DETERMINATION OF IRON CONTENT IN PORTULACA, DATES AND GREWIA

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ABSTRACT

In this investigation three Sudanese plants products were studied with the aim of determining the iron content in each, since these products were used by natives as rich sources of iron content. The three plant products were: portulaca, commonly known as Riglah; grewia, commonly known as godaim and dates which are commonly known as Balah (Barakawi).

The technique employed in this investigation was atomic absorption spectrometry. A striking feature of the data obtained is that the amount of iron present in them is dramatically different although the general and wide spread belief is that they are all very rich in this element. Thus the amount of iron found in portulaca was 100 mg/kg, in dates was 20 mg/kg and only 10 mg/kg in grewia.

Although other plant products may have iron in varying amounts, but this choice for the present investigation is mainly due to the native belief that these are the three popular iron rich products.

It can be concluded that scientific methods of determining the actual amounts of a particular element needed by human body for healthy growth can only be provided through this path way. A detailed discussion is provided for farther detailed.

Keywords: *Grewia = Grewia tenax , Dates = Balah (Barakawi) , Portulaca = Portulaca oleracea*.

1. INTRODUCTION

1.1. Iron

Iron is a chemical element with the symbol Fe (Latin: ferrum) and atomic number 26. It is a metal in the first transition series. It is the most common element in the whole planet Earth, forming much of Earth's outer and inner core, and it is the fourth most common element in the Earth's crust. It is produced in abundance as a result of fusion in high-mass stars. Like other Group 8 elements, iron exists in a wide range of oxidation states, −2 to + 6, although +2 and +3 are the most common. Elemental iron occurs in meteoroids and other low oxygen environments, but is reactive to oxygen and water. Fresh iron surfaces appear lustrous silvery-gray, but oxidize in normal air to give iron oxides, also known as rust. Unlike many other metals which form passivating oxide layers, iron oxides occupy more volume than iron metal.

Iron plays an important role in biology, forming complexes with molecular oxygen in hemoglobin and myoglobin ; these two compounds are common oxygen transport proteins in vertebrates. Iron is also the metal used at the active site of many important redox enzymes dealing with cellular respiration and oxidation and reduction in plants and animals. Iron is of greatest importance when mixed with certain other metals and with carbon to form steels. There are many types of steels, all with different properties, and an understanding of the properties of the allotropes of iron is key to the manufacture of good quality steels.

Alpha-iron, also known as ferrite, is the most stable form of iron at normal temperatures. It is a fairly soft metal that can dissolve only a small concentration of carbon (no more than 0.021% by mass at 910 °C).[1]

The melting point of iron is experimentally well constrained for pressures up to approximately 50 GPa. For higher pressures, different studies placed the γ-ε-liquid triple point at pressures differing by tens of gigapascals and yielded differences of more than 1000 K for the melting point.[2]

1.2. Isotopes

Naturally occurring iron consists of four stable isotopes: 5.845% of 54Fe, 91.754% of 56Fe, 2.119% of 57Fe and 0.282% of 58Fe. The nuclide 54Fe is predicted to undergo double beta decay, but this process had never been observed experimentally for these nuclei, and only the lower limit on the half-life was established: t1/2>3.1×1022 years. 60Fe is an extinct radionuclide of long half-life (2.6 million years).[3]

1.3. Uptake and storage

In cells, iron storage is carefully regulated; "free" iron ions do not exist as such. A major component of this regulation is the protein transferrin, which binds iron ions absorbed from the duodenum and carries it in the blood to cells.[4]

In animals, plants, and fungi, iron is often the metal ion incorporated into the heme complex. Heme is an essential component of cytochrome proteins, which mediate redox reactions, and of oxygen carrier proteins such as hemoglobin, myoglobin, and leghemoglobin. Inorganic iron also contributes to redox reactions in the iron-sulfur clusters of many enzymes, such as nitrogenase (involved in the synthesis of ammonia from nitrogen and hydrogen) and hydrogenase. Non-heme iron proteins include the enzymes methane monooxygenase (oxidizes methane to methanol), ribonucleotide reductase (reduces ribose to deoxyribose; DNA biosynthesis), hemerythrins (oxygen transport and fixation in Marine invertebrates) and purple acid phosphatase (hydrolysis of phosphate esters).
Iron distribution is heavily regulated in mammals, partly because iron ions have a high potential for biological toxicity.[5] .

1.4. Biological role

Iron is abundant in biology. Iron-proteins are found in all living organisms, ranging from the evolutionarily primitive archaea to humans. The color of blood is due to the moglobin, an iron-containing protein. As illustrated by hemoglobin, iron often is bound to cofactors, e.g. in hemes. The iron-sulfur clusters are pervasive and include nitrogenase, the enzymes responsible for biological nitrogen fixation.
Iron is a necessary trace element found in nearly all living organisms. Iron-containing enzymes and proteins, often containing heme prosthetic groups, participate in many biological oxidations and in transport. Examples of proteins found in higher organisms include hemoglobin, cytochrome, and catalase.[6]

1.5. Bioinorganic compounds

The most famous bioinorganic compounds of iron are heme proteins: hemoglobin (Shown in Figure 1), myoglobin, and cytochrome P450. These compounds can transport gases, build enzymes ,and be used in transferring electrons. Metalloproteins are a group of proteins with metal ion cofactors. Some examples of iron metalloproteins are ferritin and rubredoxin. Many enzymes vital to life contain iron, such as catalase and lipoxygenases.

1.6. Health and diet

Iron is pervasive, but particularly rich sources of dietary iron include red meat, lentils, beans, poultry, fish, leaf vegetables, tofu, chickpeas, black-eyed peas, blackstrap molasses, fortified bread, and fortified breakfast cereals. Iron in low amounts is found in molasses, teff and farina. Iron in meat (heme iron) is more easily absorbed than iron in vegetables.[5]. Although most studies suggest that heme/hemoglobin from red meat has effects which may increase the likelihood of colorectal cancer, there is still some controversy, and even a few studies suggesting that there is not enough evidence to support such claims.
Iron provided by dietary supplements is often found as iron(II) fumarate, although iron sulfate is cheaper and is absorbed equally well. Elemental iron, or reduced iron, despite being absorbed at only one third to two thirds the efficiency (relative to iron sulfate),[7] is often added to foods such as breakfast cereals or enriched wheat flour. Iron is most available to the body when chelated to amino acids.[8] and is also available for use as a common iron supplement. Often the amino acid chosen for this purpose is the cheapest and most common amino acid, glycine, leading to "iron glycinate" supplements.[9] The Recommended Dietary Allowance (RDA) for iron varies considerably based on age, gender, and source of dietary iron.[10]

1.7. Regulation of uptake

Iron uptake is tightly regulated by the human body, which has no regulated physiological means of excreting iron. Only small amounts of iron are lost daily due to mucosal and skin epithelial cell sloughing, so control of iron levels is mostly by regulating uptake.[11] Regulation of iron uptake is impaired in some people as a result of a genetic defect that maps to the HLA-H gene region on chromosome 6. In these people, excessive iron intake can result in iron overload disorders, such as hemochromatosis. Many people have a genetic susceptibility to iron overload without realizing it or being aware of a family history of the problem. For this reason, it is advised that people do not take iron supplements unless they suffer from iron_deficiency and have consulted a doctor. Hemochromatosis is estimated to cause disease in between 0.3 and 0.8% of
Caucasia [12]
Quite a wide variety of food taken by human beings is rich in iron such all sorts of meat and many plants and fruits. There are many types of plant products which enhance the absorption of iron by human body such as orange, grapefruit and many others as absorption inhibiter such as coffee and tea.
The iron content varies quite a great deal from iron sources to another .e g, beef generates about 100 calories per one gram, and lamb generates about 74 calories per gm of meat.

1.8. Portulaca

Portulaca is the type genus of the flowering plant family Portulacaceae, comprising about 40-100 species found in the tropics and warm temperate regions. They are also sometimes known as Rose Moss or more commonly Moss Roses. (Shown in Figure 2).

Common Portulaca is widely considered an edible plant, and in some areas an invasive type of weed. Some *Portulaca* species are used as food plants by the larvae of some Lepidoptera species including the Nutmeg .

Portulaca can be eaten raw or cooked, and lends itself to stir fry dishes. Some say it has a slight lemon-like taste and mushroom-like texture. It is relatively easy to grow in more northern climates, including the New England area in the United States.

1.8.1. Iron in Portulaca

Ali I. Mohamed and Ahmed S. Hussein studied the Chemical composition of portulaca at different stages of the plant age. They stated that Iron content varied significantly among growth stages, and roots and leaves had the highest Fe content (121.47 and 33.21 mg, respectively).[13]

1.9. DATES

The fruit is known as a date. The fruit's English name, as well as the Latin species name dactylifera, both come from the Greek word for "finger", because of the fruit's elongated shape. Dates are oval-cylindrical, 3–7 cm long, and 2–3 cm diameter, and when unripe, range from bright red to bright yellow in colour, depending on variety. Dates contain a single seed about 2–2.5 cm long and 6–8 mm thick. Three main cultivar groups of date exist: soft (e.g. 'Barhee', 'Halawy', 'Khadrawy', 'Medjool'), semi-dry (e.g. 'Dayri', 'Deglet Noor', 'Zahidi'), and dry (e.g. 'Thoory'). The type of fruit depends on the glucose, fructose and sucrose content.

The date palm is dioecious, having separate male and female plants. They can be easily grown from seed, but only 50% of seedlings will be female and hence fruit bearing, and dates from seedling plants are often smaller and of poorer quality. Most commercial plantations thus use cuttings of heavily cropping cultivars, mainly 'Medjool' as this cultivar produces particularly high yields of large, sweet fruit. Plants grown from cuttings will fruit 2–3 years earlier than seedling plants.

Dates are naturally wind pollinated but in both traditional oasis horticulture and in the modern commercial orchards they are entirely pollinated manually. Natural pollination occurs with about an equal number of male and female plants. However, with assistance, one male can pollinate up to 100 females. Since the males are of value only as pollinators, this allows the growers to use their resources for many more fruit producing female plants. Some growers do not even maintain any male plants as male flowers become available at local markets at pollination time. Manual pollination is done by skilled labourers on ladders. In some areas such as Iraq the pollinator climbs the tree using a special climbing tool that wraps around the tree trunk and the climber's back to keep him attached to the trunk while climbing. Less often the pollen may be blown onto the female flowers by a wind machine

Fresh dates, clockwise from top right (Shown in Figure 3): crunchy, crunchy opened, soft out of skin, soft. Parthenocarpic cultivars are available but the seedless fruit is smaller and of lower quality.

Dates ripen in four stages, which are known throughout the world by their Arabic names kimri (unripe), khalal (full-size, crunchy), rutab (ripe, soft), tamr (ripe, sun-dried). A 100 gram portion of fresh dates is a source of vitamin Cand supplies 230 kcal (960 kJ) of energy. Since dates contain relatively little water, they do not become much more concentrated upon drying, although the vitamin C is lost in the process.

Dates are an important traditional crop in Turkey, Iraq, Arabia, and north Africa west to Morocco and are mentioned more than 50 times in the Bible. In Islamic countries, dates and yogurt or milk are a traditional first meal when the sun sets during Ramadan. Dates (especially Medjool and Deglet Noor) are also cultivated in southern California, Arizona and southern Florida in the United States.

Date palms can take 4 to 7 years after planting before they will bear fruit, and produce viable yields for commercial harvest between 7 to 10 years. Mature date palms can produce 80–120 kilograms (176–264 lb) of dates per harvest season, although they do not all ripen at the same time so several harvests are required. In order to get fruit of marketable quality, the bunches of dates must be thinned and bagged or covered before ripening so that the remaining fruits grow larger and are protected from weather and pests such as birds.

1.9.1. Iron in Dates

F.I.Obahiabon and J.O.Erhabor stated that dates contains iron up to 2.3 mg/100g [14]

1.10. Grewia tenax

Grewia tenax is a multistemmed shrub up to 2 m tall, usually rounded but generally battered and untidy due to browsing. Bark smooth, grey, very fibrous so that twigs are hard to break. Leaves alternate, almost circular in

outline, 1.5-4 cm in diameter, margins toothed and prominently tri-nerved at the base, often hairy, particularly beneath with star shaped hairs. Stipules inconspicuous, falling early. Flowers solitary or in pairs, axillarily placed, petals white, about 1 cm long; sepals long and recurved. Fruit orange-red at maturity (Shown in Figure 4), with 1-4 spheroid lobes. Grewia tembensis and Grewia tenax are virtually indistinguishable in fruit. The specific epithet refers to the plant's tenacious growth habit. The genus was named after Nehemiah Grew , one of the founders of plant physiology.

Grewia tenax is highly drought resistant and occurs in the driest savannas at desert margins and regions of higher rainfall, where it grows in thickets on termite mounds in otherwise seasonally flooded country. In the Sahel it grows in rocky places on hills and slopes, in regions with 100-600 mm of rain per annum.

Native : Algeria, Botswana, Chad, Djibouti, Ethiopia, Iran, Kenya, Mali, Mauritania, Morocco, Namibia, Niger, Nigeria, Saudi Arabia, Senegal, Somalia, South Africa, Sudan, Tanzania, Uganda, Zimbabwe Exotic : India, Pakistan

The fruits consumed by man and animals contain a large amount of iron and can be made into a refreshing drink. Fruit storage can be extended by drying. The dead leaves are eaten, but only while they remain on the plant. Fodder: Young leaves are consumed by livestock, they are slightly palatable at the end of dry seasons, and have fairly good feed value. Apiculture: Bees visit the flowers for pollen and nectar. Fuel: The branches are used as firewood, and can be used in charcoal making. Fibber: The bark is used to make ropes and for binding purposes in house construction. Timber: Grewia tenax wood is used in making weapons such as clubs, bows, arrows and for other general purposes. Poison: A mucilaginous bark preparation is used by women against hair vermin. Medicine: In Kenya plant parts are used as a remedy for colds and chest complaints and also as a chief constituent in a typhoid remedy.

1.10.1. Iron in Grewia tenax

G.O. Mohammed Elhassan and S.M.Yagy stated that Grewia tenax contains iron up to 20.8 mg/100 g . [15]

The aim of this study was to determine the iron content in Portulaca, Grewia and dates.

2. MATERIALS AND METHODS

2.1. Study Area

The study was conducted in Khartoum – Sudan. Origin of Portulaca was farms of Halfaya – Khartoum north. Dates origin was Addabbra – Northern State. Grewia tenax is mainly cultivated in Western Sudan , Kurdufan state.

2.2. Study Subjects

Subjects included Portulaca, dates and Grewia . only the plant fruit was used in dates and Grewia tenax. Regarding Portulaca, the whole plant was used.

2.3. Data Collection

Data were collected from merchants of Portulaca, dates and Grewia tenax in local markets in Khartoum.

2.4. Samples Collection and Preparation

The sample prepared for estimation of iron content were first dried in an oven set at 105c for constant weight. Thus portulaca , grewia tenax and dates were dried under the same conditions. Each sample was grounded in a mortar and made readly for the succeeding steps of the analysis.

2.5. Experimental Examination

Atomic absorption spectrophotometry Technique was performed.

2.5.1. Principle

Determination of iron content in portulaca,dates and rewia tenax was done using atomic absorption spectroscopy .The technique makes use of absorption spectrometry to assess the concentration of an analyte in a sample. It requires standards with known analyte content to establish the relation between the measured absorbance and the analyte concentration. In short, the electrons of the atoms in the atomizer can be promoted to higher orbitals (excited state) for a short period of time (nanoseconds) by absorbing a defined quantity of energy (radiation of a given wavelength). This amount of energy, i.e., wavelength, is specific to a particular electron transition in a particular element. In general, each wavelength corresponds to only one element, and the width of an absorption line is only of the order of a few picometers (pm), which gives the technique its elemental selectivity.

2.6. Method

From each of the three investigated sample 0.5 gms are accurately weighed in 250 mL beaker. Then , 25 mL of 6 M hydrochloric acid was added to each sample in the beaker , and boiled for about 30 min, till the volume of solution drops to about 5 mL .About 5 mL of hot water was added to each sample and boiled .The contents of each beaker were very carefully filtered into a calibrated 50 mL volumetric flasks and made to the volume by addition of deionized water. [16]

3. RESULT AND DISCUSSION

The general native belief that these three plant products are the only Fe rich source is now very clearly put forward before them. The actual content of iron in each , besides the other sources of iron eg meat, etc, are also known and thus compared with the finding presented in this investigation, plants and fruits which also contain substantial amount of iron are also known.

The knowledge of food constituents together with body need are of utmost relevance to the present investigation. Publish belief may by based on casual observation or a general remark made by someone but the scientific investigation helps very much in removing many cob-webs masking the truth.

The main aim of this work was to determine the iron content in Sudanese vegetable (portulaca) and fruits (grwia tenax and dates) .Oure results shows that The percentage of iron content in the three samples are involved in table(1). portulaca has ahigher content(100 mg/kg) compared to the other fruits dates(20 mg/kg) and grwia tenax (10 mg/kg) . similar results were obtained for Mohamed Al, Hussein who studied the iron content in portulaca (121.47 and 33.21 mg/kg for roots and leaves respectively) and F.I.Obahiabon and J.O.Erhabor stated that dates contains iron up to 23mg/kg and G.O.Mohammed Elhassan and S.M.Yagy stated that grewia tenax contains iron up to 208mg/kg

The different iron content which observed for different samples is due to the different climatic and soil types, which differ from country to others, climatic condition , particularly temperature and light intensity, have an especially strong effect on the nutritional quality of fruits and vegetables, also, the rootstock used for fruits and vegetables trees, mulching, irrigation, fertilization and other cultural practices influence the water and nutrient supply to the plants, which can affect the composition and quality attributes of the harvested plants parts.

Fruits and vegetables are important sources of nutrients and offer advantages over dietary supplements, because of low cost and wide availability. In daily diet fruits and vegetables have been strongly associated with reduced risk for iron deficient.

Iron is an important component of hemoglobin and intake of iron in human body from fruits and vegetables is very good to health.

4. CONCLUSION

1- It is now evident that iron as is explained in the introduction that it is needed for human body for healthy growth.

2- The iron content in plants, fruits and different type, of meat are clearly studied by the extensive research carried out for this purpose.

3- The iron content in portulaca, dates and grewia tenax is quite substantial that they are taken in different forms of preparations for the iron they content.

4- Knowledge as indicated by carrying out experiments through investigation helps very much in determining the actual amount, and there for direct public to the right product to be taken.

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5. FIGURES AND TABLES

Table 1: The Percentages of Iron in Portulaca, Dates and Grewia.

Sample	Amount of Iron in Sample (mg/kg)
Portulaca	100
Dates	20
Grewia	10

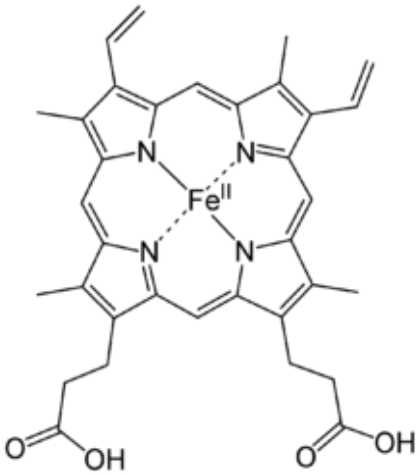

Figure 1: Structure of heme Adapted from: http://en.wikipedia.org/wiki/human_iron_metabolism

Figure 2: Portulaca Adapted from http://www.blog.halalcosmeticproducts.com

Figure 3:Dates Adapted from : http://en.wikipedia.org/wiki/File:Freshdates.JPG

Figure 4: Grewia-tenax Adabted from : www.hort.purdue.edu/.../figures/Grewia-tenax.jpg

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