely linked to this is the fugacity of water, which determines the amount of water that is converted into the gas phase and can be transported to the atmosphere[22,15] .

Questions on the formation of the global hydrological cycle are not easily answered. Prerequisites for a hydrosphere as a requirement for life are:

- The planet must have acquired sufficient water to form oceans.
- This water must have penetrated from the Earth's interior to the surface.
- It must not be lost to space.
- It must be mostly available in its liquid state.

On Earth, all these requirements are met. Its basics are derived from the initial state of matter and comprise size, orbit, rotation and chemical composition of the Earth[23].

2.5Water In Three States:

solid (ice), liquid and vapor (here mostly invisible water vapor, cooling and condensing, is building clouds. Water is an inorganic, transparent, tasteless, odorless, and nearly colorless chemical substance, which is the main constituent of Earth's hydrosphere and the fluids of all known living organisms. It is vital for all known forms of life, even though it provides no calories or organic nutrients. Its chemical formula is H_2O, meaning that each of its molecules contains one oxygen and two hydrogen atoms, connected by covalent bonds. %).[24].

"Water" is the name of the liquid state of H_2O at standard ambient temperature and pressure. It forms precipitation in the form of rain and aerosols in the form of fog. Clouds are formed from suspended droplets of water and ice, its solid state. When finely divided, crystalline ice may precipitate in the form of snow. The gaseous state of water is steam or water vapor. Water moves continually through the water cycle of evaporation, transpiration (evapotranspiration),condensation, precipitation, and runoff, usually reaching the sea[25,22].

Water covers 71% of the Earth's surface, mostly in seas and oceans. Small portions of water occur as groundwater (1.7%), in the glaciers and the ice caps of Antarctica and Greenland (1.7%), and in the air as vapor, clouds (formed of ice and liquid water suspended in air), and precipitation (0.001%).%)[20,25].Water plays an important role in the world economy. Approximately 70% of the freshwater used by humans goes to agriculture. Fishing in salt and fresh water bodies is a major source of food for many parts of the world. Much of the long-distance trade of commodities (such as oil, natural gas, and manufactured products) is transported by boats through seas, rivers, lakes, and canals. Large quantities of water, ice, and steam are used for cooling and heating, in industry and homes[26,22].

Water is an excellent solvent for a wide variety of substances both mineral and organic; as such it is widely used in industrial processes, and in cooking and washing. Water, ice and snow are also central to many sports and other forms of entertainment, such as swimming, pleasure boating, boat racing, surfing, sport fishing, diving, ice skating and skiing Properties of water **[**27,18].

2.6Water Chemistry Analysis

Water is the chemical substance with chemical formula H_2O; one molecule of water has two hydrogen atoms covalently bonded to a single oxygen atom. Water is a tasteless, odorless liquid at ambient temperature and pressure. Liquid water has weak absorption bands at wavelengths of around 750 nm which cause it to appear to have a blue color. This can easily be observed in a water-filled bath or wash-basin whose lining is white. Large ice crystals, as in glaciers, also appear blue[28].

Under standard conditions, water is primarily a liquid, unlike other analogous hydrides of the oxygen family, which are generally gaseous. This unique property of water is due to hydrogen bonding. The molecules of water are constantly moving in relation to each other, and the hydrogen bonds are continually breaking and reforming at timescales faster than 200 femtoseconds (2×10−13 seconds). However, these bonds are strong enough to create many of the peculiar properties of water, some of which make it integral to life [29].

2.7 Properties of Water

The free encyclopedia Jump to navigation Jump to search HOH" redirects here. For other uses, see HOH (disambiguation.(For broader coverage of this topic, see Water.Water H_2O The water molecule has this basic geometric structure Ball-and-stick model of a water molecule Space filling model of a water molecule A drop of water falling towards water in a glass Names IUPAC name water, ox dance Other names[30].

2.8 Electrical Properties

a. Electrical Conductivity

Pure water containing no exogenous ions is an excellent insulator, but not even "deionized" water is completely free of ions. Water undergoes auto-ionization in the liquid state, when two water molecules form one hydroxide anion ($OH^-$and one hydronium cati.

+on (H_3O^+Because water is such a good solvent, it almost always has some solute dissolved in it, often a salt. If water has even a tiny amount of such an impurity, then the ions can carry charges back and forth, allowing the water to conduct electricity far more readily[31].

It is known that the theoretical maximum electrical resistivity for water is approximately 18.2 MΩ·cm (182 kΩ· m) at 25 °C. This figure agrees well with what is typically seen on reverse osmosis, ultra-filtered and deionized ultra-pure water systems used, for instance, in semiconductor manufacturing plants. A salt or acid contaminant level exceeding even 100 parts per trillion (ppt) in otherwise ultra-pure water begins to noticeably lower its resistivity by up to several kΩ·m.[citation needed]

In pure water, sensitive equipment can detect a very slight electrical conductivity of 0.05501 ± 0.0001 μS/cm at 25.00 °C. Water can also be electrolyzed into oxygen and hydrogen gases but in the absence of dissolved ions this is a very slow process, as very little current is conducted. In ice, the primary charge carriers are protons (see proton conductor). Ice was previously thought to have a small but measurable conductivity of 1×10−10 S/cm, but this conductivity is now thought to be almost entirely from surface defects, and without those, ice is an insulator with an immeasurably small conductivity[32,29].

2.9 Chemical And Physical Properties

a. Molecular Structure

The repulsive effects of the two lone pairs on the oxygen atom cause water to have a bent, not linear, molecular structure, allowing it to be polar. The hydrogen-oxygen-hydrogen angle is 104.45°, which is less than the 109.47° for ideal sp3 hybridization .The valence bond theory explanation is that the oxygen atom's lone pairs are physically larger and therefore take up more space than the oxygen atom's bonds to the hydrogen atoms. The molecular orbital theory explanation (Bent's rule) is that lowering the energy of the oxygen atom's nonbonding hybrid orbital's (by assigning them more s character and less p character) and correspondingly raising the energy of the oxygen atom's hybrid orbital's bonded to the hydrogen atoms (by assigning them more p character and less s character) has the net effect of lowering the energy of the occupied molecular orbital's because the energy of the oxygen atom's nonbonding hybrid orbital's contributes completely to the energy of the oxygen atom's lone pairs while the energy of the oxygen atom's other two hybrid orbital's contributes only partially to the energy of the bonding orbital's (the remainder of the contribution coming from the hydrogen atoms' 1s orbital's [33].

b. Chemical Properties

In liquid water there is some self-dissociation giving hydronium ions and hydroxide ions.[12]

$2H_2O \rightleftharpoons H_3O + OH^-$

The equilibrium constant for this reaction, known as the ionic product of water, Kw, has a value of about 10^{-14} at 25 °C. At neutral pH, the concentration of the hydroxide ion (OH^-equal to that of the (solvated) hydrogen ion (H^+ with a value close to 10^{-7}mol dm^{-3} at 25 °C [34].

Geochemistry

Action of water on rock over long periods of time typically leads to weathering and water erosion, physical processes that convert solid rocks and minerals into soil and sediment, but under some conditions chemical reactions with water occur as well, resulting in metabolism or mineral hydration, a type of chemical alteration of a rock which produces clay minerals. It also occurs when Portland cement hardens. Water ice can form clathrate compounds, known as clathrate hydrates, with a variety of small molecules that can be embedded in its spacious crystal lattice. The most notable of these is methane clathrate, 4 CH_4 •2H_3O, naturally found in large quantities on the ocean floor[35,12].

2.10 Properties of Water

Water and Water Model

Water (H_2O) is a polar inorganic compound that is at room temperature a tasteless and odorless liquid, nearly colorless with a hint of blue. This simplest hydrogen chalcogenide is by far the most studied chemical compound and is described as the "universal solvent" for its ability to dissolve many substances. This allows it to be the "solvent of life": indeed, water as found in nature almost always includes various dissolved substances, and special steps are required to obtain chemically pure water. Water is the only common substance to exist as a solid, liquid, and gas in normal terrestrial condition.

States

The three common states of matter Along with oxidane, water is one of the two official names for the chemical compound H_2O; it is also the liquid phase ofH_2O .The other two common states of matter of water are the solid phase, ice, and the gaseous phase, water vapor or steam. The addition or removal of heat can cause phase transitions: freezing (water to ice), melting (ice to water), vaporization (water to vapor), condensation (vapor to water), sublimation (ice to vapor) and deposition (vapor to ice)[36].

Density

Water differs from most liquids in that it becomes less dense as it freezes. In 1 atm pressure, it reaches its maximum density of 1,000 kg/m3 (62.43 lb/cu ft) at 3.98 °C (39.16 °F). The density of ice is 917 kg/m3 (57.25 lb/cu ft), an expansion of 9%. This expansion can exert enormous pressure, bursting pipes and cracking rocks (see Frost weathering). In a lake or ocean, water at 4 °C sinks to the bottom and ice forms on the surface, floating on the liquid water. This ice insulates the water below, preventing it from freezing solid. Without this protection, most aquatic organisms would perish during the winter.

Phase Transitions

At a pressure of one atmosphere (atm), ice melts or water freezes at 0 °C (32 °F) and water boils or vapor condenses at 100 °C (212 °F). However, even below the boiling point, water can change to vapor at its surface by evaporation (vaporization throughout the liquid is known as boiling). Sublimation and deposition also occur on surfaces. For example, frost is deposited on cold surfaces while snowflakes form by deposition on an aerosol particle or ice nucleus. In the process of freeze-drying, a food is frozen and then stored at low pressure so the ice on its surface sublimates.

The melting and boiling points depend on pressure. A good approximation for the rate of change of the melting temperature with pressure is given by the Clausius–Clapeyron relation:

are the molar volumes of the liquid and gas phases. In most substances, the volume increases when melting occurs, so the melting temperature increases with pressure. However, because ice is less dense than water, the melting temperature decreases. In glaciers, pressure melting can occur under sufficiently thick volumes of ice, resulting in sub glacial lakes [37,31].

The Clausius-Clapeyron relation also applies to the boiling point, except now the vapor phase has a much lower density than the liquid phase, so the boiling point increases with pressure. Water can remain in a liquid state at high temperatures in the deep ocean or underground. For example, temperatures exceed 205 °C (401 °F) in Old Faithful, a geyser in Yellowstone National Park. In hydrothermal vents, the temperature can exceed 400 °C (752 °F).[32]At sea level, the boiling point of water is 100 °C (212 °F). As atmospheric pressure decreases with altitude, the boiling point decreases by 1 °C every 274 meters. High-altitude cooking takes longer than sea-level cooking. For example, at 1,524 meters (5,000 ft), cooking time must be increased by a fourth to achieve the desired result(Conversely, a pressure cooker can be used to decrease cooking times by raising the boiling temperature. In a vacuum, water will boil at room temperature.

2.11Physical Properties Of Water

The study of chemical hydrogeology is largely the study of how solids and solute interact in, and with, water. With the exception of direct evaporation of a volatile compound, and the direct photo degree dation of a pure compound, all other processes must account for water, either as a solvent, a reactant, or a competitor. Knowledge of the physical and chemical properties of water, therefore, is fundamental to an understanding of aquatic chemistry). The key properties of water are dipole moment, dielectric constant, heat capacity, and its ability to both donate and accept protons. This imparts on water the ability to hydrogen bond with itself, to hydrogen bond with both proton donors and proton acceptors, to dissociate, to coordinate with ions and other dipoles, and to store and transport heat. The basic structure of a water molecule is well known:

..O--H bond length = 95.7 picometers

H--O---H angle = 104.5°

O-H bond energy = 450 kJ/mol

Dipole moment = 1.83 debyes

The structure of liquid water, however, is still debated, and to understand solubility, an under standing of water structure, and hydrogen bonding is necessary[38].

Hydrogen Bonding

Hydrogen bonding between liquid water molecules explains many of the physical and chemical properties. Hydrogen bonding in liquid water allows water to self-associate, which significantly changes its behavior. The strong hydrogen bonding in water explains Property Value.

Table (2.1) :Property Value

Properties	**value**
Molar mass	18.015
Molar Volume	55.5 moles/liter
Boiling Point (BP)	100°C at 1 atm
Freezing point (FP)	0°C at 1 atm
Triple point	273.16 K at 4.6 torr
Surface Tension	73 dynes at 20°C
Surface Tension	0.0212 atm at 20°C
H of vaporization	40.63 kJ/mol
ΔH of Fusion	6.013 kJ/mol
Heat Capacity (cp)	4.22 kJ/kg.K
Dielectric Constant (ε)	78.54 at 25°C
Viscosity	1.002 centipoise at 20°C
Density	1 g/cc
Density maxima	4°C

2.12Basic physical properties:

Selected physical properties of water are given in Table (2.1).To put these in context, comparison is made to the organic solvents methanol and dim ethyl ether, where one and two of the hydrogen atoms are replaced by a methyl group, respectively. Water is a small solvent, occupying about0.03 nm3per molecule in the liquid state at room temperature and pressure, yet it is highly cohesive because of the strong intermolecular interactions (hydrogen bonds, or H-bonds) between the oxygen and hydrogen atoms. This is reflected in its high boiling point, the large amount of heat needed to vaporize it, and its high surface tension.

Replacement of one or both of the hydrogen dramatically weakens these intermolecular interactions, reducing the magnitude of these quantities. The strong cohesive interactions in water also result in:

(1) a high viscosity, since for a liquid to flow interactions between neighboring molecules must constantly be broken; and

(2) a high specific heat capacity – the ability to store a large amount of potential energy for a given increment in kinetic energy (temperature).In part water's high specific heat and heat of vaporization relative to other liquids results from its small size. More intermolecular interactions are contained in a given volume of water than comparable liquids. When this is taken into account by expressing the specific heat and heat of vaporization on a molar basis, methanol and water are comparable. The surface tension of water, however, is still anomalously large after accounting for differences in size. Water has one of the highest dielectric constants of any nonmetallic liquid. It also has the remarkable properties of expanding when it is cooled from 48C to its freezing point, and again when it freezes. Both the expansion of water and its high dielectric constant reflect subtle structural features of liquid water at the molecular level[39].

2.13 Biological Relevance Of Water's Physical Properties

Water, owing to its high boiling point, exists predominantly in its liquid form in the range of environments where life flourishes, although the other two phases, ice and vapor, play an essential role in shaping the environment. The high specific heat and heat of vaporization of water have important consequences for organisms at the cellular and physiological level, in particular for the efficiency of processes involving heat transfer, temperature regulation, cooling, etc. Viscosity is the major parameter of water that determines how fast molecules and ions can bet ransported and how rapidly they diffuse in aqueous solution. It thus provides a physical upper limit to the rates of many molecular level events, within which organisms must live and evolve. These include the rates of ion channel conductance, association of substrates with enzymes, binding rates, and rates of macromolecular assembly. It also sets an upper bound to the length scale over which biological processes can occur purely by diffusion. In many cases, for example in enzyme–substrate reactions, evolution has pushed the components of living systems to the limits set by water's viscosity. The high surface tension of water is relevant at two levels. First, below a length scale of about 1mm surface tension forces dominate gravitational and viscous forces, and the air–water interface becomes an effectively impenetrable barrier. This becomes a major factor in the environment and life style of small insects, bacteriaand other microorganisms. Second, at the molecular(0.1–100 nm) scale the surface tension plays a key rolein water's solvent properties. The high dielectric constant of water also plays an important role in its action as solvent. The biological significance of the expansion of water upon cooling below 48C and upon freezing, though crucial, is largely indirect through geophysical aspects such as ocean and lake freezing, the formation of the polar ice cap, and in weathering by freeze–thaw cycles[40,38].

2.14Molecular Structure and Polarity

The geometry of the water molecule is illustrated. It consists of two O–H bonds of length 0.096nmat an angle of 104.58. Other basic properties of water are its size, shape and polarity. Atoms that are not bonded will repel each other strongly if brought close enough that their electronorbital's overlap. At larger distances two atoms attract each other weakly due to an induced dipole-induced dipole (London dispersion) force. The combination of repulsive and attractive interactions is termed the van der Waals interaction. The point at which the repulsive and attractive forces balance is commonly used to define the diameter of an atom, which for oxygen and hydrogen are0.32nm and 0.16 nm, respectively. The water molecule is thus approximately spherical. Water is electrically neutral, but because the electro negativity of oxygen is much greater than that of hydrogen the electron distribution is concentrated more around the former, i.e. water is electrically polarized, having a permanent dipole moment of 6_10230Cm in the gas phase. The dipole moment is even larger in liquid and ice because neighboring water dipoles mutually polarize each other. A useful way to represent the polarity of a molecule is to assign a partial charge to each atom, so as to reproduce the molecule's net charge, dipole moment, and possibly higher-order electrical moments. The magnitude of an atom's partial charge is a measure of its polarity. For water there is about 10.5 on each hydrogen, and a charge of opposite sign and twice this magnitude on the oxygen. In contrast, the hydrogen's of an apolarmolecule such as methane have a partial charge of _0.1, and methane's dipole moment is zero. Thus water is a very polar molecule with the ability to make strong electrostatic interactions with itself, other molecules and ions. Putting all this together, one can picture a water molecule as a slightly sticky sphere of radius 0.32nm in which two positive charges of 11/2 and a negative charge of 21 are embedded at the hydrogen and oxygen atomic centers respectively (Figure 1b). Many of liquid water's properties, including its cohesiveness, its high heat of vaporization, dielectric constant and surface tension can be explained with this simple molecular model. Other properties such as the temperature dependence of the density need more sophisticated model that includes water's flexibility, polarizability and quantum mechanical effects[41,40].

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2.15 Dielectric Constant

The dielectric constant is a measure of how easily a material is polarized by an electric field relative to vacuum. It is defined by the magnitude of the dielectric polarization(dipole moment per unit volume) induced by a unit field. Water has nearly 80 times the dielectric constant of vacuum, and it is an order of magnitude more polarizable than most organic solvents. The dielectric constant of a polar liquid such as water depends on four major factors the permanent dipole moment of the molecule, the density of dipoles, how easily they can reorient in response to afield, and how cooperative this reorientation is. Water has a high dipole moment, it is small so there are a large number of dipoles per unit volume, and in the liquid state they are easily and rapidly (within 10 ps) reoriented. In addition, because water is extensively H bonded, the polarization response is cooperative: water molecules cannot simply reorient independently of their neighbors. They effectively reorient in groups of about three. Finally, there is a small contribution to the dielectric constant(c.2–3) from the polariz ability and flexibility of water. All these factors explain the very high dielectric constant of water. Decreasing the temperature increases the dielectric constant since it reduces the randomizing thermal fluctuations that oppose dipole alignment by an electrostatic field. Interestingly, the static dielectric constant of water continues to increase through the freezing point. The high dielectric constant of ice demon strates the importance of the cooperative effect of dipole reorientation, although the time scale of reorientation is six orders of magnitude longer[43].

2.16Ionization

Because the O–H bond of water is strongly polarized, the electron density around the hydrogen atom is very low and the O–H bond is rather weak compared with most covalent bonds. Thermal fluctuations in the liquid often (every 20 ms or so) result in sufficient further polarization of the O–H bond that the hydrogen nucleus can dissociate as a proton, or H1ion. Water being an excellent solvent for ions, it can solvate the resulting

OH2and H1ions, the latter primarily as H_3O1. As a consequence dissociated water has a relatively long lifetime of about 100 ms in pure water before recombination. The hydrogen ion is highly mobile in liquid water, diffusing about five times more rapidly than water itself. Remarkably, the mobility of a proton in ice is higher still, clearly demonstrating that proton transport occurs not so much by movement of a single proton, but by a hopping mechanism between H-bonded waters, whereby a water molecule accepts a proton on one side, and releases a proton on the other side. Since the lifetime of an individualH3O1ion is 1ps, about five orders of magnitude shorter than the lifetime of dissociated water, many hopping events occur before recombination. This lifetime is also shorter than the molecular translation time, again indicating that direct diffusion of the H3O1cannot account for the high proton mobility. The ionization constant of water is orders of magnitude higher than that of most organic solvents. Water's unique ability to ionize easily and to solvate OH2and H1ions allows it to partake in OH2and H1exchange with many polar solutes. Water can donate itsH1to a base, or accept (solvate) H1from an acid. Acid–base and proton exchange reactions are pervasive in biology, occurring in protein folding, protein binding, enzyme catalysis, ion pumping, ion channel reactions bioenergetics pathways, synthesis of ATP, and in the chemiosmotic mechanisms of energy transduction, to name a few. Communication of a biological signal or transmission of energy via protons is also extremely rapid due to the facile ionization of water and the high proton mobility.

2.17Hydrogen Bonding

Water Structure

Water exists in three phases: vapor, liquid and ice, the last of which has at least nine known forms. For biological phenomena, the most important is the liquid phase. It is useful, however, when describing its structure to use the simplest form of ice, Ice I, as a reference. The structures of both are dominated by the hydrogen-bonding inter action. The hydrogen bond (H-bond) is a strong bond formed between a polar hydrogen and another heavy atom, usually carbon, nitrogen, oxygen or sulfur in biological molecules. In the gas phase the strength of an H bond between two waters is 22.7 kJ mole, although in liquids and solids its strength is greatly dependent on geometry and the surrounding molecules. It is sometimes characterized as intermediate between ionic and covalent bonds in character, although its energy as a function of the length and angle can be quite accurately described by a Columbic interaction between the partial atomic charges on the hydrogen, the heavy atom it is covalently attached to, and the oxygen, nitrogen, carbon or sulfur atom with which it is making the H-bond. Ice I is a tetrahedral lattice where each water makes-bonds to four other waters, which lie equidistant from each other at the vertices of a regular tetrahedron with edge lengths of 0.45 nm. The H-bonds are 0.275 nm long measured from oxygen to oxygen, and linear (08 H-bond angle). The H-bonding pattern of ice is symmetrical: each water makes two donor H bonds with its hydrogen atoms, and two acceptor H-bonds with the hydrogen atoms of neighboring waters. The 2–2H-bonding symmetry is an important feature of water. Combined with an H–O–H bond angle very close to the ideal tetrahedral angle of 109.58, and with the tendency for the four neighboring waters to repel each other electro-statically, it is sufficient to explain the tetrahedral –H bonding pattern of Ice I and the persistence of the tetrahedral pattern in liquid water. A different way of describing the structure of Ice I is to count up the number of neighbors each water has as a function of distance[44].

Starting at the central water depicted in figure 1cand moving out, the first four neighbors are found at a distance of 0.275 nm. The next set is encountered at 0.45 nm: 12 waters that are H-bonded to the first four neighbors. Continuing out, shells of water are encountered at discrete distances. The resulting radial distribution function (rdf) is characteristic of a crystalline solid, and consists of discrete peaks. The number of waters in the first peak defines the 'coordination' number, which in Ice I is four. Liquids do not have a single structure since the molecules are in constant motion but the rdf is an extremely useful way to describe their average structure. The rdf for liquids is normalized to one so that the value at any point is the average number of waters found at that distance relative to the number expected if the distribution of water molecules were completely random, i.e. if there were no structure. The broad overlapping peaks decaying away to a constant value of one at large distances is characteristic of a liquid .The first peak or hydration shell indicates that there is a high probability that two waters will be separated by about 0.25–0.30 nm, the range of H-bonding distances. Beyond 0.3 nm there is a dip since waters at this distance are likely to overlap with those in the first shell, then there is a smaller peak at 0.45 nm, which is the remains of the second layer seen in the Ice I structure. The area under the first peak gives the coordination number of water at 258Cas 4.7. This is somewhat higher than for Ice I, indicating that the lattice structure has partially collapsed, and each water on average makes an H bond to more than four waters. Organic solvents typically have coordination numbers of 6 or higher, so by comparison water has an 'open' structure. Experiments and computer simulations show that the open structure results from the high degree of angular ordering in liquid water. It is bimodal, and should be contrasted with the H-bond angle distribution for Ice, which is a single peak at 08. In liquid four of the H bonds are approximately linear (mean angle of about 128), and very close to their length in Ice I. This indicates that much of the tetrahedral structure of Ice I persists in liquid water, albeit in a distorted form. The H-bond to the additional neighbor(s) is more distorted, with an average angle of about 528, since these neighbors have to sit in a face of the tetrahedron formed by the primary hydration waters[45].

The open tetrahedral structure is also responsible for the anomalous temperature dependence of water density. Water contracts upon melting, and continues to contract until it reaches a temperature of 4C, above which itexpands like most liquids. In the contraction phase the collapse of the open tetrahedral structure due to increasingly bent H-bonds outweighs the normal tendency for materials to expand because the molecules become further apart[46,45].

2.18 Parameters Of Water Quality

There are three types of water quality parameters physical, chemical, and biological .

a. Physical Parameters Of Water Quality

Turbidity

Turbidity is the cloudiness of water. It is a measure of the ability of light to pass through water. It is caused by suspended material such as clay, silt, organic material, plankton, and other particulate materials in water .
Turbidity in drinking water is esthetically unacceptable, which makes the water look unappetizing. The impact of turbidity can be summarized in the following points:

1. It can increase the cost of water treatment for various uses .
2. The particulates can provide hiding places for harmful microorganisms and thereby shield them from the disinfection process .

3. Suspended materials can clog or damage fish gills, decreasing its resistance to diseases, reducing its growth rates, affecting egg and larval maturing, and affecting the efficiency of fish catching method .

4. Suspended particles provide adsorption media for heavy metals such as mercury, chromium, lead, cadmium, and many hazardous organic pollutants such as polychlorinated biphenyls (PCBs), polycyclic aromatic hydrocarbons (PAHs), and many pesticides .

5. The amount of available food is reduced because higher turbidity raises water temperatures in light of the fact that suspended particles absorb more sun heat. Consequently, the concentration of the dissolved oxygen (DO) can be decreased since warm water carries less dissolved oxygen than cold water. Turbidity is measured by an instrument called nephe lometricturbidi meter, which expresses turbidity in terms of NTU or TU. A TU is equivalent to 1 mg/L of silica in suspension. Turbidity more than 5 NTU can be visible to the average person while turbidity in muddy water, it exceeds 100 NTU . Groundwater normally has very low turbidity because of the natural filtration that occurs as the water penetrates through the soil [46].

b. Temperature

Palatability, viscosity, solubility, odors, and chemical reactions are influenced by temperature . Thereby, the sedimentation and chlorination processes and biological oxygen demand (BOD) are temperature dependent . It also affects the biosorption process of the dissolved heavy metals in water . Most people find water at temperatures of 10–15°C most palatable .

c. Color

Materials decayed from organic matter, namely, vegetation and inorganic matter such as soil, stones, and rocks impart color to water, which is objectionable for esthetic reasons, not for health reasons .Color is measured by comparing the water sample with standard color solutions or colored glass disks . One color unit is equivalent to the color produced by a1 mg/L solution of platinum (potassium chloroplatinate (K_2PtCl_6)).The color of a water sample can be reported as follows:

• Apparent colorist the entire water sample color and consists of both dissolved and suspended components color .

• True color is measured after filtering the water sample to remove all suspended material. Color is graded on scale of 0 (clear) to 70 color units. Pure water is colorless, which is equivalent to 0 color units [47,46].

d. Taste And Odor

Taste and odor in water can be caused by foreign matter such as organic materials, inorganic compounds, or dissolved gasses . These materials may come from natural, domestic, or agricultural sources .The numerical value of odor or taste is determined quantitatively by measuring volume of sample A and diluting it with a volume of sample B of an odor-free distilled water so that the odor of the resulting mixture is just detectable at a total mixture volume of 200 ml. The unit of odor or taste is expressed in terms of a threshold number as follows:

TON or TTN = (A + B) / A (1)where TON is the threshold odor number and TTN is the threshold taste number.

e. Solids

Solids occur in water either in solution or in suspension. These two types of solids can be identified by using a glass fiber filter that the water sample passes through. By definition, the suspended solids are retained on the top of the filter and the dissolved solids pass through the filter with the water .If the filtered portion of the water sample is placed in a small dish and then evaporated, the solids as a residue. This material is usually called total dissolved solids or TDS [48,47].

Total solid (TS) = Total dissolved solid (TDS) + Total suspended solid (TSS) (2)Water can be classified by the amount of TDS per liter as follows:

• freshwater: <1500 mg/L TDS;

• brackish water: 1500–5000 mg/L TDS;

• saline water: >5000 mg/L TDS.

The residue of TSS and TDS after heating to dryness for a defined period of time and at a specific temperature is defined as fixed solids. Volatile solids are those solids lost on ignition (heating to 550°C).These measures are helpful to the operators of the wastewater treatment plant because they roughly approximate the amount of organic matter existing in the total solids of wastewater, activated sludge, and industrial wastes .

2.19 Chemical Parameters Of Water Quality

a. pH

pH is one of the most important parameters of water quality. It is defined as the negative logarithm of the hydrogen ion concentration . It is a dimensionless number indicating the strength of an acidic or a basic solution .Actually, pH of water is a measure of how acidic/basic water is .Acidic water contains extra hydrogen ions (H^+) and basic water contains extra hydroxyl(OH^-) ions ,pH ranges from 0 to 14, with 7 being neutral. pH of less than 7 indicates acidity, whereas a pH of greater than 7 indicates a base solution. Pure water is neutral, with a pH close to 7.0 at 25°C. Normal rainfall has apH of approximately 5.6 (slightly acidic) owing to atmospheric carbon dioxide gas. Safe ranges of pH for drinking water are from 6.5 to 8.5 for domestic use and living organisms need .A change of 1 unit on a pH scale represents a 10-fold change in the pH ,so that water with pH of 7 is 10 times more acidic than water with a pH of 8, and water with a pH of 5 is 100 times more acidic than water with a pH of 7. There are two methods available for the determination of pH: electrometric and colorimetric methods[49].

Excessively high and low pHs can be detrimental for the use of water. A high pH makes the taste bitter and decreases the effectiveness of the chlorine disinfection, thereby causing the need for additional chlorine . The amount of oxygen in water increases as pH rises. Low-pH water will corrode or dissolve metals and other substances .Pollution can modify the pH of water, which can damage animals and plants that live in the water .The effects of pH on animals and plants can be summarized as follows:

• Most aquatic animals and plants have adapted to life in water with a specific pH and may suffer from even a slight change .

• Even moderately acidic water (low pH) can decrease the number of hatched fish eggs, irritate fish and aquatic insect gills, and damage membranes .

• Water with very low or high pH is fatal. A pH below 4 or above 10 will kill most fish, and very few animals can endure water with a pH below 3 or above 11 .

• Amphibians are extremely endangered by low pH because their skin is very sensitive to contaminants . Some scientists believe that the current decrease in amphibian population throughout the globe may be due to low pH levels induced by acid rain. The effects of pH on other chemicals in water can be summarized as follows:

• Heavy metals such as cadmium, lead, and chromium dissolve more easily in highly acidic water (lower pH). This is important because many heavy metals become much more toxic when dissolved in water .

• A change in the pH can change the forms of some chemicals in the water. Therefore, it may affect aquatic plants and animals . For instance, ammonia is relatively harmless to fish in neutral or acidic water. However, as the water becomes more alkaline (the pH increases), ammonia becomes progressively more poisonous to these same organisms.

b. Acidity

Acidity is the measure of acids in a solution. The acidity of water is its quantitative capacity to neutralize a strong base to a selected pH level . Acidity in water is usually due to carbon dioxide, mineral acids, and hydrolyzed salts such as ferric and aluminums fates. Acids can influence many processes such as corrosion, chemical reactions and biological activities . Carbon dioxide from the atmosphere or from the respiration of aquatic organisms causes acidity when dissolved in water by forming carbonic acid (H_2CO_3). The level of acidity is determined by titration with standard sodium hydroxide (0.02 N)using phenolphthalein as an indicator .

c. Alkalinity

The alkalinity of water is its acid-neutralizing capacity comprised of the total of all treatable bases. The measurement of alkalinity of water is necessary to determine the amount of lime and soda needed for water softening (e.g., for corrosion control in conditioning the boiler feed water) . Alkalinity of water is mainly caused by the presence of hydroxide ions (OH^-), bicarbonate ions (HCO_3^-),and carbonate ions (CO_3^{2-}), or a mixture of two of these ions in water. As stated in the following equation, the possibility of OH^- and HCO_3^- ions together are not possible because they react together to produce CO_3^{2-}ions:

$$OH^- + HCO^-_3 \rightarrow CO_3^{2-} + H_2O$$

Alkalinity is determined by titration with a standard acid solution (H2SO4 of0.02 N) using selective indicators (methyl orange or phenolphthalein).The high levels of either acidity or alkalinity in water may be an indication of industrial or chemical pollution. Alkalinity or acidity can also occur from natural sources such as volcanoes. The acidity and alkalinity in natural waters provide buffering action that protects fish and other aquatic organisms from sudden changes in pH. For instance, if an acidic chemical has somehow contaminated a lake that had natural alkalinity, a neutralization reaction occurs between the acid and alkaline substances; the pH of the lake water remains unchanged. For the protection of aquatic life, the buffering capacity should be at least 20 mg/L as calcium carbonate[50,46].

Chapter Three

Previous Studies

3.1 Introduction

Many research has been published concerning the physical properties of water. This chapter present some of them.

3.2Magnetic Treatment of Irrigation Water: Experimental Results and Application Conditions

The effects of magnetic treatment on irrigation water have been studied by Jacob and others . They showed that the main effects were the increase of the number of crystallization centers and the change of the free gas content. Both effects improve the quality of irrigation water. As an example, changes in natural water due to magnetic treatment in a commercially available apparatus, Magna lawn 2000, have been studied. On the basis of laboratory and field results, the type and the chemical content of natural water for which a magnetic treatment method is the most efficient have been determined. Our analysis shows that the important components for effective magnetic treatment are flow rate through the apparatus and certain chemical parameters of water, namely, carbonate water hardness of more than 50 mg/L and concentration of hydrogenous ions in water at pH>7.2. Irrigation with magnetically treated water is the most effective for soils with high soda content[51].

3.3Effect Of Magnetized Water On Workability And Compressive Strength Of Concrete

In this research study of Taghried, the effect of magnetized water on workability and compressive strength of concrete was studied, in order to obtain operative concrete with high resistance and at a lower cost. Data were collected from previous studies and researches. The magnetized water was prepared using the magnetic treatment system. Four concrete mixes were prepared, one without magnetized water and three with. Cement reduction of 12.5 % and 25 % was imposed on the last two mixes with magnetized water. Slump and compressive strength tests were carried out on all four mixes and it was found out that concrete produced by the magnetic technology is easy to operate without affecting the compressive resistance of concrete. It was also found that magnetized water increases the compressive resistance of concrete while cement is reduced up to 25%.

Based on this research study, the following conclusions emerged:

• Magnetized water effectively enhances concrete workability (up to +400%)

• Concrete cube's weight can be reduced approximately 3 % with the use of magnetized water

• Compressive strength is increased up to 10 % with the use of magnetized water.

• Cement content can be reduced up to 75 % without affecting compressive strength when combined with the useof magnetized water[52].

3.4Magnetic Field Influence on The Properties of Water Treatedby Reverse Osmosis

The current study is focused on reviewing the rapid growing of magnetic water use in different science fields and in measuring the influence of several intensities of magnetization on the chemical and electrical properties of tap water treated by reverse osmosis. This work which was done by Mahdi includes water circulation for 24h in magnetic fields of intensities 500, 1000, 1500, and 2000G. The magnetization of water increases some ions in the water such as Mg, K, Na, Cl, and SiO_2 and decreases Ca and SO_3. The main application of magnetic water is the improvement of the geotechnical properties of soft and swelling soil through precipitation of calcite in pores which increases the bond between soil particles and the strength of the soil[53].

The results of the present study showed that the circulation of water in a magnetic field increases the pH which indicates increasing water alkalinity. The nucleation of alkaline content increased from 16mg/L for reference water to 88mg/L for water treated with magnetic field of 2000G intensity. Also, the magnetic treatment reduces the nucleation of calcium mineral and sulfate content. The results from this research are focused on the influences of magnetic field of varying intensity on the chemical and electrical properties of water treated by reverse osmosis. The experiments changed the content of ions in water
as follows:

• After the use of magnetic treatment, pH, EC and TDS increased with increased magnetic field intensity.

• Some positive and negative ions such as Mg, K, Na, Cl, Alkaline, and SiO_2 increased.

• Some positive and negative ions such as Ca and SO_4decreased.

• The strength of soil could be improved by this method without using chemical additives to the soil through calcite precipitation. The amounts of sulfate in magnetic field decreased, which is useful to protect concrete from erosion, but the magnetization causes increase in the content of chloride which attacks the reinforcement steel of foundation and causes corrosion.

3.5Bio-friendly magnetic water is ecofriendly

Dhrubo showed that there is a long history of the use of magnets to improve the quality and health benefits of water. Many countries have been using magnetic water for patients with digestive, urinary and nervous problems, for pain, swelling and many other ailments. Whether all of the claims are true or false remains to be tested by science. However, Magnetic Therapy has been accepted by many for the relief of pain. It is now accepted that each of our cells possess a small magnetic field and that water can be magnetized. Then, the logical conclusion is that magnetic water has the ability to affect our cells and help our body perform as it was meant. There is much evidence that bio-magnetic water is beneficial and none that it can be harmful. Anecdotal evidence of the health benefits of magnetized water abounds. Magnetized water is claimed to be energy-building, activating, cleansing and detoxifying. There are reports of people resolving bladder problems, recovering quickly from a stroke, alleviating arthritis pain and reducing blood pressure by drinking magnetized water. It is perhaps reasonable to assume that if scientific studies on animals have proven that magnetized water has health benefits, then it should also be beneficial to humans. However, so far there have been no systematic, clinical trials done to prove or disprove the healing effects of magnetized water in humans. The effects of the North Pole (negative) and South Pole (positive) magnetism are quite different. North polarity stabilizes, calms and sedates and also reduces pain, infection and inflammation. South polarity, on the other hand, is acid producing, enervating, biologically disorganizing and may accelerate bacteria growth. Magnets with a South polarity should only be used under the care of a trained practitioner if at all.

What is Bio-Magnetic Water?

Water is paramagnetic – meaning that it will hold a magnetic charge. In nature, the earth's magnetic field naturally charges water in lakes, wells and running streams. However, as water passes through treatment plants and is transported through pipes to your home or work place, it loses its magnetic charge. Treating water with magnetic fields simple restores the natural energy and balance that nature intended. Magnetized water has more hydroxyl(OH-) ions that form alkaline molecules which reduces the acidity. Normal tap water has a pH of about 7. Magnetized water is more alkaline and can have a pH as high as 9.2. Magnetizing water reduces the surface tension of the water making it feel softer. It is thinner, wetter and more absorbable, so it is better able to penetrate cell walls and deliver the nutrients that it carries.

H2O H + + OH- H :O:H

Health Benefits Our body is over 70% water. All biological functions including circulation, digestion, absorption and excretion depend on water. Water is required for blood, the lymphatic system and healthy skin and muscles. It is well known among health professionals that when we are sick, the pH of our body is more acidic. Magnetized water, which is more alkaline, raises the pH of our body, which allows the body to get rid of the toxins. Bio magnetized water is believed to be energy-building, activating, cleansing and detoxifying. People have reported resolving bladder problems, recovering quickly from a stroke, alleviating arthritis pain, reducing blood pressure and breaking up kidney and gall stones by drinking magnetic water. Scientific studies have proven that magnetized water has health benefits for animals. Therefore it seems reasonable that it should also be beneficial for humans. Reported health benefits of drinking magnetic water include:

(1) Magnetic water tastes sweeter and has more clarity. (2) Magnetic water reduces acidity in the body and promotes a more alkaline pH (pH>7). (3) Magnetic water promotes healing of wounds and burns. (4) Magnetic water has a therapeutic effect of digestive, nervous, and urinary systems. (5) Magnetic water can be beneficial for asthma, fevers, colds, coughs, bronchitis and sore throats. (6) Magnetic water canbe beneficial

for menstrual and menopause discomfort. (7) Magnetic water revitalized the body. (8) Magnetic water has a positive effect on the autonomic nervous system. (9) Magnetic water can help regulate the heart function and clear clogged arteries. (10) Magnetic water is beneficial for kidney ailments (removal and prevention of stones), gout, obesity (it improves metabolic activity) and premature aging. (11) Magnetic water helps relieve pain. (12) Magnetic water infuses energy into the body, controls bacteria, and stimulates brain function. (13) Magnetic water can help dissipate toxic deposits in the body's connective tissue. (14) Magnetic water can regulate blood pressure (high or low). (15) Magnetic water can be used to wash and disinfect external cuts and scrapes. (16) Magnetic water will remove the plaque on your teeth if you use it to brush your teeth, rinse your mouth, and drink. (17) Magnetic water will make the hair softer and more manageable while using less shampoo when used to wash the hair. (18) Magnetic water is ionic so it helps reset the charge on cell walls, thus promoting better circulation.

Pets: Your pets will enjoy many of the same benefits from bio-magnetic water that you do. They will drink more water, have more energy and feel younger and healthier. A friend was giving her dogs magnetic water. When she moved, she temporarily had to give them tap water. After a few days, they began scratching all the time. When she started them back on bio-magnetic water, the scratching stopped almost completely.

Plants: Bio-Magnetized water will help your plants grow stronger, greener and larger. In one study seedlings’ germination rates were 68 % with bio magnetized water, while with non-magnetized water only 8% germinated. In another study, Texas A&M researchers found that squash weighed 24%more when it was grown with magnetized water vs. non-magnetized water. Bio-magnetic water is more solvent and has a lower surface tension, so nutrients in the water are absorbed more readily. Thus you get a healthier plant while using less fertilizer. Other Fluids & Uses: Almost any fluid can be magnetized. Using Bio-Magnetic Water will drastically improve the taste of coffee, tea and foods. Foods and beverages made using magnetic water will acquire the same healing powers as bio magnetic water. Cosmetics, facial and skin products function a lot better when magnetized. Magnetized milk will give vigor and vitality to the weak and exhausted person. Magnetized milk has been proven useful for recuperating and enhancing sexual power. When fruit juices are treated with bio-magnets, they become more refreshing and give more nourishment. Beer can be magnetized to give better effect. Magnetized olive oil can be very rewarding in the treatment of gout and rheumatism. Use bio-magnetic water to make your coffee and after a month or two the inside of your coffeemaker will look like new. The bio-magnetic water will remove the scale build-up in your coffeemaker.

How to make Bio-Magnetic Water: Making Bio magnetic water is quite simple: just place a glass or container filled with water on a magnetic pad. Never use a metal container. You want to use a container that has a flat bottom without any raised edges. You want the bottom of the container touching the magnet pad. How long you need to leave the water on the magnet will depend on how much water you have. It won’t hurt to leave it there longer; you can even just leave the container on the pad and refill it as you use the water. The water will stay magnetized for several days after you take it off the magnet [54].

3.6Effects of magnetized water application on soil and maize growth indices under different amounts of salt in the water

Application of low quality water for irrigation is compulsive in facing water scarcity. Use of a magnetic field is an approach to overcome this challenge. This study of Meysam and other examined the impact of magnetic field technology on improving germination under water of different salinity levels. An experiment was conducted to determine the effects of saline water levels, i.e. (S1):0.5, (S2):2, (S3):4 and (S4):6 dS/combined with magnetized technology (with or without) on maize growth. Thus, magnetic treatment

was applied by passing the irrigation water through a 1,500 mT magnetic field at 3 liters per minute(lpm) flow rate. Some emergence indices, such as emergence index, emergence rate index (ERI) and mean emergence time, were used to evaluate the germination of maize seed. As for soil properties after plant harvest, the use of magnetically treated irrigation water reduced soil pH but increased soil electrical conductivity and available N and P. ERI increased from 7.6 to 10.2, 9.1 to 11.1, 10.3 to 13.3,and 11.8 to 13.3 when applying the magnetized field for S1, S2, S3 and S4, respectively. Overall, the growth parameters of maize were improved by using magnetic technology with saline water, while the opposite trend was shown for increasing salinity without magnetic treatment.

Results of the experiment revealed some beneficial effects of magnetically treated water for maize seed germination. Irrigation with magnetically treated water increased the vegetative growth of maize seeds in all treatments. Application of magnetized saline water for maize seed emergence reduced the MET as compared with non-magnetized water. Although magnetic water treatment is an environmentally friendly technique and easy to handle, further research is required to understand the ambiguous mechanism of the magnetic field in order to turn it into a technology for sustainable farming[55].

3.7 Preparation of Electric- and Magnetic-Activated Water and Its Influence on the Workability and Mechanical Properties of Cement

Cement-based materials were prepared by Kaiyue ,with activated water induced by a magnetic field or electric field represent a possible solution to environmental issues caused by the worldwide utilization of chemical admixtures. In this contribution, electric- and magnetic-activated water have been produced. The workability and mechanical properties of cement mortar prepared with this activated water have been investigated. The results indicate that the pH and absorbance (Abs) values of the water varied as the electric and magnetic field changed, and their values increased significantly, exhibiting improved activity compared with that of the untreated water. In addition, activated water still retains activity within 30 min of the resting time. The fluidity of the cement paste prepared with electric-activated water was significantly larger than that of the untreated paste. However, the level of improvement differed with the worst performance resulting from cement paste prepared with alternating voltage activated water. In terms of mechanical properties, both compressive strength and flexural strength obtained its maximum values at 280 mT with two processing cycles. The compressive strength increased 26% as the curing time increased from 7 days to 28 days and flexural strength increased by 31%. In addition, through the introduction of magnetic-activated water into cement mortar, the mechanical strength can be maintained without losing its workability when the amount of cement is reduced.

The physical properties of electric- and magnetic-activated water and their influence on the workability and mechanical properties of cement mortar were investigated. On the basis of these results, we can draw the following conclusions:

(1) The physical properties of activated water, including the pH and Abs values, varied as the electric and magnetic field changed, and their values

increased significantly, exhibiting improved activity compared with that of the untreated water. The pH values with remarkable enhancement came from water treated with a high voltage of 2400 V, high frequency signals of 15 MHz, an alternating voltage of 15 V, and a magnetic field intensity of 650 mT. The obvious improvement in the Abs values were obtained at the wavelengths of 195 nm for the electric field and 190 nm for the magnetic field. In addition, activated water still retains activity within 30 min of thirsting time.

(2) The workability of cement paste prepared with activated water could be improved to varying degrees, and the improvement was more prominent for samples with longer curing times. However, the level of improvement differed with the worst performance resulting from cement paste prepared with alternating voltage-activated water. For the fluidity of cement paste prepared with magnetic-activated water, the best performance was observed for water treated with a magnetic intensity of 280 mT coupled with a current velocity of 1.0 m/s.

(3) The mechanical strength of cement mortar prepared with magnetic-activated water can be improved by 27% in compressive strength and 31% in flexural strength as the curing time increased from 7 days to 28 days. They both obtained its maximum values at 280 mT with two processing cycles. In addition, through the introduction of magnetic-activated water into cement mortar, the mechanical strength can be maintained without losing its workability when the amount of cement is reduced. Since the cleaner production is the norm in industry and technology today and as it is a preventative method of dealing with environmental and economic issues, it must be pointed out that water treatment by electric or magnetic filed is one of the main features of cleaner production aspects because it brings many environmental and economic benefits. However, water treatment by electric or magnetic

filed is still a controversial subject as the reported results have low reproducibility and little consistence. In addition, the various factors including magnetic impurities and dissolved ions make the experiment difficult to control. The presented results may provide some theoretical guidance to the application of activated water on cement-based materials[56] .

3.8 Magnetized Water: Science or Fraud?

L.lahuerta showed that magnetized water can improve plant and crop growth and strength. It remove deposits and delay corrosion. The water acidity is reduced and surface tension decreased. Soap produce more foam and clothes wash better .This comes from the fact that water physical and chemical properties changed[57].

3.9 The effect of magnetized water on some characteristics of growth and chemical constituent in rice

In the work done by Fatemeh two rice groups were examined. One is irrigated with normal water, while the other's irrigated with magnetize water .The result obtained showed that the magnetized one grows better and contain more carbohydrate and total protein [58].

3.10 Summary and critique

Many papers has been published concerning magnetized water[59,60,61,62,63]. These papers concentrate their work on a wide variety of applications [62,63,64,65,66].The fields of applications are in medicine ,agriculture an engineering [68,69,70,71,72].All experiments done indicates that using magnetic field improve the physical and chemical properties of materials [73,74,75,76,77].However the researches does not speak about the effect of container and food supplements on water properties.

Chapter Four

Materials and Methods

4.1 Introduction

in this chapter experimental work which was carried out will presented using different sample of natural product solution putted in to four different container to study the effect of those container on the Ph, conductivity an ionization of the natural product solution dissolved on tab water in addition optical proper ties using UV techniques

4.2 Material

In this work four different types of water containers were used to see how these containers affect the water inside them. These samples are pride made of clay, container made of steel, container made of plastic and container made of glass .Five different types of food supplements were dissolved in water. These are ginger, fenugreek, mint, cinnamon ,and lemons

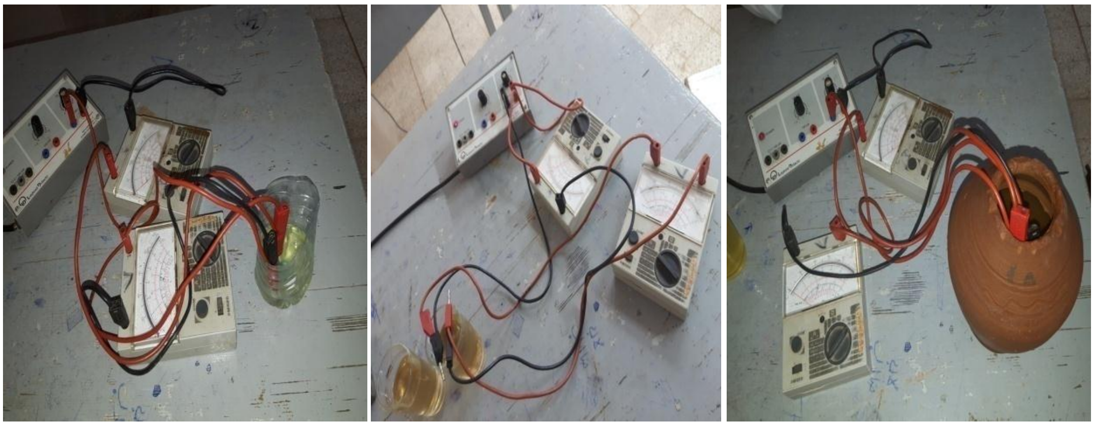
4.2.1Equipments

The teguments used in this work are Ph meter ,conductivity meter ,ultraviolet spectrometer(UV),and an electrical circuit consisting of voltmeter , ammeter and two electrodes immersed in water to measure ionization degree

4.3 Experimental Equipments and Experimental Setup

Figure(4.3.1) :Two types of ph meter

Figure(4.3.2) :Conductivity meter and measurement of conductivity



Figure(4.3.3) :Ionization measurement of plastic, glass and pride (arranged from left to right)

Figure(4.3.4) :Ionization measurement of cinnom and fenugreek (arranged from left to right).

Figure(4.3.5) :Ultraviolet spectrometer

4.4Method

Water properties of water samples like Ph ,conductivity ,and ionization were determined

1-Water from water pipes are directly powered inside the pride clay, glass, steel ,and plastic

2-Their Ph ,conductivity ,and ionization were measured and recorded in tables. This is done using ph and conductivity meters beside an electric circuit for ionization.

3- The food supplements ginger, fenugreek, mint, cinnamon ,and lemons

Were immersed in water for about10 hours. Different concentrations of the extracts of these supplements were prepared by adding one cc,2cc,3cc up to 10cc to equal amounts of water using cc injector.

4-Their PH, conductivity, and ionization were measured and recorded in tables

5-The spectra of water in pride clay were measured using UV spectrometer, after water is poured. were the first water sample was taken after the water takes 15 minutes and his UV spectrum was displayed. The second water sample was taken after 15 minutes from taking the first sample. This process was repeated 10 times

Chapter Five
Results and Discussion

5.1 Introduction

This chapter is concerned with results, discussion and conclusion.

5.2 Results

The following tables and figures exhibited the results of ph and conductivity meters

5.2.1 Results Conductivity and Ionization

Table (5.1) :Measured results of relation between volt and current (ionization) for water in pride

V	I	R=V/I	Ec=I/V
1.2	.5	2.4	4.17
1.35	1	1.35	7.41
1.5	1.5	1	1
1.55	2	.78	1.29
1.6	2.5	.64	1.56
1.7	3	.57	1.75
1.8	3.5	.51	1.96
1.9	4	.48	2.083
2.0	4.5	.44	2.27
2.1	5	.42	2.38

Table (5.2) :Measured results of relation between volt and current (ionization) for water in steel

V	I	R=V/I	Ec=I/V
.3	.5	.6	1.67
.5	1	.5	2
.7	1.5	.47	2.13
.9	2	.45	2.22
1.05	2.5	.42	2.38
1.2	3	.4	2.5
1.3	3.5	.37	2.70
1.45	4	.36	2.78
1.55	4.5	.34	2.94
1.65	5	.33	3.03

Table (5.3) :Relation between concentration and conductivity and volt current(ionization) for Mint in glass after 15min

Concentration(cc)	I(μ A)	Conductivity(μS)	V(volt)
1	5	2	2.5
2	10	2	5
3	15	1.875	8
4	20	1.818	11
5	25	1.786	14
6	30	1.875	16
7	35	1.842	19
8	40	1.818	22

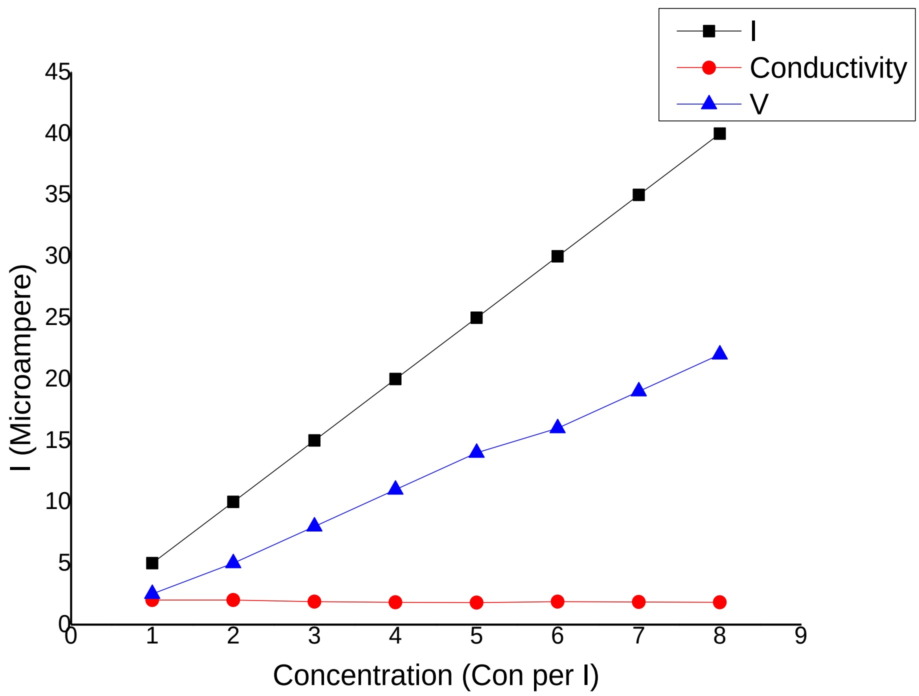


Figure (5.3) :Relation between concentration and conductivity and volt current (ionization) for Mint in glass after 15min

Table (5.4) :Relation between conductivity and volt current(ionization) for Mint in glass after 30min

Concentration(cc)	I(μ A)	Conductivity(μS)	V(volt)
1	5	1.67	3
2	10	1.818	5.5
3	15	1.818	8.25
4	20	1.818	11
5	25	1.786	14
6	30	1.818	16.5
7	35	1.842	19
8	40	1.839	21.75

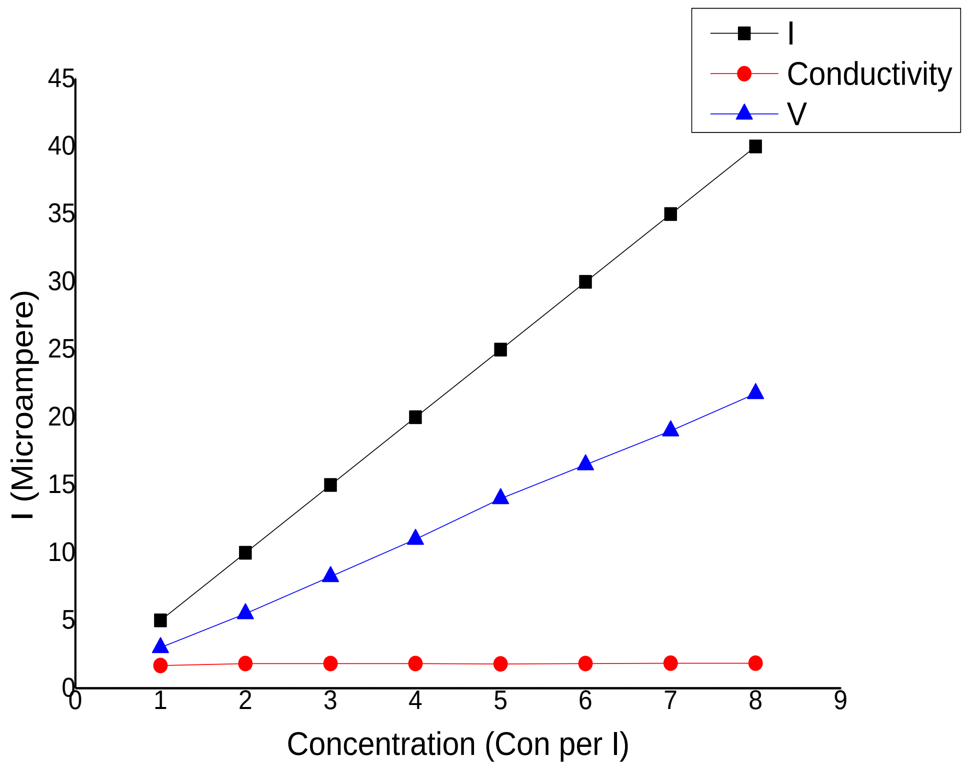


Figure (5.4) :Relation between conductivity and volt current(ionization) for Mint in glass after 30min

Table (5.5) :Relation between conductivity and volt current (ionization) for Mint in glass after 45min

Concentration(cc)	I(µ A)	Conductivity(µS)	V(volt)
1	5	1.818	2.75
2	10	1.818	5.5
3	15	1.765	8.5
4	20	1.861	10.75
5	25	1.852	13.5
6	30	1.875	16
7	35	1.867	18.75
8	40	1.861	21.5

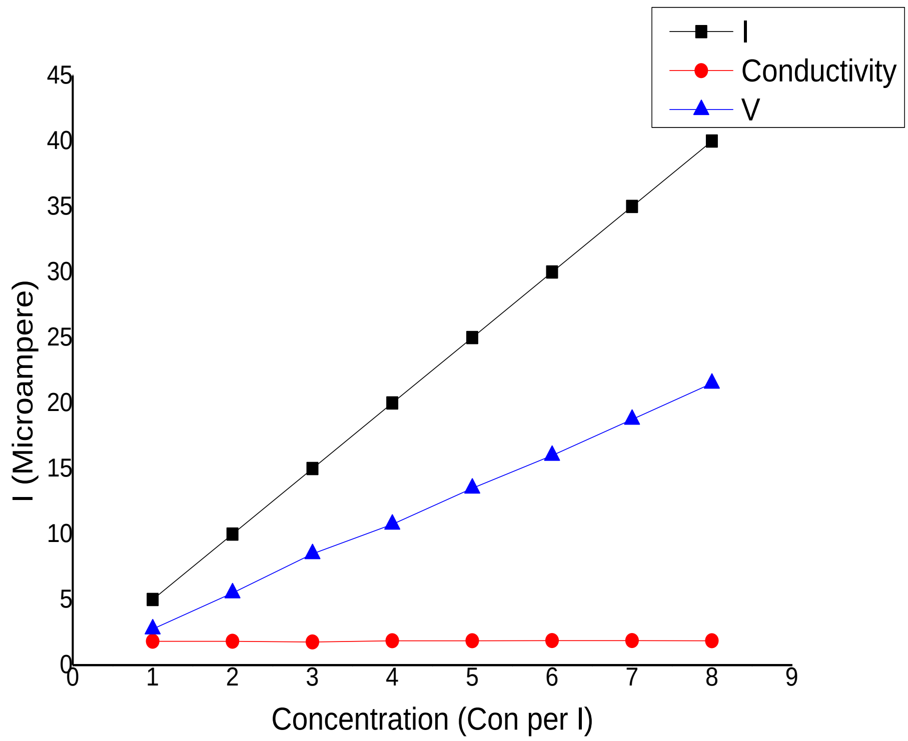


Figure (5.5) :Relation between conductivity and volt current (ionization) for Mint in glass after 45min

Table (5.6) :Relation between conductivity and volt current (ionization) for Mint in steel after 15min

Concentration(cc)	I(μ A)	Conductivity(μS)	V(volt)
1	5	5	.1
2	10	6.25	.16
3	15	7.5	.20
4	20	8.333	.24
5	25	8.333	.30
6	30	7.895	.38
7	35	8.333	.42
8	40	8.696	.46

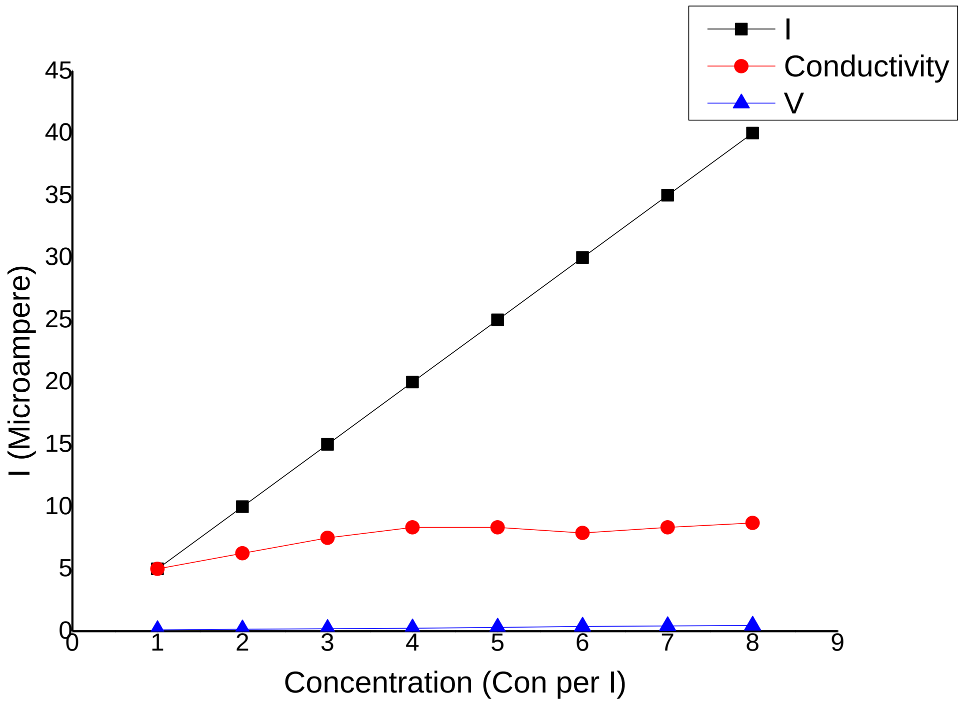


Figure (5.6) :Relation between conductivity and volt current (ionization) for Mint in steel after 15min

Table (5.7) :Relation between conductivity and volt current (ionization) for Mint in steel after 30min

Concentration(cc)	I(µ A)	Conductivity(µS)	V(volt)
1	5	1.786	.28
2	10	3.125	.32
3	15	4.167	.36
4	20	5.128	.39
5	25	5.814	.43
6	30	6.522	.46
7	35	6.731	.52
8	40	7.407	.54

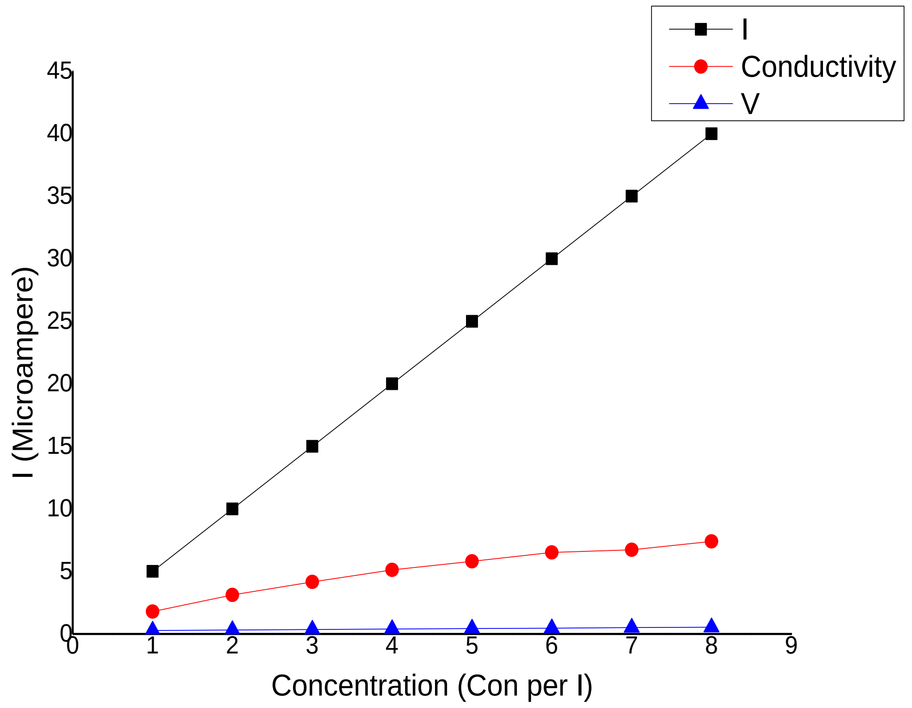


Figure (5.7) :Relation between conductivity and volt current (ionization) for Mint in steel after 30min

Table (5.8) :Relation between conductivity and volt current (ionization) for Mint in glass after 24hour

Concentration(cc)	I(μ A)	Conductivity(μS)	V(volt)
1	5	2.778	.18
2	10	3.571	.28
3	15	4.412	.34
4	20	5.263	.38
5	25	5.952	.42
6	30	6.522	.46
7	35	7	.50
8	40	7.273	.55

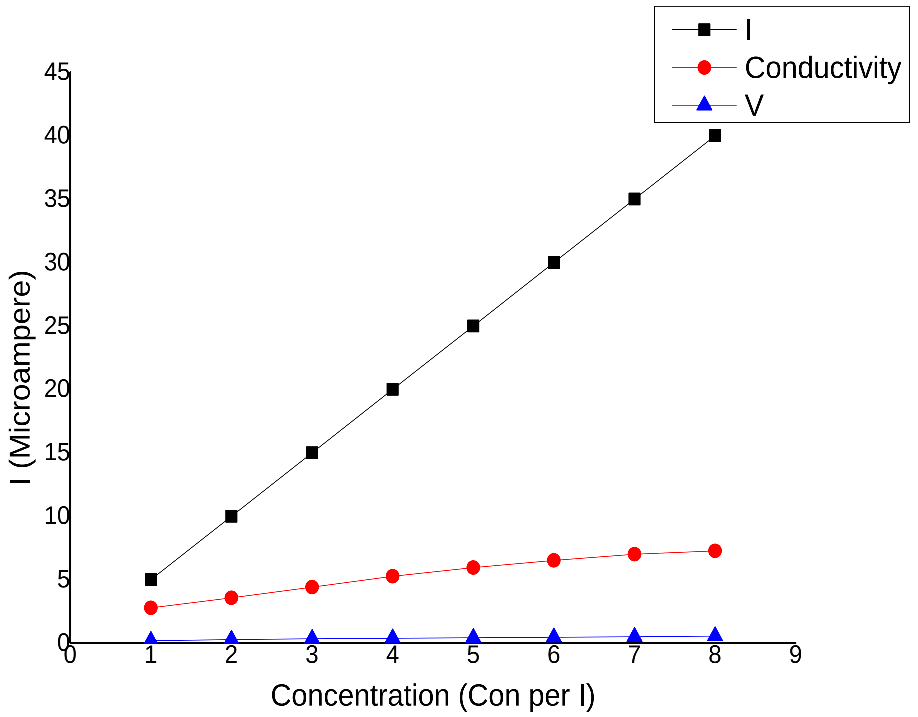


Figure (5.8) :Relation between conductivity and volt current (ionization) for Mint in glass after 24min

Table (5.9) :Relation between conductivity and volt current (ionization) for Mint in plastic after 15min

Concentration(cc)	I(μ A)	Conductivity(μS)	V(volt)
1	5	6.25	.08
2	10	7.143	.14
3	15	6.818	.22
4	20	7.143	.28
5	25	7.353	.34
6	30	6.818	.44
7	35	7	.50
8	40	6.897	.58

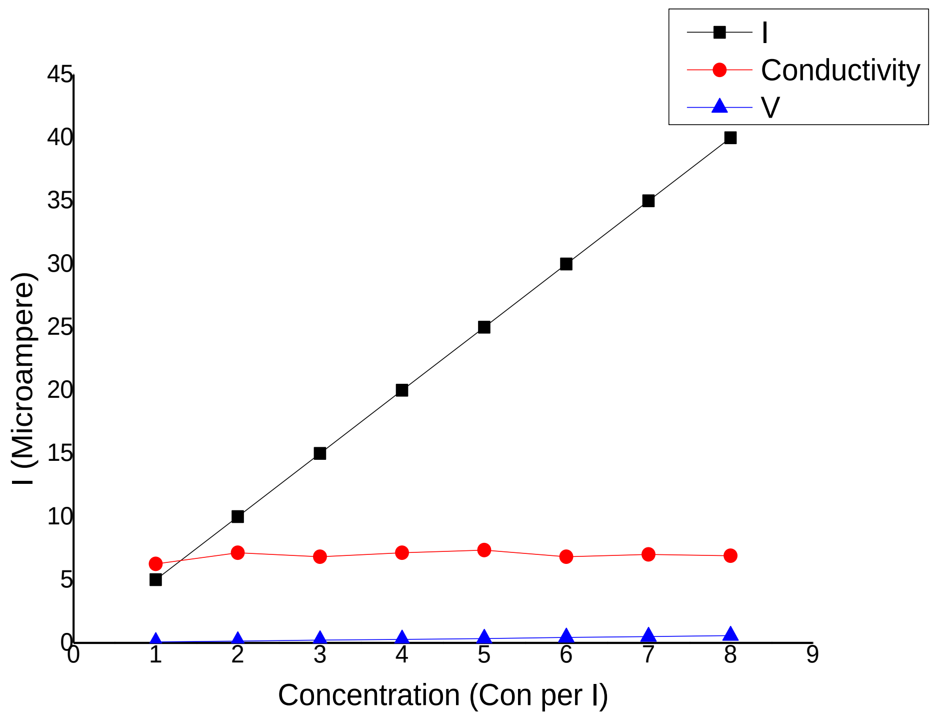


Figure (5.9) :Relation between conductivity and volt current (ionization) for Mint in plastic after 15 hour

Table (5.10) :Relation between conductivity and volt current (ionization) for Mint in pride after 15min

Concentration(cc)	I(µ A)	Conductivity(µS)	V(volt)
1	5	6.25	.08
2	10	6.25	.16
3	15	6.25	.24
4	20	6.452	.31
5	25	6.25	.40
6	30	6.522	.46
7	35	6.731	.52
8	40	6.897	.58

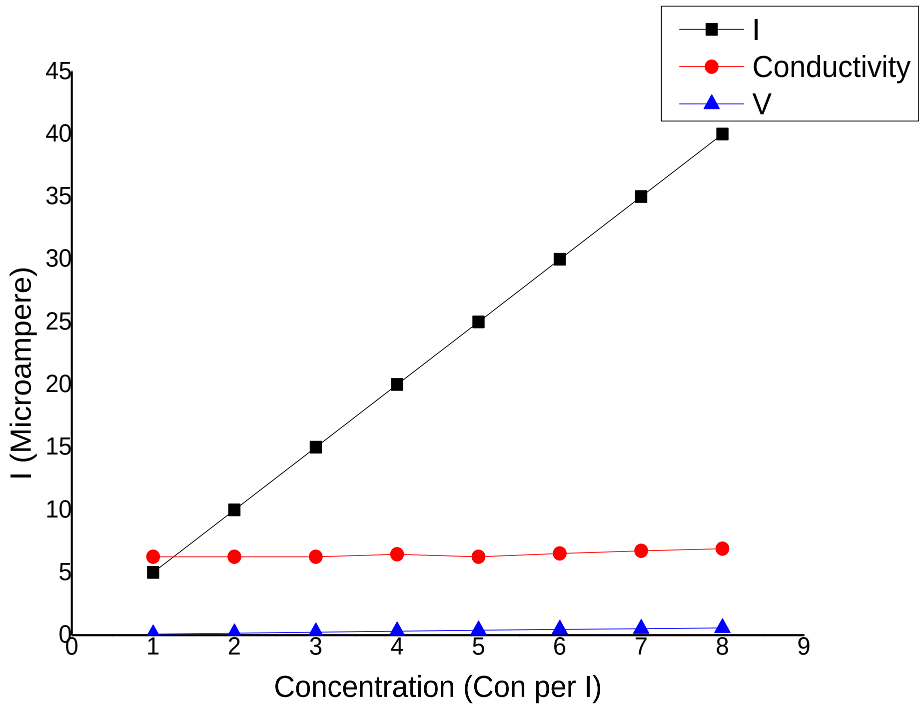


Figure (5.10) :Relation between conductivity and volt current(ionization) for Mint in pride after 15min

Table (5.11) :Relation between conductivity and volt current (ionization) for ginger in glass after 0min

Concentration(cc)	I(μ A)	Conductivity(μS)	V(volt)
1	5	3.333	.015
2	10	2.5	.04
3	15	2.727	.055
4	20	2.667	.075
5	25	2.632	.095
6	30	2.727	.11
7	35	2.692	.13
8	40	2.667	.15

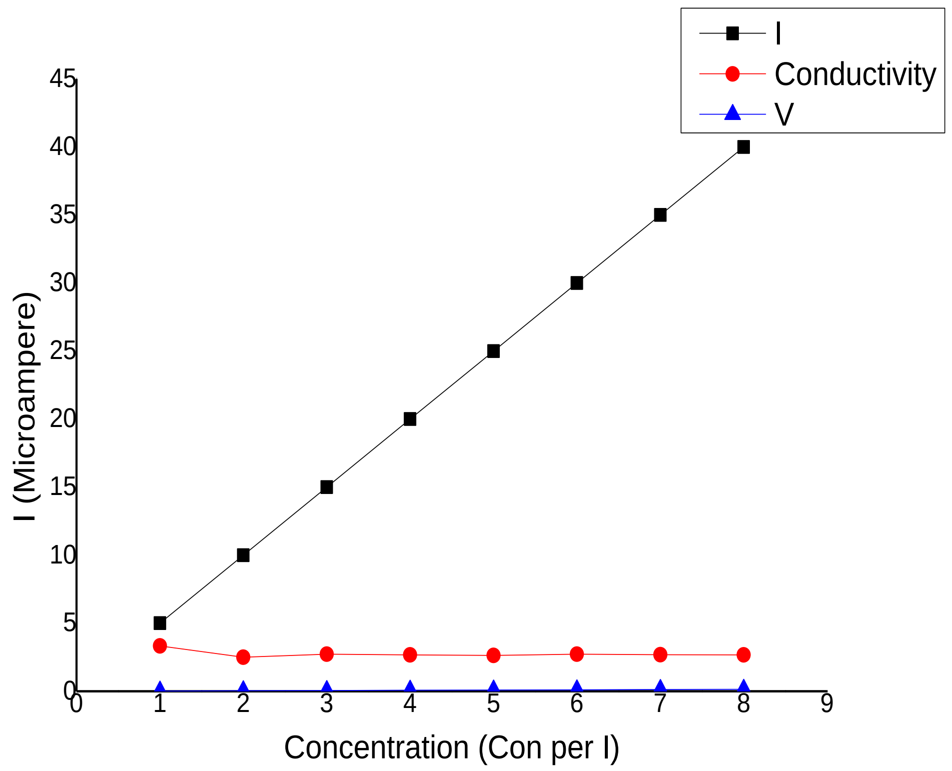


Figure (5.11) :Relation between conductivity and volt current (ionization) for ginger in glass after 0min

Table (5.12) :Relation between conductivity and volt current (ionization) for ginger in glass after 14min

Concentration(cc)	I(μ A)	Conductivity(μS)	V(volt)
1	5	2	.02
2	10	2.222	.045
3	15	2	.075
4	20	2	.1
5	25	1.852	.135
6	30	1.714	.175
7	35	1.667	.21
8	40	1.633	.245

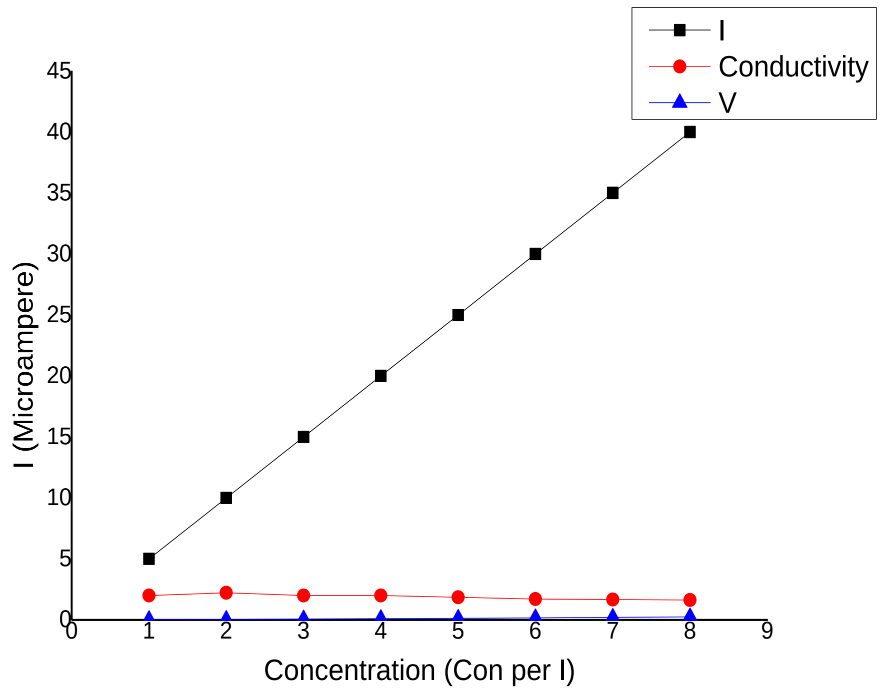


Figure (5.12) :Relation between conductivity and volt current (ionization) for ginger in glass after 14min

Table (5.13) :Relation between conductivity and volt current (ionization) for ginger in glass after 30min

Concentration(cc)	I(μ A)	Conductivity(μS)	V(volt)
1	5	5.882	.085
2	10	7.692	.13
3	15	8.824	.17
4	20	9.524	.21
5	25	1.020	.245
6	30	1.091	.275
7	35	1.029	.34
8	40	1.111	.36

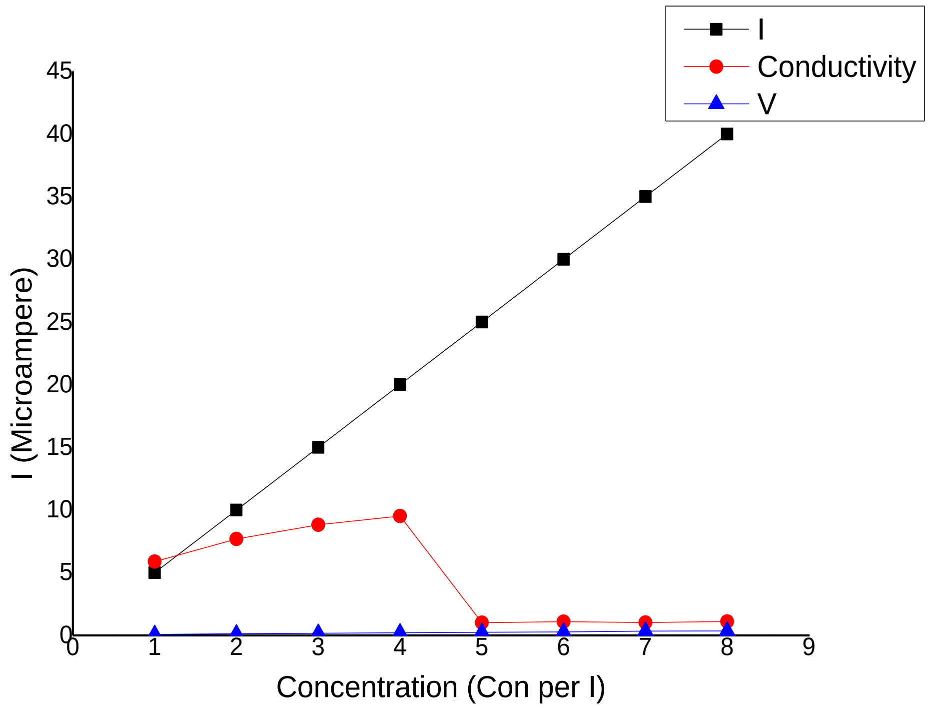


Figure (5.13) :Relation between conductivity and volt current (ionization) for ginger in glass after 30min

Table (5.14) :Relation between conductivity and volt current (ionization) for ginger in glass after 45min

Concentration(cc)	I(μ A)	Conductivity(μS)	V(volt)
1	5	5	.1
2	10	7.143	.14
3	15	8.333	.18
4	20	9.091	.22
5	25	9.615	.26
6	30	1	.30
7	35	1.029	.34
8	40	1.053	.38

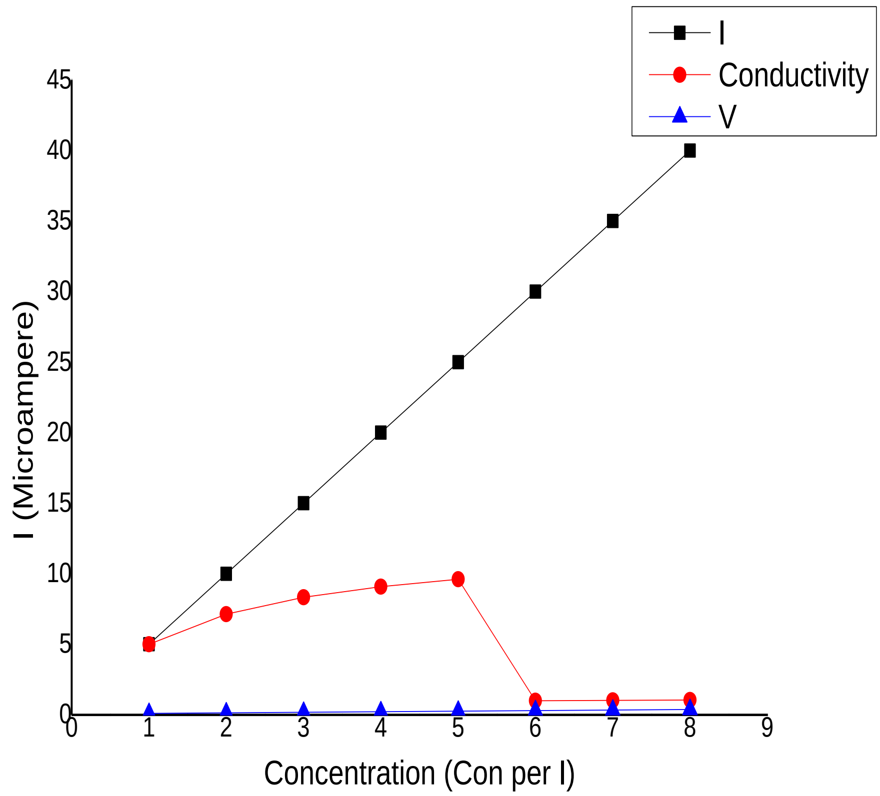


Figure (5.14) :Relation between conductivity and volt current (ionization) for ginger in glass after 45min

Table (5.15) :Relation between conductivity and volt current (ionization) for lemon in glass after 0min

Concentration(cc)	I(µ A)	Conductivity(µS)	V(volt)
1	5	6.25	.08
2	10	1	.1
3	15	1.111	1.35
4	20	1.333	.15
5	25	1.25	.20
6	30	1.25	.24
7	35	1.25	.28
8	40	0	0

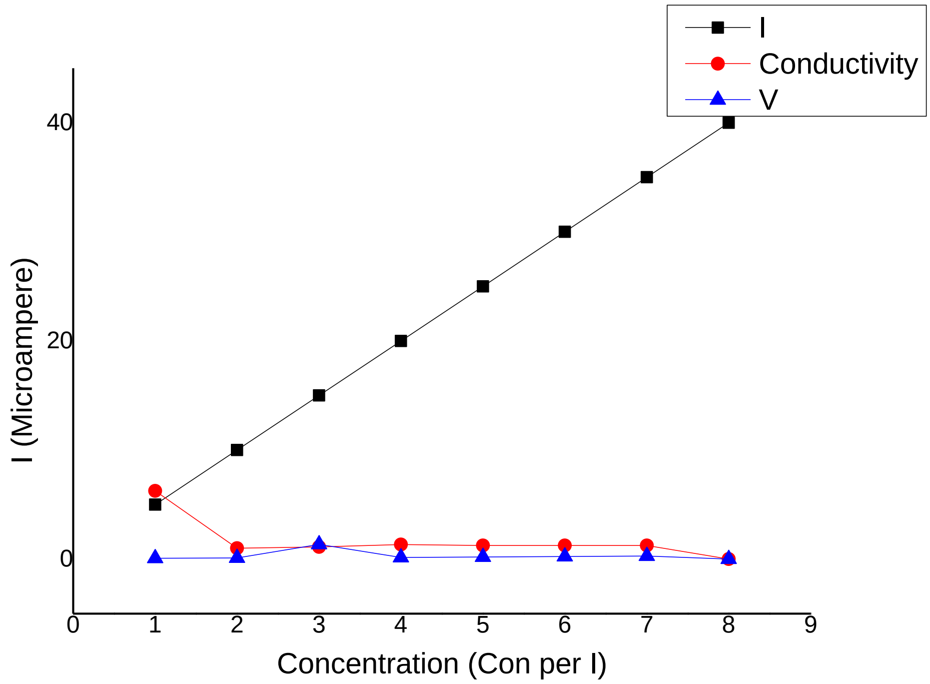


Figure (5.15) :Relation between conductivity and volt current (ionization) for lemon in glass after 0min

Table (5.16) :Relation between conductivity and volt current (ionization) for lemon in glass after 24hour

Concentration(cc)	I(μ A)	Conductivity(μS)	V(volt)
1	5	2.5	.02
2	10	2.5	.04
3	15	2.5	.06
4	20	2.5	.08
5	25	2.381	.105
6	30	2.4	.125
7	35	2.424	.145
8	40	2.424	.165

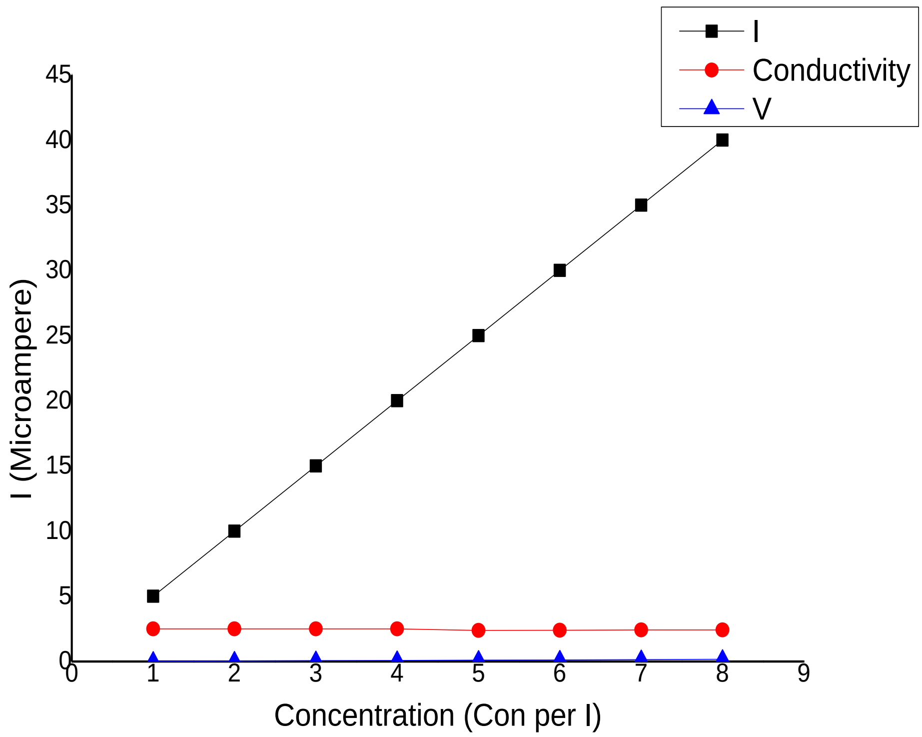


Figure (5.16) :Relation between conductivity and volt current (ionization) for lemon in glass after 24hour

Table (5.17) :Relation between conductivity and volt current (ionization) for lemon in copper

Concentration(cc)	I(μ A)	Conductivity(μS)	V(volt)
1	5	2.5	.02
2	10	2	.05
3	15	2	.075
4	20	1.905	.105
5	25	1.852	.135
6	30	1.765	.17
7	35	1.795	.195
8	40	1.702	.235

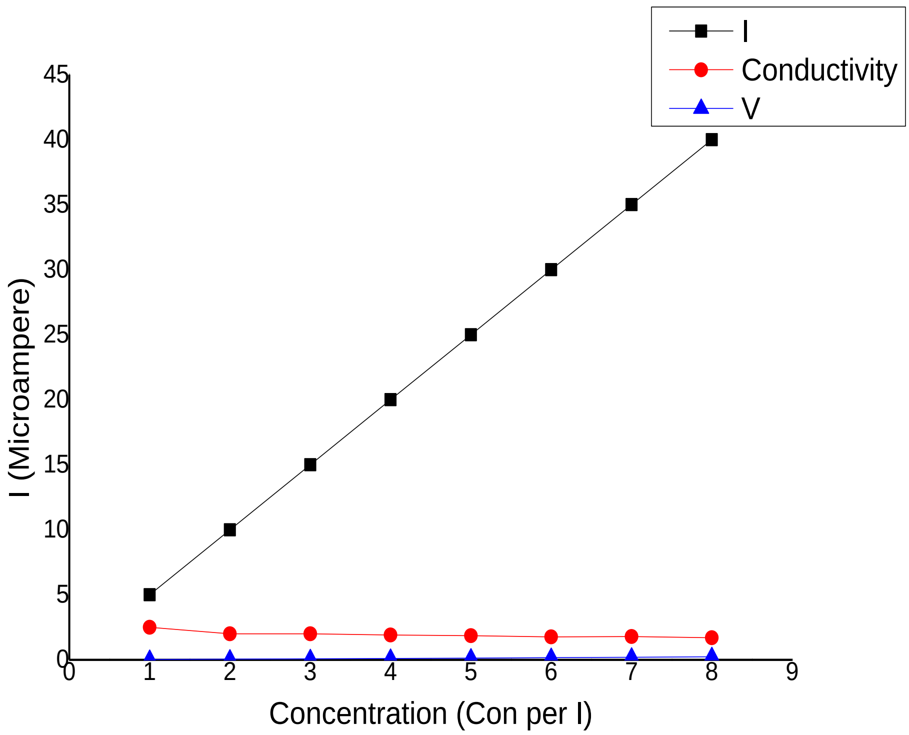


Figure (5.17) :Relation between conductivity and volt current (ionization) for lemon in copper

Table (5.18) :Relation between conductivity and volt current (ionization) for lemon in copper in 24hour

Concentration(cc)	I(μ A)	Conductivity(μS)	V(volt)
1	5	2	.025
2	10	1.818	.055
3	15	1.765	.85
4	20	1.818	.11
5	25	1.786	.14
6	30	1.818	.165
7	35	1.892	.185
8	40	1.861	.215

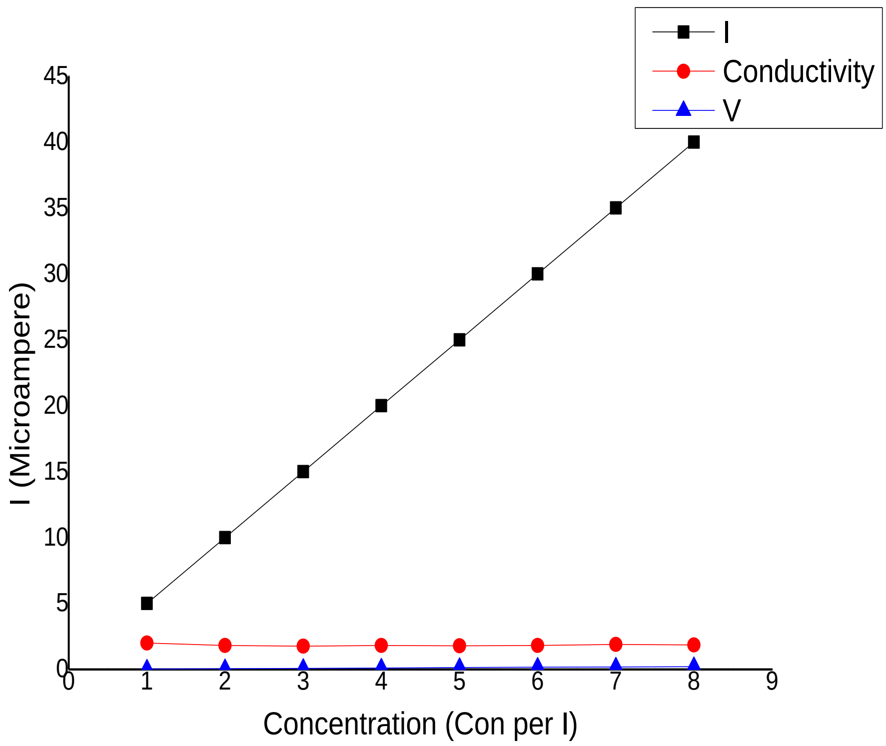


Figure (5.18) :Relation between conductivity and volt current (ionization) for lemon in copper in 24hour

Table (5.19) :Relation between conductivity and volt current (ionization) for lemon in plastic

Concentration(cc)	I(μ A)	Conductivity(μS)	V(volt)
1	5	1.667	.03
2	10	1.667	.06
3	15	1.875	.08
4	20	2	.1
5	25	2.083	.12
6	30	2.143	.14
7	35	2.188	.16
8	40	2.222	.18

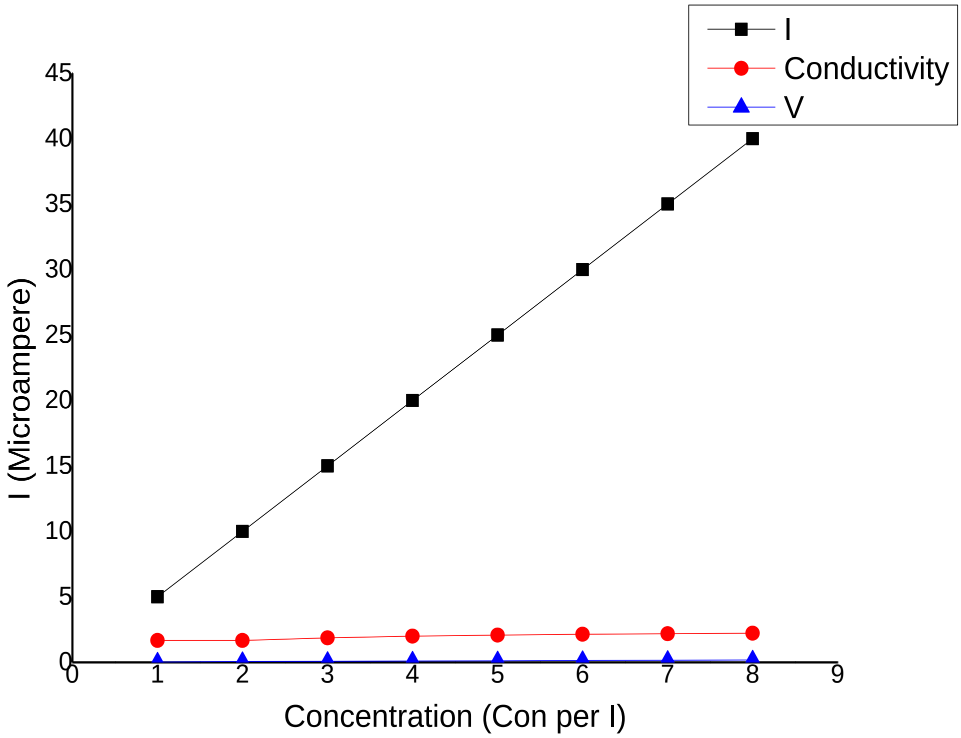


Figure (5.19) :Relation between conductivity and volt current(ionization) for lemon in plastic

Table (5.20): Relation between conductivity and volt current (ionization) for lemon in steel

Concentration(cc)	I(µ A)	Conductivity(µS)	V(volt)
1	5	1.25	.04
2	10	1.111	.09
3	15	1.071	.14
4	20	1	.20
5	25	1	.25
6	30	0	0
7	35	0	0
8	40	0	0

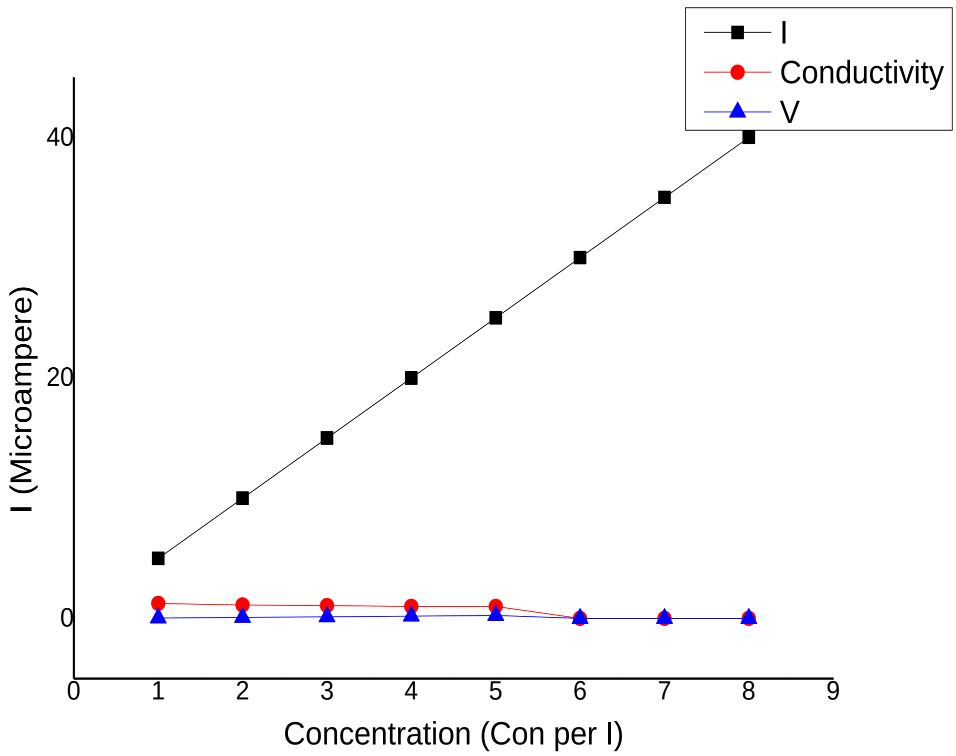
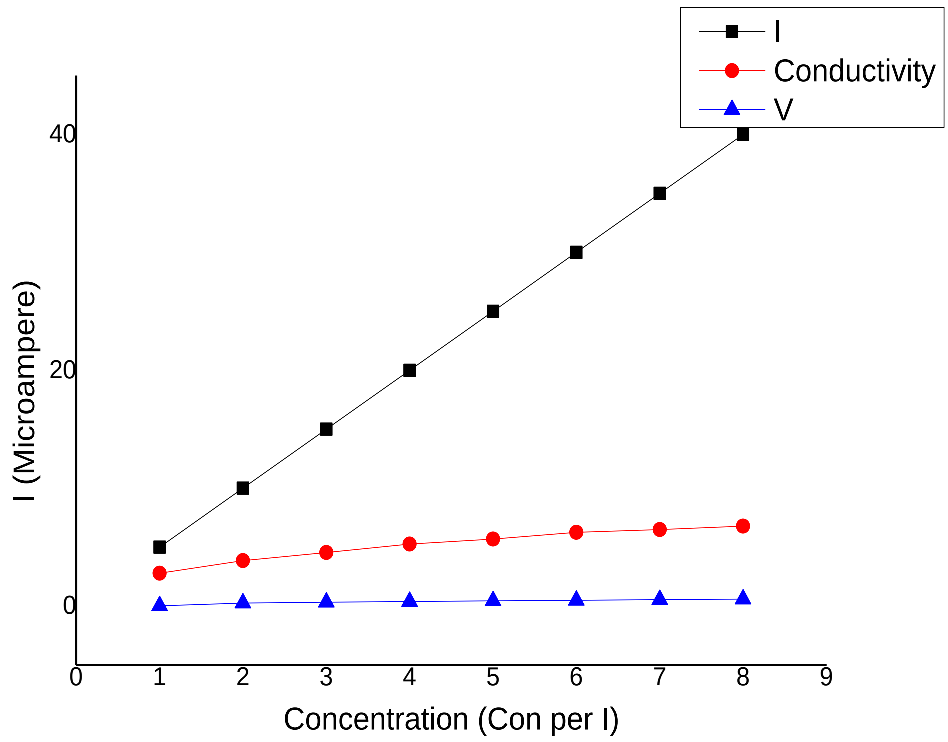


Figure (5.20): Relation between conductivity and volt current (ionization) for lemon in steel

Table (5.21) :Relation between conductivity and volt current (ionization) for cinnom in glass after 0 min

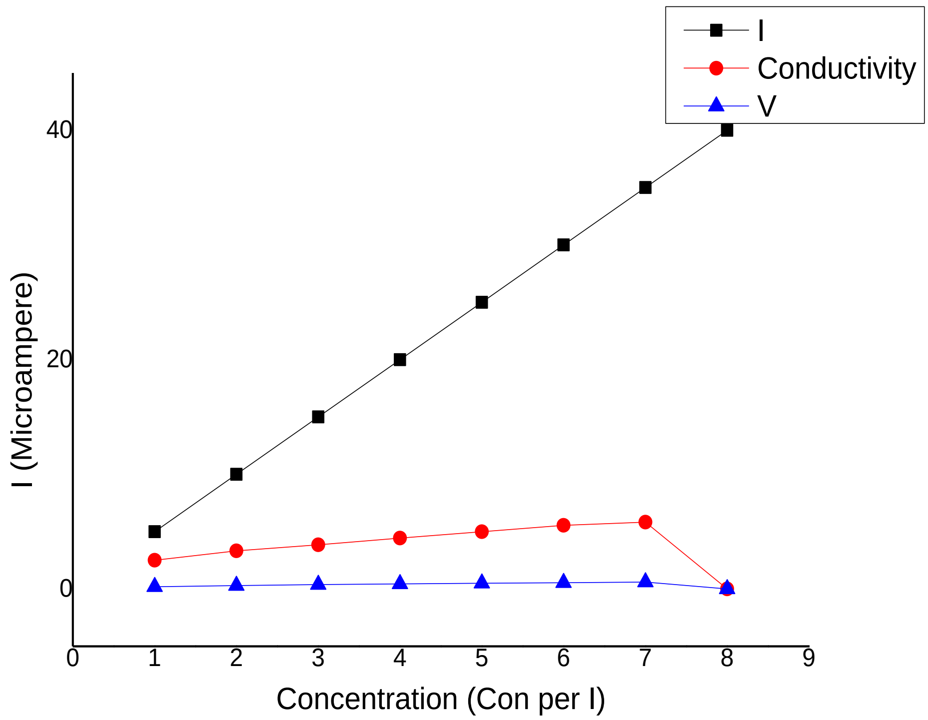
Concentration(cc)	I(μ A)	Conductivity(μS)	V(volt)
1	5	2.778	.018
2	10	3.846	.26
3	15	4.546	.33
4	20	5.263	.38
5	25	5.682	.44
6	30	6.25	.48
7	35	6.482	.54
8	40	6.779	.59



Figure(5.21) :Relation between conductivity and volt current (ionization) for cinnom in glass after 0 min

Table (5.22) :Relation between conductivity and volt current (ionization) for cinnom in glass after 15 min

Concentration(cc)	I(μ A)	Conductivity(μS)	V(volt)
1	5	2.5	.20
2	10	3.333	.30
3	15	3.846	.39
4	20	4.444	.45
5	25	5	.50
6	30	5.556	.54
7	35	5.833	.54
8	40	0	0



Figure(5.22) :Relation between conductivity and volt current (ionization) for cinnom in glass after 15 min

Table (5.23) :Relation between conductivity and volt current (ionization) for cinnom in steel

Concentration(cc)	I(μ A)	Conductivity(μS)	V(volt)
1	5	2.778	.18
2	10	4.167	.24
3	15	5	.30
4	20	5.556	.36
5	25	5.952	.42
6	30	6.522	.46
7	35	7.292	.48
8	40	7.692	.52

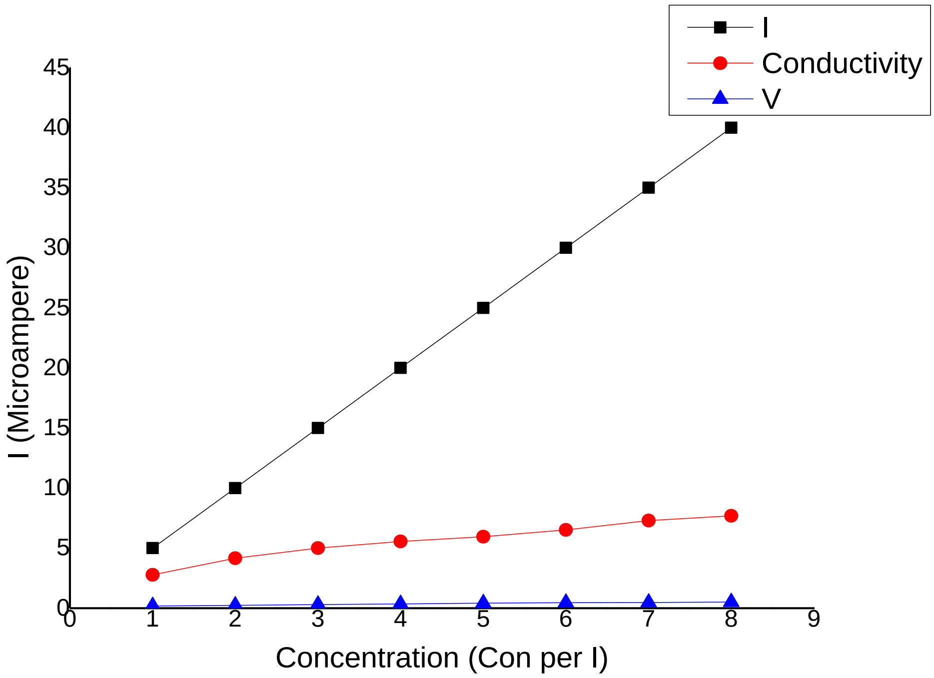


Figure (5.23) :Relation between conductivity and volt current (ionization) for cinnom in steel

Table (5.24) :Relation between conductivity and volt current (ionization) for cinnom in plastic

Concentration(cc)	I(μ A)	Conductivity(μS)	V(volt)
1	5	8.333	.06
2	10	7.692	.13
3	15	8.333	.18
4	20	8.333	.24
5	25	7.353	.34
6	30	7.895	.38
7	35	8.333	.42
8	40	8.333	.48

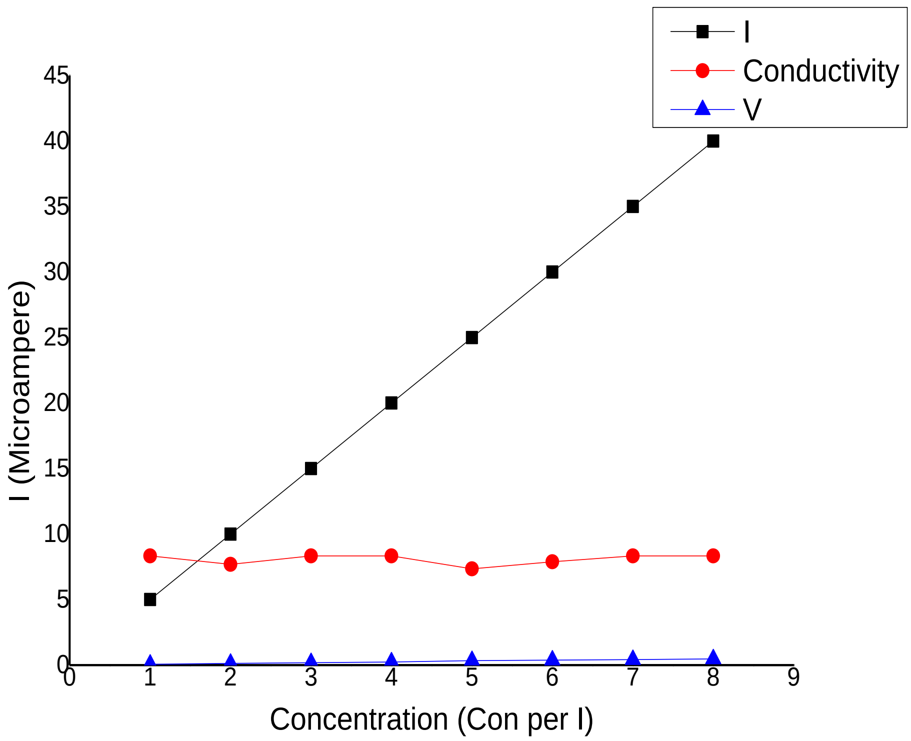


Figure (5.24) :Relation between conductivity and volt current (ionization) for cinnom in plastic

Table (5.25) :Relation between conductivity and volt current (ionization) for cinnom in pride

Concentration(cc)	I(μ A)	Conductivity(μS)	V(volt)
1	5	1.25	.04
2	10	2	.05
3	15	1.875	.08
4	20	2	.1
5	25	1.042	.24
6	30	1.071	.28
7	35	1.029	.34
8	40	1	.40

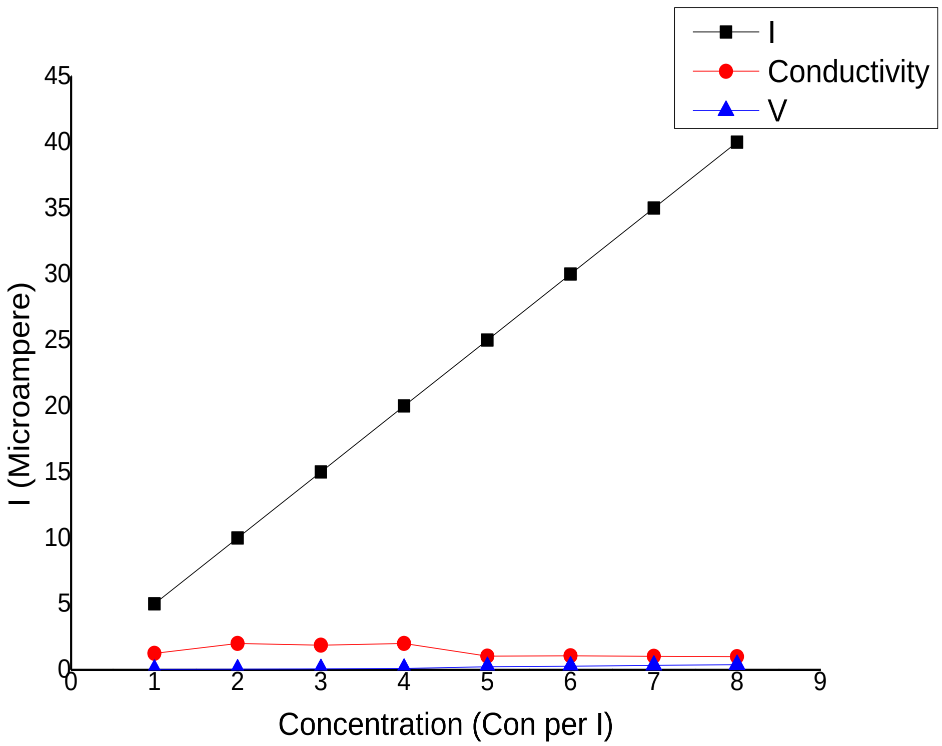


Figure (5.25) :Relation between conductivity and volt current (ionization) for cinnom in pride

Table (5.26) :Relation between conductivity and volt current (ionization) for fenugreek in glass after 0min

Concentration(cc)	I(µ A)	Conductivity(µS)	V(volt)
1	5	1.25	.04
2	10	1.111	.09
3	15	1.071	.14
4	20	1.111	.18
5	25	1.136	.22
6	30	1.154	.26
7	35	1.167	.30
8	40	1.176	.34

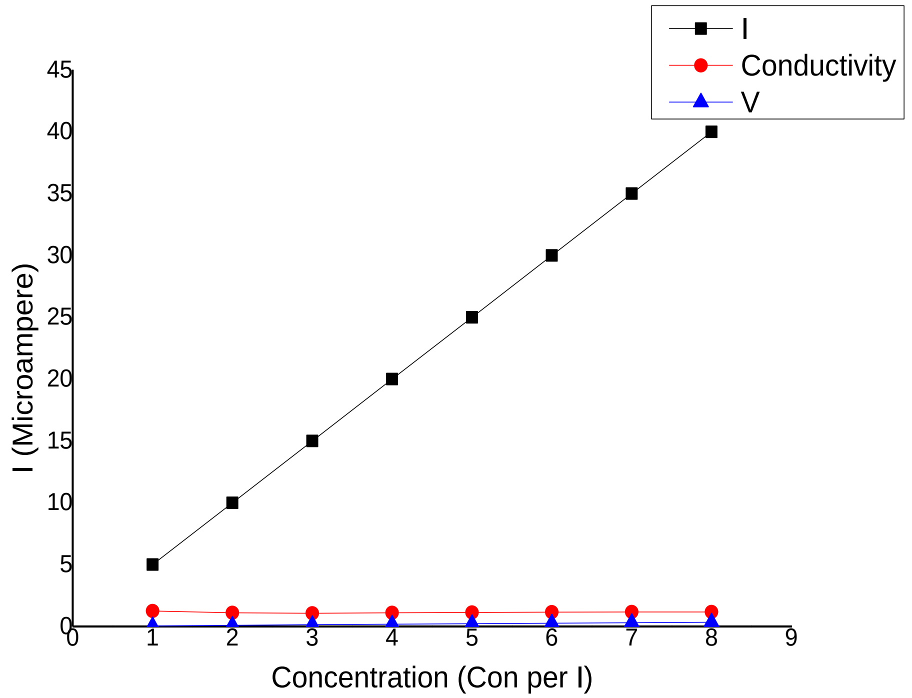


Figure (5.26) :Relation between conductivity and volt current(ionization) for fenugreek in glass after 0min

Table (5.27) :Relation between conductivity and volt current(ionization) for fenugreekin glass after 15min

Concentration(cc)	I(µ A)	Conductivity(µS)	V(volt)
1	5	8.333	.06
2	10	1.25	.08
3	15	1.5	.1
4	20	1.538	.13
5	25	1.667	.15
6	30	1.765	.17
7	35	1.842	.19
8	40	1.905	.21

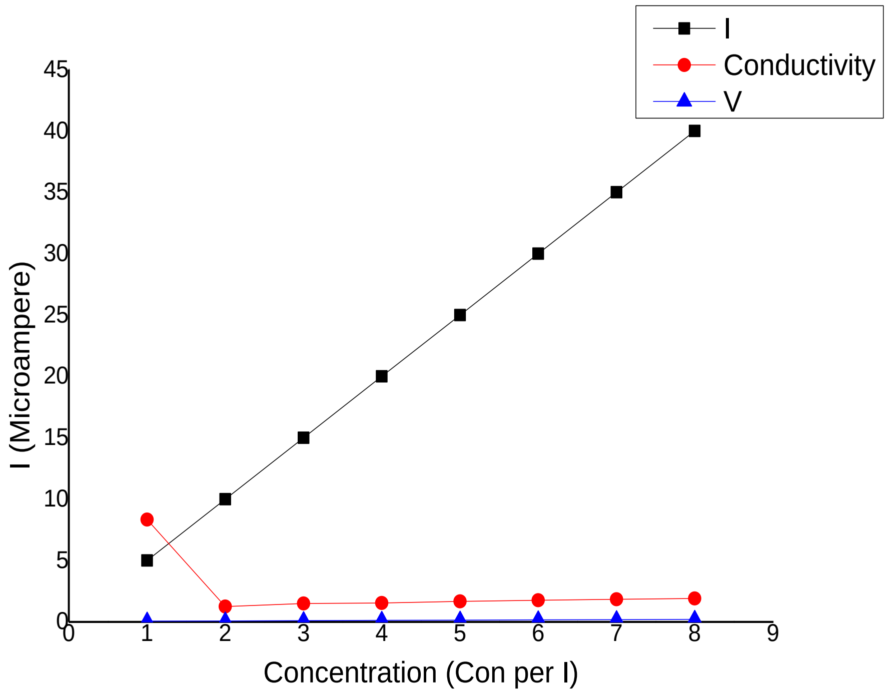


Figure (5.27) :Relation between conductivity and volt current(ionization) forfenugreek in glass after 15min

Table (5.28) :Relation between conductivity and volt current (ionization) forfenugreek in glass after 24hour

Concentration(cc)	I(µ A)	Conductivity(µS)	V(volt)
1	5	1.563	.32
2	10	1.667	.60
3	15	1.744	.86
4	20	2.128	.94
5	25	2.5	1
6	30	2.5	1.2
7	35	3.302	1.06
8	40	3.636	1.1

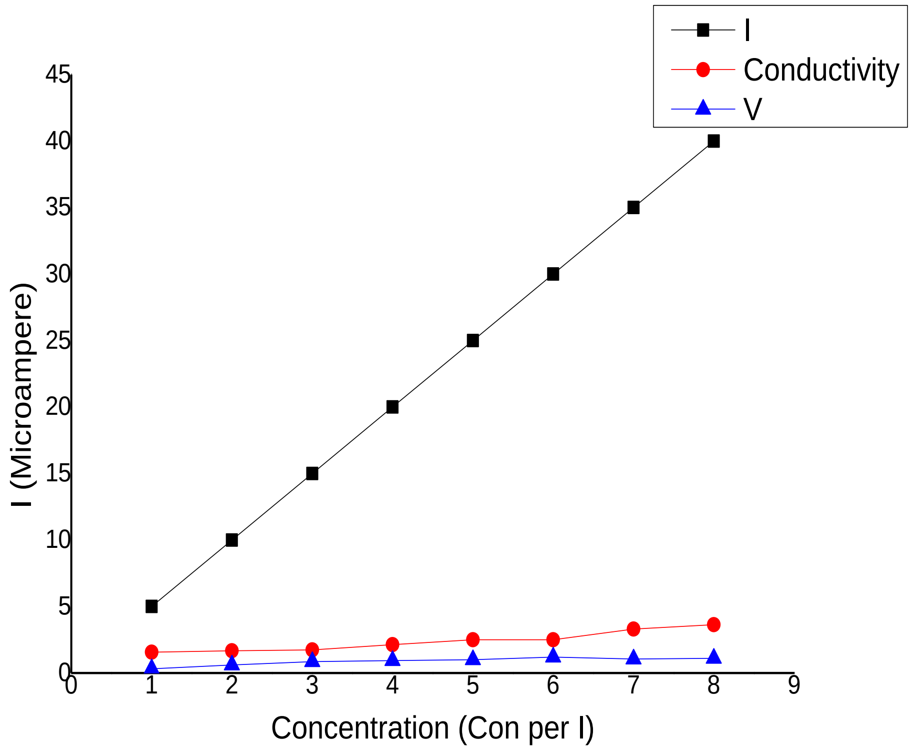


Figure (5.28) :Relation between conductivity and volt current (ionization) for in fenugreekglass after 24hour

Table (5.29): Relation between conductivity and volt current (ionization) for infenugreek plastic after 0min

Concentration(cc)	I(μ A)	Conductivity(μS)	V(volt)
1	5	6.25	.08
2	10	7.143	.14
3	15	7.5	.2
4	20	5.263	.38
5	25	7.353	.34
6	30	7.5	.40
7	35	8.333	.42
8	40	8.696	.46

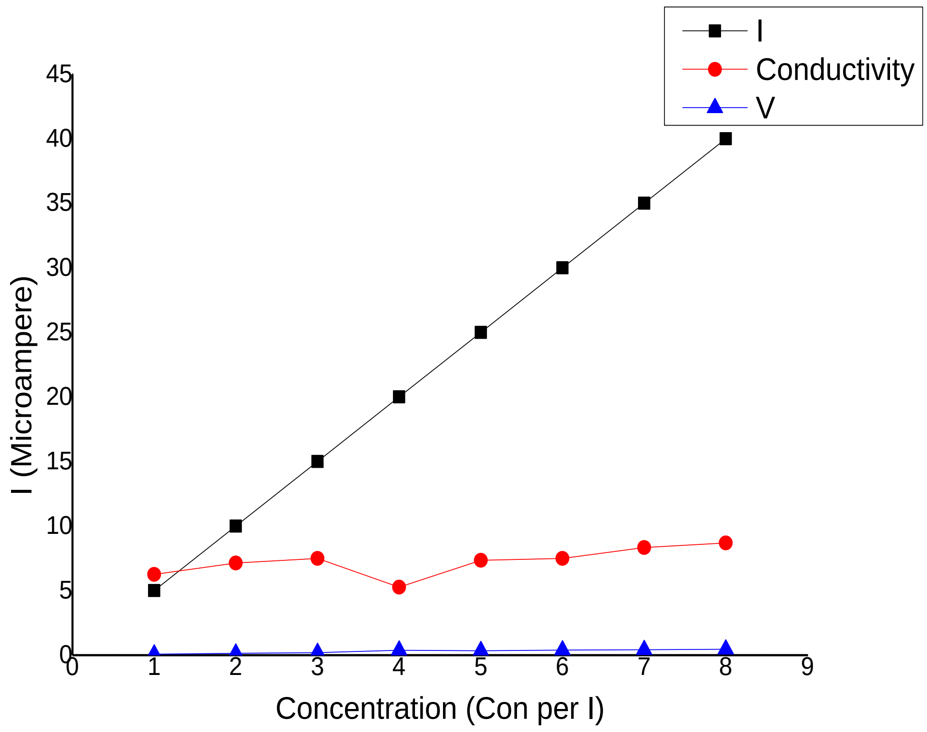


Figure (5.29): Relation between conductivity and volt current (ionization) for infenugreek plastic after 0min

Table (5.30) :Relation between conductivity and volt current(ionization) for fenugreek in plastic after 15min

Concentration(cc)	I(µ A)	Conductivity(µS)	V(volt)
1	5	1	.05
2	10	8.333	.12
3	15	8.824	.17
4	20	9.091	.22
5	25	8.621	.29
6	30	8.824	.34
7	35	9.211	.38
8	40	9.302	.43

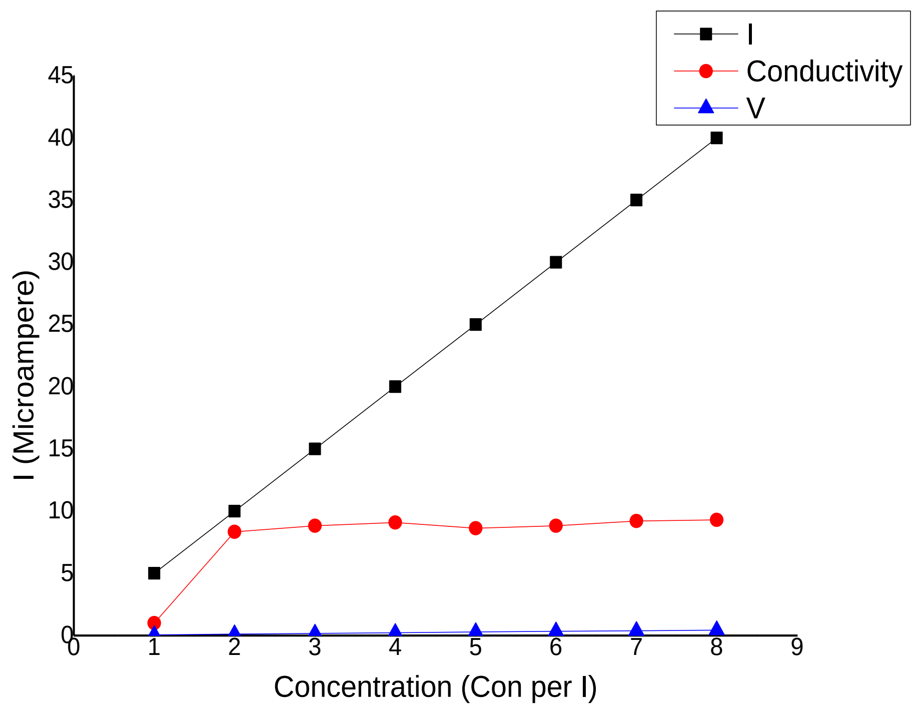


Figure (5.30) :Relation between conductivity and volt current(ionization) for fenugreek in plastic after 15min

Table (5.31) :Relation between conductivity and volt current (ionization) for fenugreek in pride

Concentration(cc)	I(μ A)	Conductivity(μS)	V(volt)
1	5	6.25	.08
2	10	7.143	.14
3	15	7.895	.19
4	20	8	.25
5	25	8.333	.30
6	30	8.824	.34
7	35	9.211	.38
8	40	9.524	.42

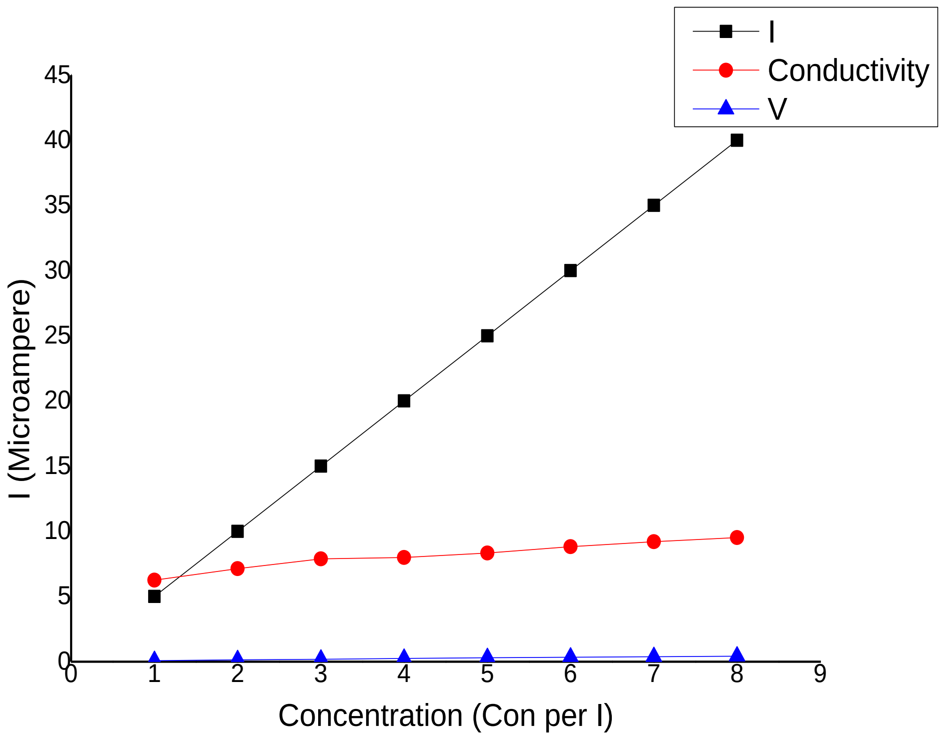


Figure (5.31):Relation between conductivity and volt current (ionization) for fenugreek in pride

5.2.2 Results Of ph

Table (5.32) :Relation between Concentration and Ph for mint in glass 15 min

Concentration(cc)	PH
1	7.38
2	7.30
3	7.19
4	7.17
5	7.12
6	7.03
7	7.02
8	6.99
9	6.95
10	6.95

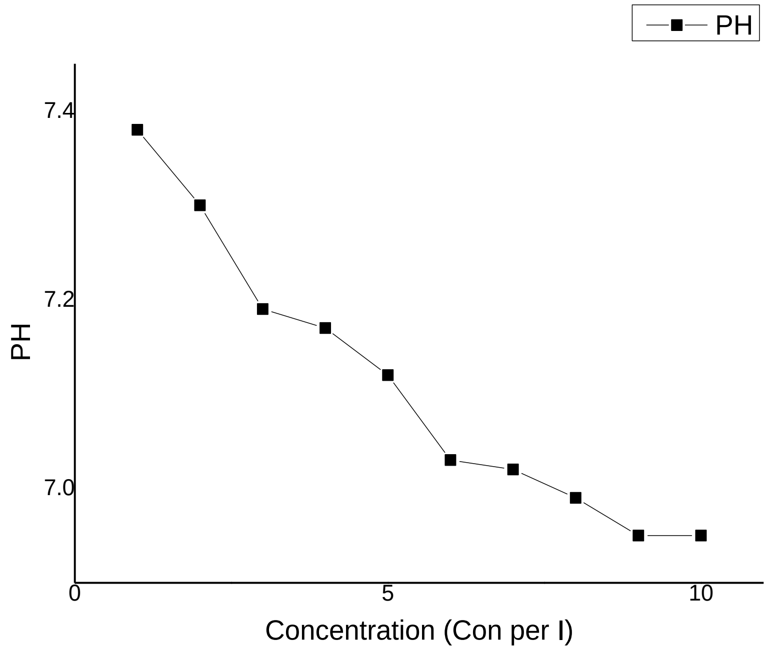


Figure (5.32) :Relation between Concentration and Ph for mint in glass 15 min

Table (5.33): Relation between Concentration and Ph for mint in glass 30 min

Concentration(cc)	PH
1	7.25
2	7.24
3	7.17
4	7.15
5	7.10
6	7.09
7	7.06
8	7.03
9	6.99
10	6.96

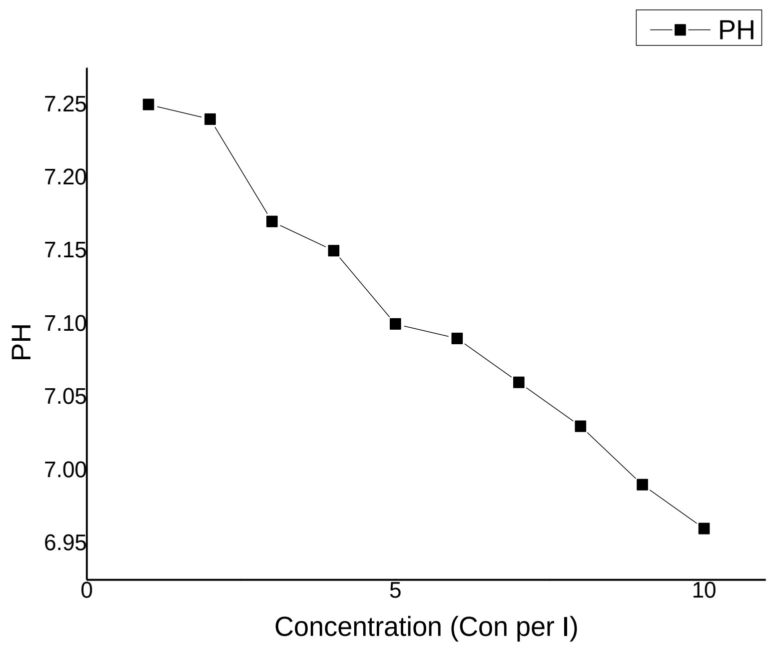


Figure (5.33): Relation between Concentration and Ph for mint in glass 30 min

Table (5.34) :Relation between Concentration and Ph for mint in glass 45 min

Concentration(cc)	PH
1	7.14
2	7.26
3	7.20
4	7.20
5	7.15
6	7.12
7	7.10
8	7.04
9	7.03
10	7.00

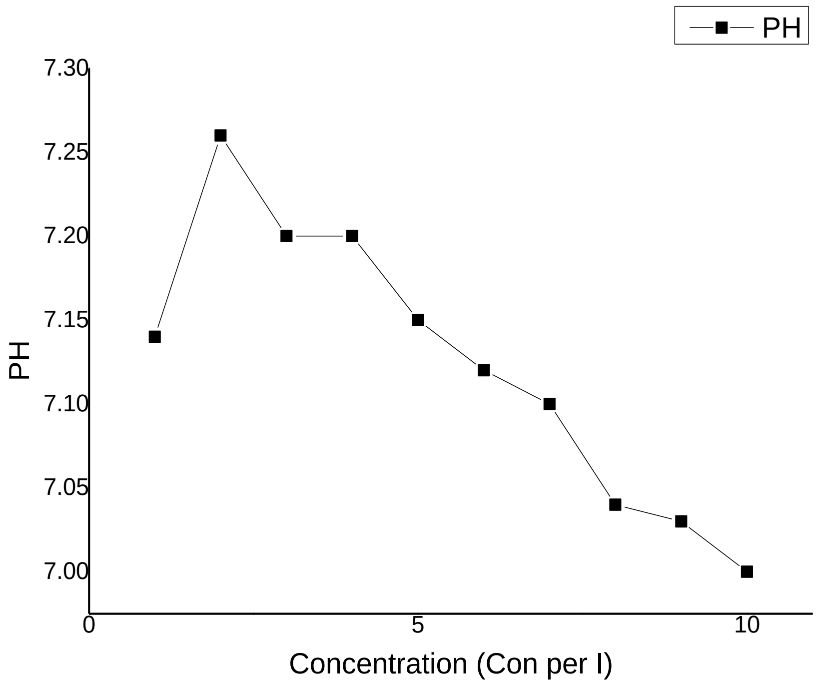


Figure (5.34) :Relation between Concentration and Ph for mint in glass 45 min

Table (5.35) :Relation between Concentration and Ph for ginger in glass 15 min

Concentration(cc)	PH
1	7.49
2	7.58
3	7.64
4	7.68
5	7.72
6	7.74
7	7.73
8	7.72
9	7.80
10	7.76

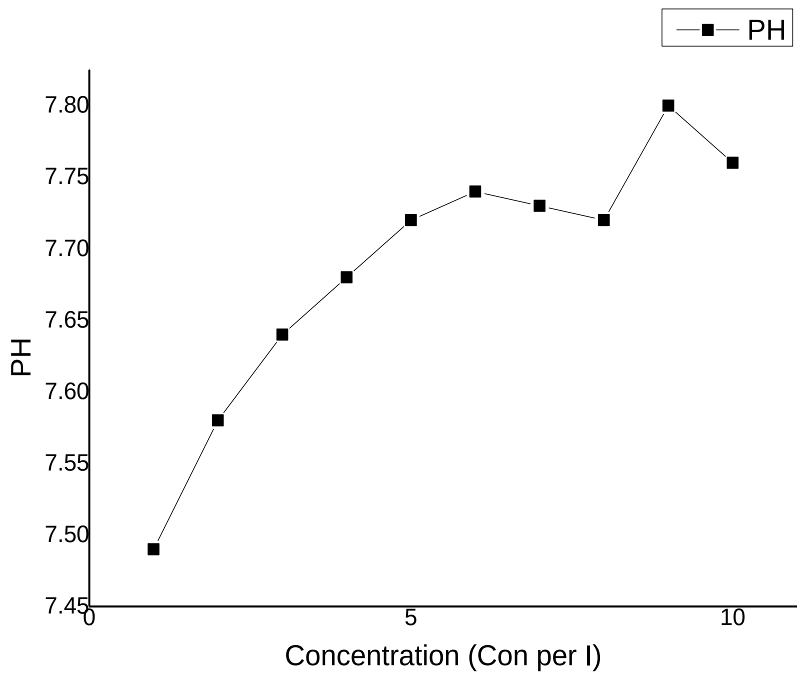


Figure (5.35) :Relation between Concentration and Ph for ginger in glass 15 min

Table (5.36) :Relation between Concentration and Ph for ginger in glass 30 min

Concentration(cc)	PH
1	7.85
2	7.85
3	7.85
4	7.80
5	7.82
6	7.81
7	7.79
8	7.79
9	7.78
10	7.80

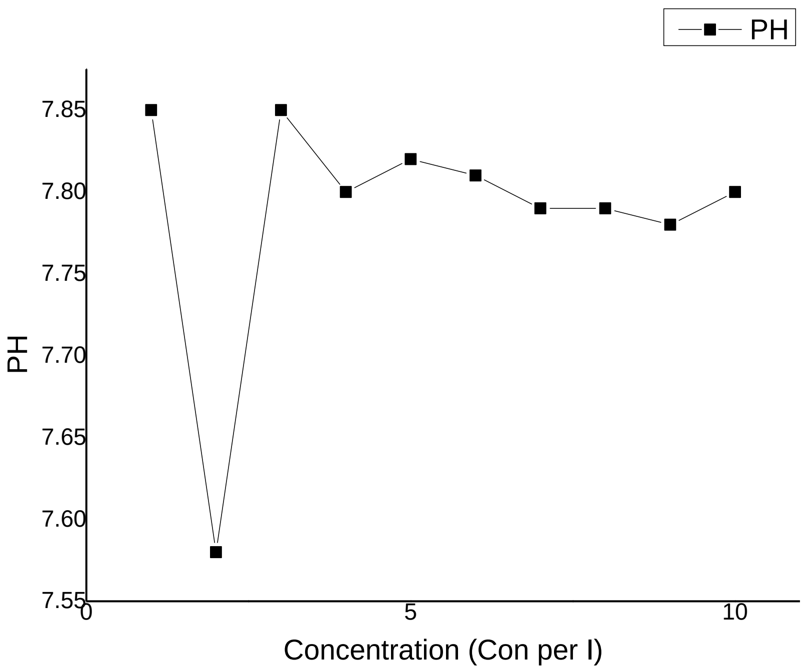


Figure (5.36) :Relation between Concentration and Ph for ginger in glass 30 min

Table (5.37) :Relation between Concentration and Ph for ginger in glass 45 min

Concentration(cc)	PH
1	7.81
2	7.86
3	7.80
4	7.78
5	7.78
6	7.78
7	7.76
8	7.78
9	7.78
10	7.78

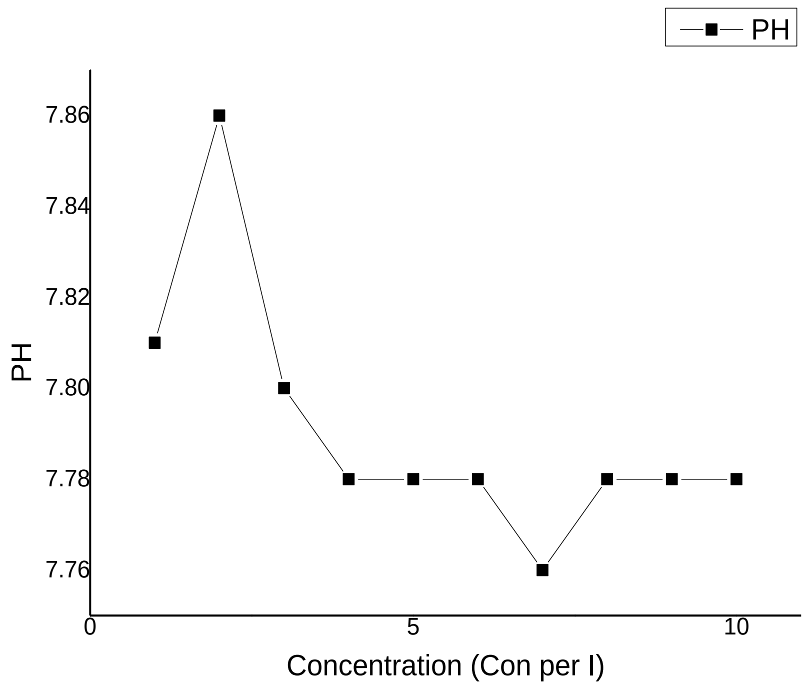


Figure (5.37) :Relation between Concentration and Ph for ginger in glass 45 min

Table (5.38) :Relation between Concentration and Ph for fenugreek in glass 15 min

Concentration(cc)	PH
1	7.28
2	7.27
3	7.27
4	7.25
5	7.23
6	7.19
7	7.19
8	7.19
9	7.13
10	7.12

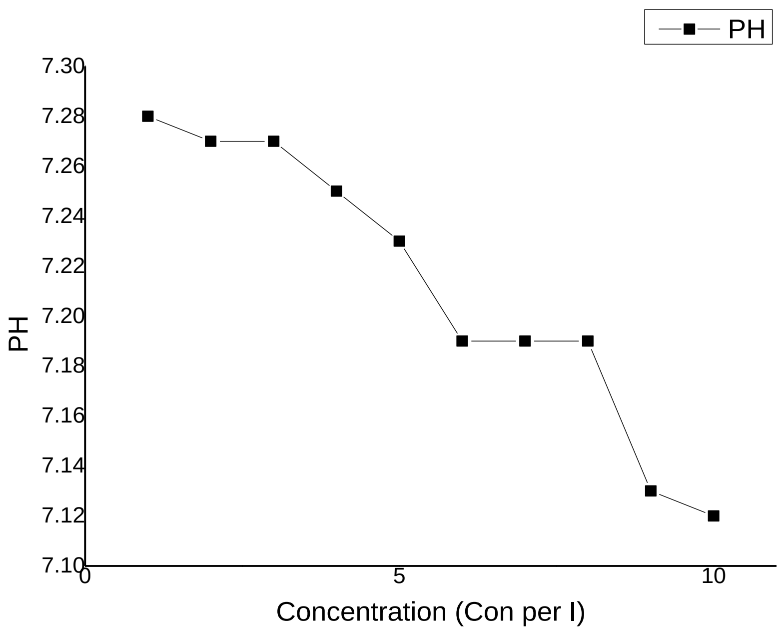


Figure (5.38) :Relation between Concentration and Ph for fenugreek in glass 15 min

Table (5.39) :Relation between Concentration and Ph for fenugreek in glass 30 min

Concentration(cc)	PH
1	7.43
2	7.38
3	7.37
4	7.35
5	7.30
6	7.29
7	7.25
8	7.23
9	7.19
10	7.16

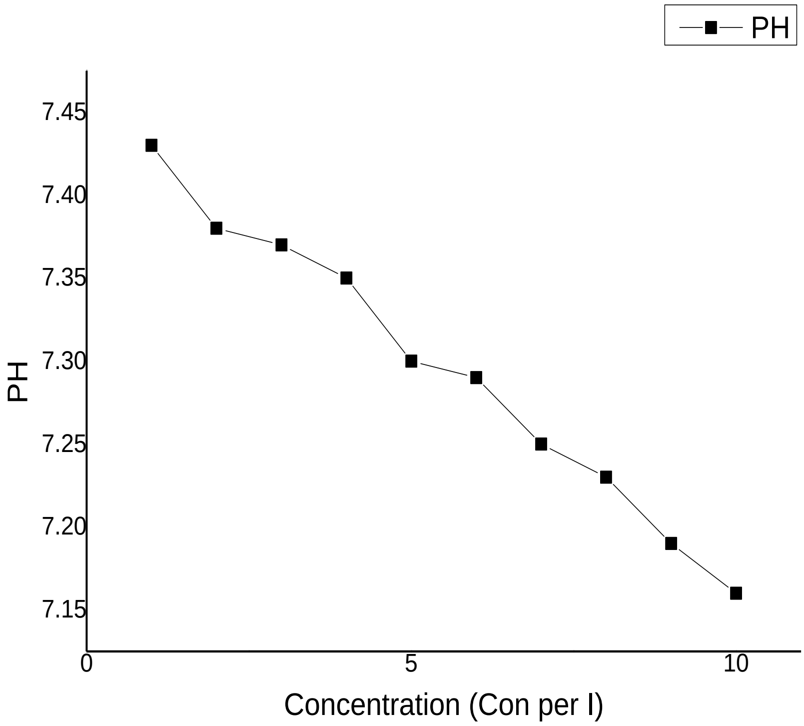


Figure (5.39) :Relation between Concentration and Ph for fenugreek in glass 30 min

Table (5.40) :Relation between Concentration and Ph for fenugreek in glass 45 min

Concentration(cc)	PH
1	7.21
2	7.42
3	7.42
4	7.37
5	7.34
6	7.29
7	7.27
8	7.19
9	7.11
10	7.17

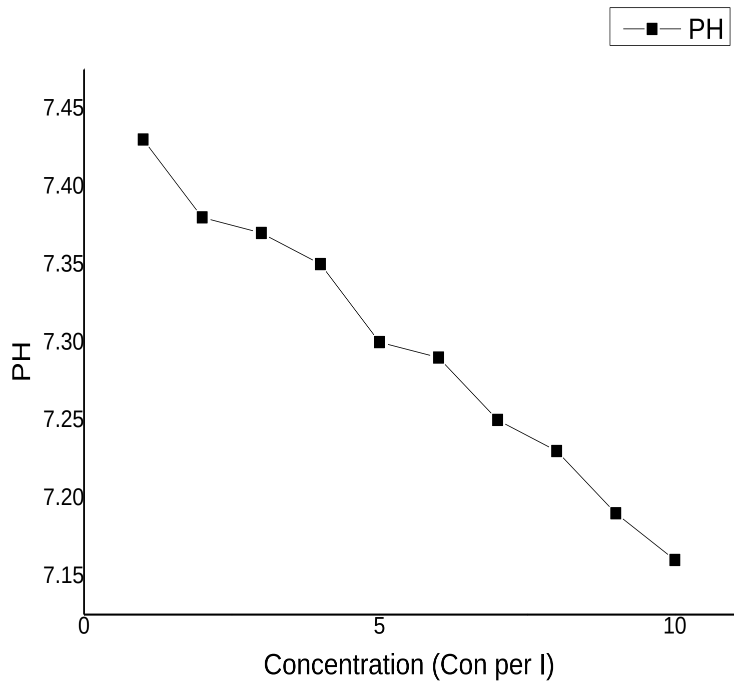


Figure (5.40) :Relation between Concentration and Ph for fenugreek in glass 45 min

Table (5.41): Relation between Concentration and Ph for cinnom in glass 15 min

Concentration(cc)	PH
1	7.24
2	7.32
3	7.27
4	7.20
5	7.19
6	7.17
7	7.23
8	7.21
9	7.25
10	7.22

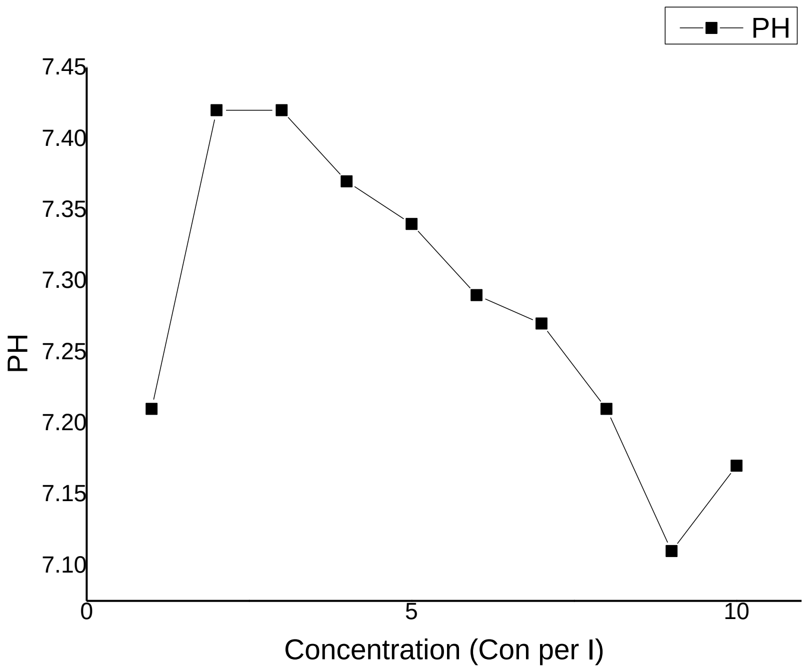


Figure (5.41): Relation between Concentration and Ph for cinnom in glass 15 min

Table (5.42) :Relation between Concentration and Ph for cinnom in glass 30 min

Concentration(cc)	PH
1	7.39
2	7.35
3	7.33
4	7.31
5	7.29
6	7.28
7	7.24
8	7.21
9	7.17
10	7.15

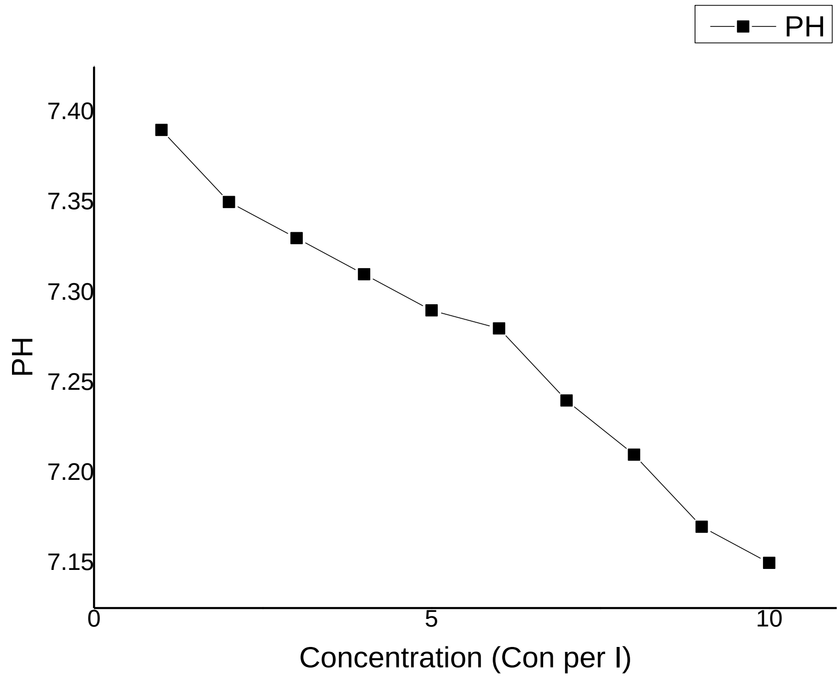


Figure (5.42) :Relation between Concentration and Ph for cinnom in glass 30 min

Table (5.43) :Relation between Concentration and Ph for cinnom in glass 45 min

Concentration $_{cm}$	PH
1	7.46
2	7.42
3	7.36
4	7.33
5	7.34
6	7.31
7	7.27
8	7.26
9	7.24
10	7.23

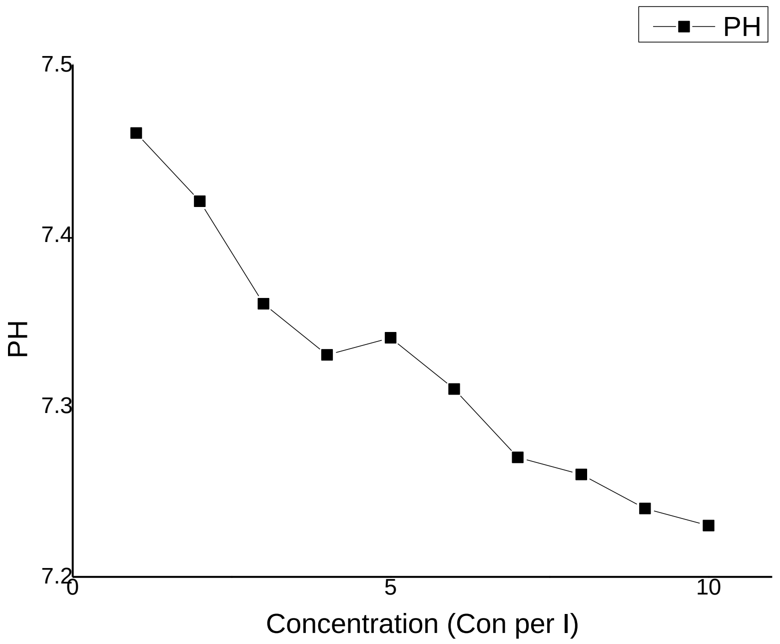


Figure (5.43) :Relation between Concentration and Ph for cinnom in glass 45 min

Table (5.44): Relation between Concentration and Ph for lemon in glass 15 min

Concentration(cc)	PH
1	4.09
2	3.35
3	3.15
4	3.03
5	2.98
6	2.90
7	2.85
8	2.83
9	2.81
10	2.77

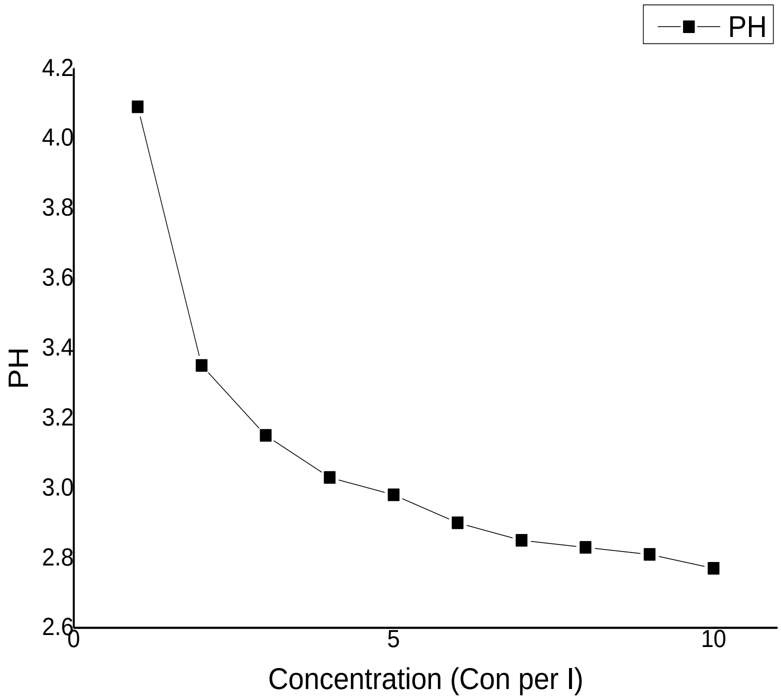


Figure (5.44): Relation between Concentration and Ph for lemon in glass 15 min

Table (5.45): Relation between Concentration and Ph for lemon in glass 30 min

Concentration $_{cm}$	PH
1	3.90
2	3.30
3	3.12
4	3.00
5	2.94
6	2.87
7	2.84
8	2.80
9	2.78
10	2.73

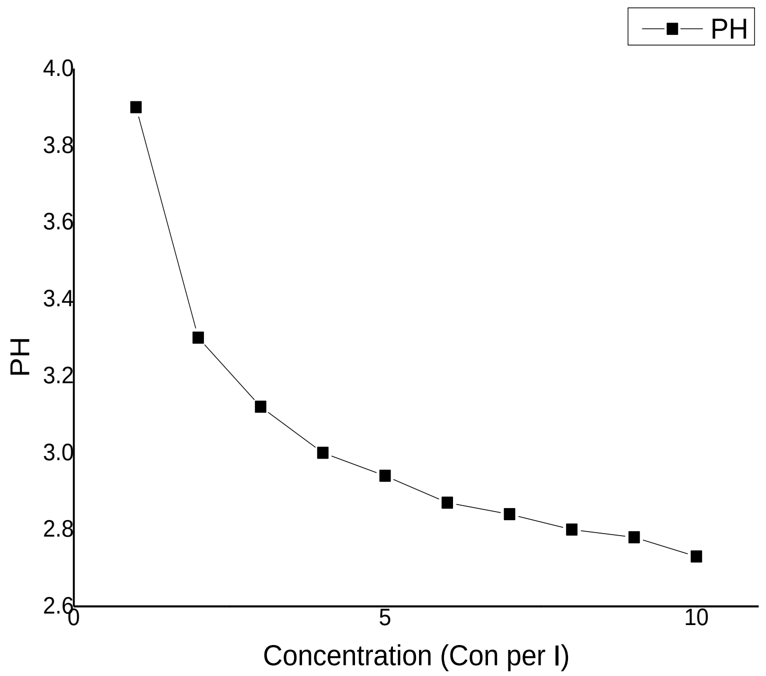


Figure (5.45): Relation between Concentration and Ph for lemon in glass 30 min

Table (5.46) :Relation between Concentration and Ph for lemon in glass 45 min

Concentration $_{cm}$	PH
1	3.90
2	3.29
3	3.08
4	2.95
5	2.89
6	2.83
7	2.83
8	2.77
9	2.74
10	2.70

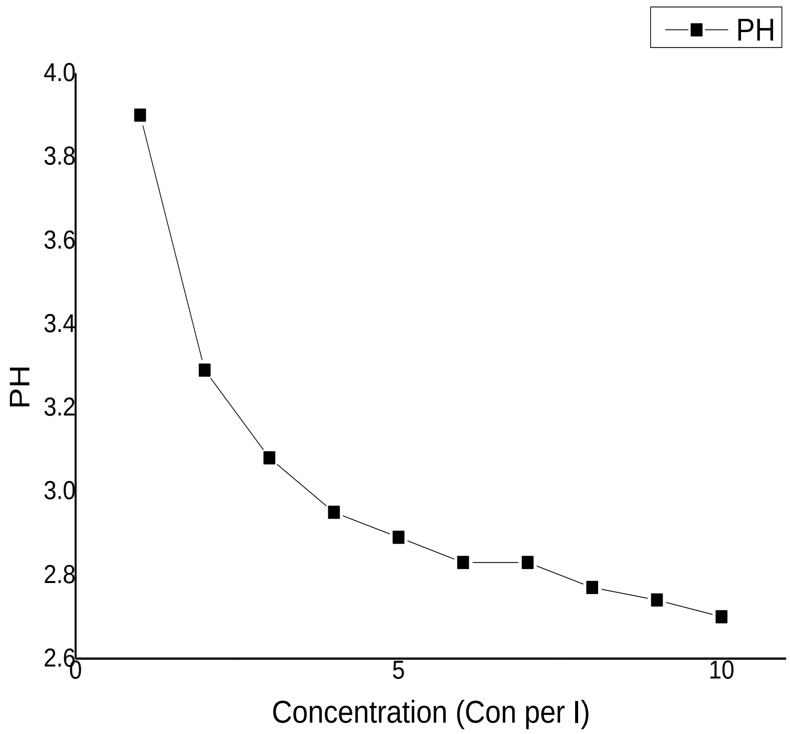


Figure (5.46) :Relation between Concentration and Ph for lemon in glass 45 min

Table (5.47) :Change of water Ph for different container with time

sample	T_1=10min	T_2=20min	T_3=30min	T_4=40min	T_5=60min
pride	5.75	6.28	6.09	6.41	7.17
glass	5.69	5.92	5.86	6.05	6.04
plastic	5.67	5.82	5.80	5.99	5.99
steel	5.68	5.82	5.95	5.99	6.02

5.2.3 Results Of UV

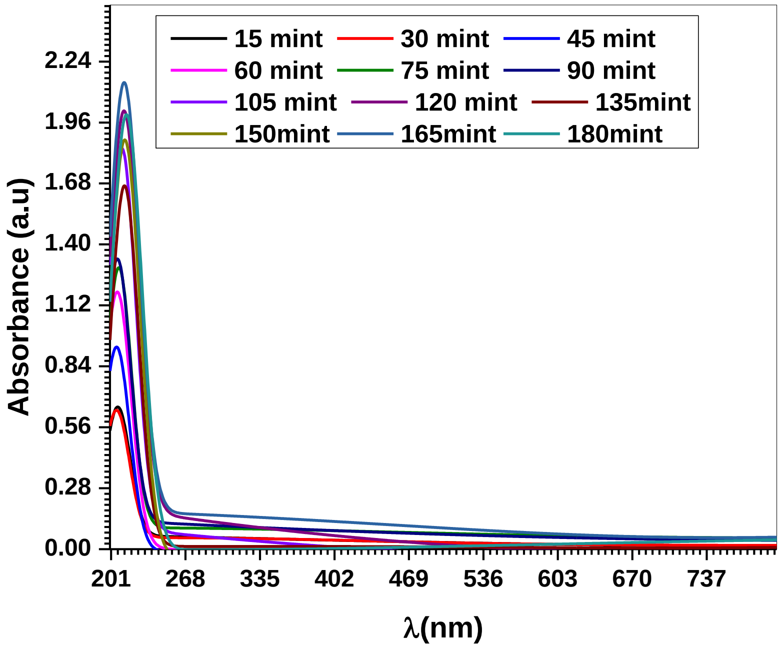


Figure (5.48):The absorbance of water in pride with different time

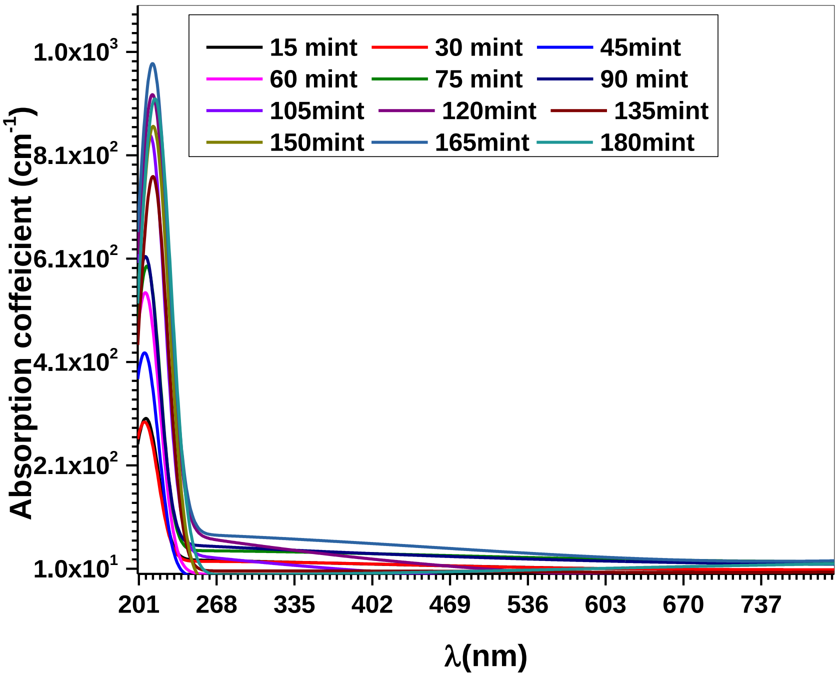


Figure (5.49): The absorption coefficient of water in pride with different time

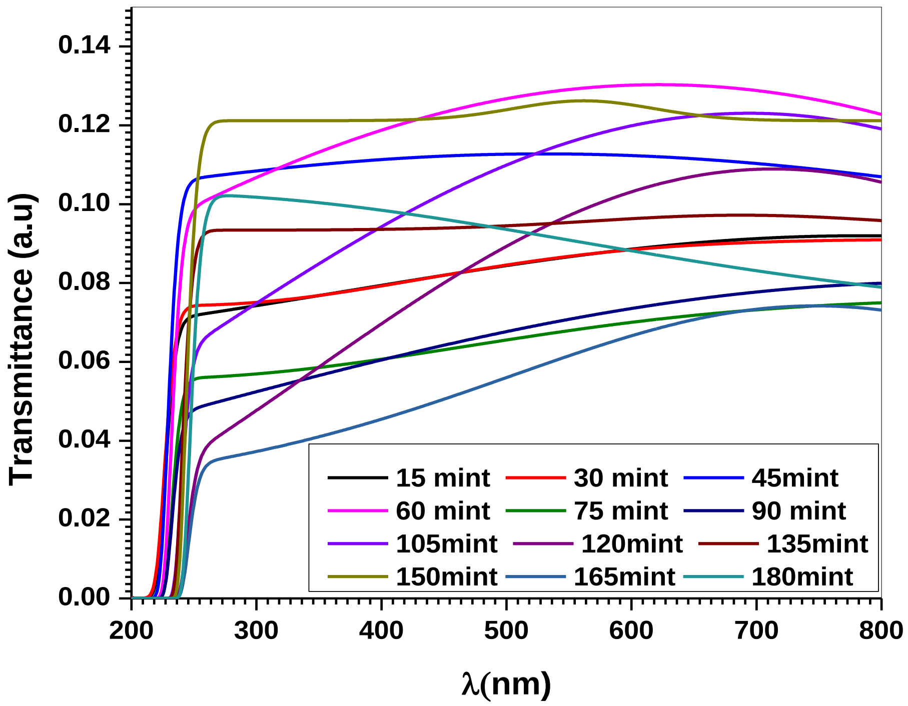
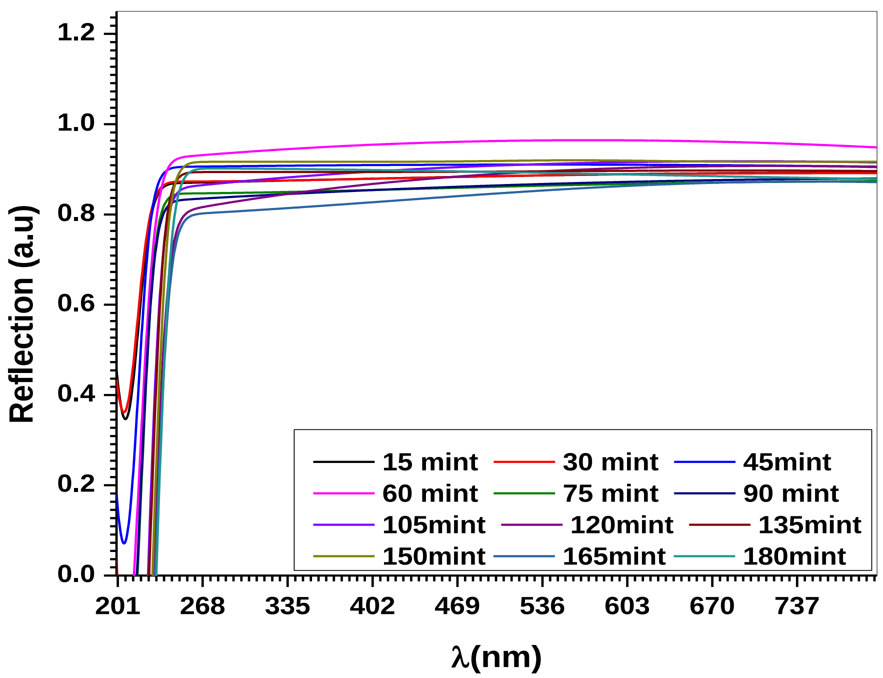


Figure (5.50): The transmittance of water in pride with different time



Figure(5.51):The reflection of water in pride with different time

5.3 Discussion

The PH and ionization degree of water when one added mint, ginger , lemon, cinnom, and fenugreek to water then put them in glass, steel, pride and sometimes copper containers were studied . The changes of water PH and ionization degree with time when the water was put in glass, steel and pride were also studied. The change of UV absorption coefficient of water in pride with time was also studied.

Figures(5.3),(5.4),…and (5.10) which determine the change of mint water conductivity and ionization degree when the containers are glass, steel ,plastic and pride shows that the conductivity become almost constant when the mint concentration increases, then waiting for 15,30 and 45 minutes. For steel the conductivity shows gentle increase. The ionization degree was measured using ammeter (in µA) and voltmeter (in volts). The reading of current shows considerable increase in the ionization degree, while the voltage almost remain constant. This may be attributed to the fact that the current scale which is in µA is very sensitive to measure any ionization change. The voltage scale which is in volts are very large to detect any small changes in the range of µvolt. The current reading shows considerable increase of ionization upon increasing mint concentration. This is quite obvious, as for as mint consists of ionized elements that dissolve themselves in water.

When ginger was put in glass for 0,15,30 and 45 minutes the conductivity increases then decreases gently then become constant . The ionization degree increases considerably as observed by µA ammeter see figures (5.11),(5.12),(5.13) and (5.14).

For lemon in glass conductivity decrease then become almost constant. However for copper and steel the conductivity become almost constant, while the ionization degree increases upon increasing lemon concentration.

However for cinnom the situation is slight a bit different. The glass container shows almost constant conductivity, while steel container shows increase of conductivity with concentration. For plastic the conductivity decrease then become constant, where for pride it increase then decrease then remain almost constant.

The fenugreek results for conductivity in glass shows constant conductivity ,but in pride it become constant then it increases ,or vice versa. For plastic it decreases then become almost constant.

Unlike water with food supplements which may be ionized by elements, the PH reflects only water ionization. All PH tests were made in a glass container. For lemon ,mint and cinnom the measurements of PH immediately after pouring water or after 15,and 30 minutes shows decrease of PH upon increasing their concentrations .

However ginger PH increases with concentration. This means that all tested supplements except ginger decreases water ionization.

A final tests were done using UV and PH meter for the evolution of absorption coefficient and water ionization with time when water was poured or put in pride, glass, steel and plastic containers.

The UV result which was examined for pride only show increase of absorption coefficient with time taken by water inside the pride.

The PH tests shows that the PH increases considerably about 5to about 7 within about 60 min.

The PH in steel and glass changes slowly during 50 min water stay time .For plastic the PH almost remain constant

5.4 Conclusion:

The PH, conductivity, and ionization tests for mint, ginger, lemon, cinnom, and fenugreek when poured in pride, steel, glass and plastic containers, shows very interesting properties. It shows that the conductivity remains almost constant, while the ionization degree increases upon increasing the concentration. The constancy of conductivity may be related to fact that the conductivity device is not sensitive to very small changes.

The change of water PH and absorption when put inside pride , steel, glass and plastic shows that the pride increases water PH and absorption coefficient considerably. Other containers water PH does not change appreciably

5.5Future work and out look

1- PH , conductivity and ionization tests can be extended to other food supplements
2- The reason why some food supplements decreases PH and why others increase it needs deeper studies
3- Other physical changes like viscosity ,mobility ,energy gap, bond strength need to be investigated
4- The effect of radiation types on the water physical properties.

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