

## Assessment of Iron Concentration in Legumes, Seeds and Meats in Wad-Medni Markets, Sudan

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### Abstract

Micronutrients are essential element needed in small amounts for adequate human nutrition and include the element iron. These mineral are essential to human should have an adequate supply of iron to prevent iron deficiency anemia. The present study is aiming to determination the concentration of iron in variety of foods using the atomic absorption spectrophotometric (AAS), colorimetric and spectrophotometric methods in Wad Medani, Gezira State, Sudan. All samples were collected from Wad Medani, City markets. The results of the samples of *Triticum*, *Setaria*, *Sorghum bicolor*, *Cicer arietinum*, *Vicafaba*, *Vignanmbellala*, Meat Ckicks, Beef, Sheep meat made by the AAs were, 1.97, 2.09, 2.00, 3.11, 2.98, 3.19, 2.12, 3.76, 3.15, respectively. The results of calorimetric method of *Triticum*, *Setaria*, *Sorghum bicolor*, *Cicer arietinum*, *Vicafaba*, *Vigna nmbellala*, Meat of Ckicks, Beef, and Sheep showed the following 2.01, 2.19, 2.07, 3.54, 3.43, 3.23, 2.78, 4.13, 3.22, respectively. The results of spectrophotometric method of *Triticum*, *Setaria*, *Sorghum bicolor*, *Cicer arietinum*, *Vicafaba*, *Vigna nmbellala*, Meats of Ckicks, Beef and Sheep gave, 1.88, 2.21, 1.90, 3.07, 3.33, 3.65, 2.70, 3.88, 3.17, respectively. The results also showed that legumes contain the highest concentration of iron followed by meats. However the iron concentration in fruits and vegetables is almost equal but less than the concentration in meats. The results also showed that seeds had the lowest concentrations of iron. On the other hand the results it was found that there was no significant difference between the three methods of analysis used, according to test of (One-way ANOVA) (( $P < 0,05$ )).

## INTRODUCTION

Many plants and plant parts are eaten as food and around 2,000 plant species are cultivated for food. Many of these plant species have several distinct [cultivars](#) (Hannaford, 2006). [Seeds](#) of plants are a good source of food for animals, including humans, because they contain the nutrients necessary for the plant's initial growth, including many healthful fats, such as [omega fats](#). In fact, the majority of foods consumed by human beings are seed based foods. Edible seeds include cereals ([corn](#), [wheat](#), [rice](#), [etc.](#)), [legumes](#) ([beans](#), [peas](#), [lentils](#), [etc.](#)) and [nuts](#). [Oilseeds](#) are often pressed to produce rich oils eg. [sunflower](#), [flaxseed](#), [rapeseed](#) (including [canola oil](#)), [sesame](#), and others (Howe and Devereux, 2004). Seeds are typically high in [unsaturated fats](#) and in moderation, are considered a [health food](#), although not all seeds are edible. Large seeds, such as those from [lemons](#), pose a choking hazard, while seeds from [cherries](#) and [apples](#) contain [cyanide](#), which could be poisonous only if consumed in large volumes (Humphery, 1998). [Fruits](#) are the ripened ovaries of plants, including the seeds within. Many plants and animals have [coevolved](#) such that the fruits of the former are an attractive food source to the latter, because animals that eat the fruits may [excrete](#) the seeds some distance away. Fruits, therefore, make up a significant part of the diets of most cultures. Some botanical fruits, such as [tomatoes](#), [pumpkins](#), and [egg plants](#), are eaten as vegetables (Jango, 2005). Animals are used as food either directly or indirectly by the products they produce. [Meat](#) is an example of a direct product taken from an animal, which comes from [muscle](#) systems or from [organs](#). Food products produced by animals include [milk](#) produced by [mammary glands](#), which in many cultures is drunk or processed into [dairy products](#). In addition, birds and other animals lay [eggs](#), which are often eaten, and [bees](#) produce [honey](#), and a reduced [nectar](#) from flowers, which is a popular sweetener in many cultures. Some cultures [consume blood](#), sometimes in the form of [blood sausage](#), as a thickener for sauces, or in a [cured](#), [salted](#) form for times of food scarcity, and others use [blood](#) in stews such as [jugged hare](#) (Kripke, 2007). Some cultures and people do not consume meat or animal food products for cultural, dietary, health, ethical, or ideological reasons. [Vegetarians](#) choose to forgo food from animal sources to varying degrees. [Vegans](#) do not consume any foods that are or contain [ingredients](#) from an animal source (Jurgens, 2001). Iron deficiency (anemia) has long been recognized and is still an important nutritional deficiency problem in the country, afflicting particularly the vulnerable groups (Tee, 1989). Thus there has always been an interest in identifying local foods rich in iron.

### Objectives:

- 1- To determine the concentration of iron in foods of seeds of many crops (*Solanum tuberosum*, *Daucus cartota subsp-sativs*, *Solanum melongena*, *Phoenix dactylifera*, *Malus domestica*, *Psidium guajava*, *Triticum*, *Setaria*, *Sorghum bicolor*, *Cicer arietinum*, *Vicia faba*, and *Vigna nmbellala*, as well as Meat cicks, Beef, Sheep meat) by three techniques:
  - Atomic absorption spectrophotometric
  - Calorimetric method
  - Spectrophotometric method
- 2- To compare the concentration of iron in foods by the three methods.

## MATERIALS AND METHODS

**Sample collection:**

Samples of seeds of Three cereal plants (*Sorghum bicolor*, *Setaria* sp. and *Triticum* sp.), three Legumes plants (*Vicia faba*, *Vigna unguiculata*, and *Cicer arietinum*) and three animals (Cattle beef, Sheep meat and Chicken meat) were collected from Wad-Medani market center in Jan 2018.

**Methods:**

The samples were dried in an air oven at 105° C for three hours then charred until it ceases to smoke. The charred samples were then ashed in a muffle furnace at 550° C until a whitish or grayish ash was obtained. The ashed samples were treated with concentrated HCl acid then transferred to a volumetric flask and were made up to 50 ml. For each food sample studied two ash solutions were prepared then were read using the AAS, spectrophotometer (**SHIMADZU – ASC 7000 Made in Japan**).

**Analytical methods for spectrophotometer and Colorimeter:**

A stock solution of 5% Ammonium thiocyanate was prepared and samples of 2ppm, 4ppm, 6ppm, 8ppm and 10ppm of a standard solution of Ferrous Sulphate were then prepared. The device was turned for 30 minutes and the wave length was adjusted to (450 nm). The device was set to zero absorption of the stock solution and read the absorption of standard solution. 10ml of each sample to be analyzed were taken in 50 ml volumetric flask, 3 drops of nitric acid was added to oxidize the Ferric to Ferrous then 10 ml of 5% Ammonium thiocyanate were added, and the mixture was completed to 50ml. The samples are now ready to analyze and were then taken to the spectrophotometer and the Colorimeter to read their absorbance (**Spectrumbio 725s Made in China**), and Digital Photo Colorimeter (**AVISHKAR 015S404 Made in India**).

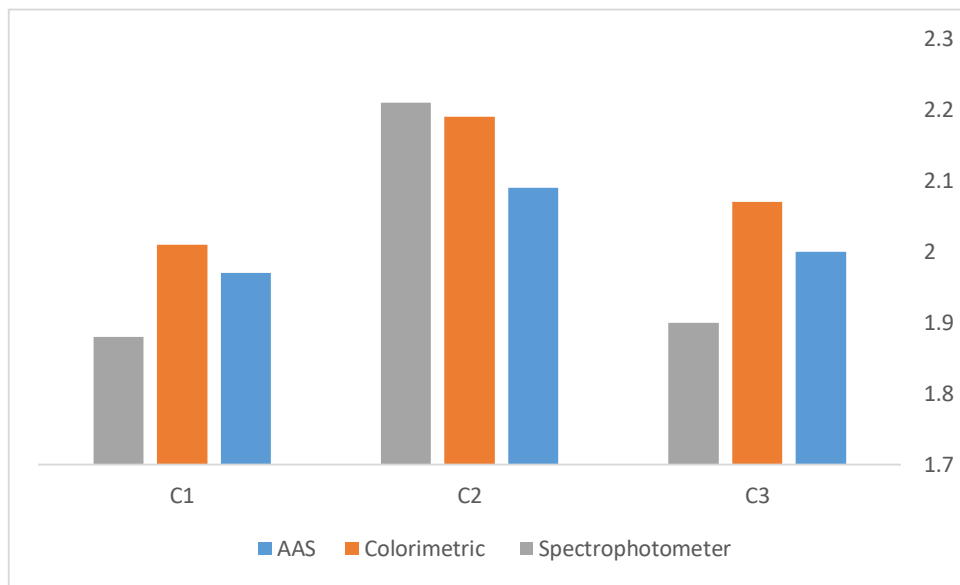
**RESULTS and DISCUSSION**

Data in Table (1) and on figure (1) show that Iron concentration was found to be 1.97 ppm, 2.01 ppm and 1.88ppm in C1 (*Triticum*) samples analyzed by AAS, Colorimetric method and Spectrophotometer method, respectively. Iron content was found to be 2.09 ppm, 2.19 ppm and 2.21ppm in C2 (*Setaria*) samples analyzed by AAS, Colorimetric method and Spectrophotometer method, respectively. The C3 (*Sorghum bicolor*) samples gave iron concentrations of 2.00 ppm when analyzed by AAS, 2.07ppm, when analyzed by Colorimetric method and 1.90 ppm when analyzed by Spectrophotometer method. The samples of C2 (*Setaria*) showed a higher iron concentration than the samples C3 (*Sorghum bicolor*) and the samples of C3 (*Sorghum bicolor*) contain higher iron concentrations than the sample C1 (*Triticum*) (figure .1). The average of iron concentrations in C1 and C2 is less than the standard one. This agreed to what Schuster and James (,2008) were found. However, the iron concentrations in C3 is more than the Standard one which disagreed with (Schuster, James, 2008).

**Table (1) Concentration of iron in seeds by AAS, Colorimetric and Spectrophotometric methods**

Sample location	Concentration of Fe ppm				
	AAS method	Colorimetric method	Spectrophotometer method	Average	Standard value
C1	1.97	2.01	1.88	1.953	35.0
C2	2.09	2.19	2.21	2.163	21.0
C3	2.00	2.07	1.90	1.990	1.90

C1: *Triticum* C2: *Setaria* C3: *Sorghum bicolor*



**Fig (3)": Concentration of Iron (ppm) in seeds plant samples**

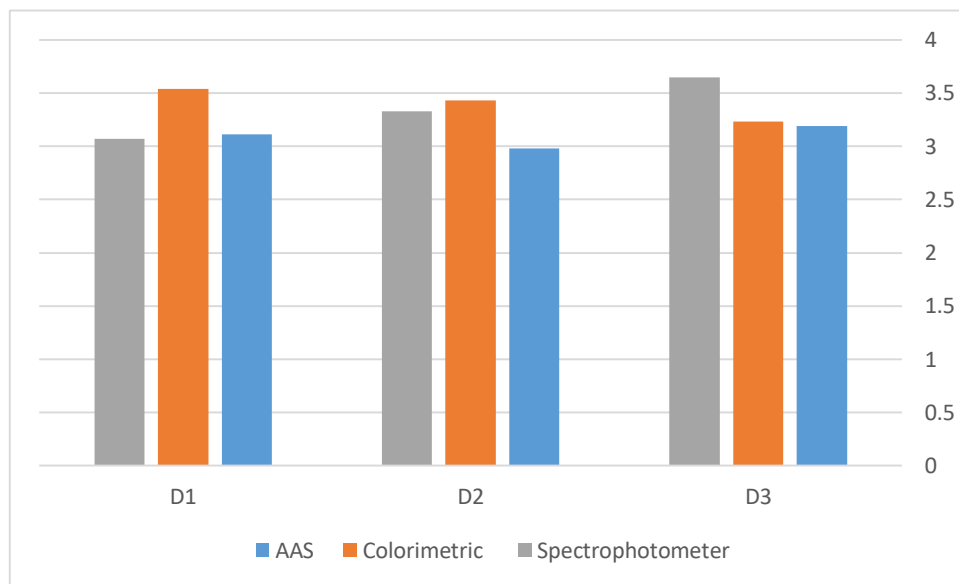
The results in Table (2) and Figure (2) showed that all the samples were containing detectable amounts of iron. Iron concentration was found to be 3.11 ppm in D1 (*Cicer arietinum*) by AAS, 3.54ppm by Colorimetric method and 3.07 ppm by Spectrophotometer method, and was found to be 2.98ppm in D2 (*Vica faba*) by AAS, 3.43ppm by Colorimetric method and 3.33ppm by Spectrophotometer method. The iron concentration was found to be 3.19 ppm in D3 (*Vigna nmbellala*) by AAS, 3.23ppm by Colorimetric method and 3.65ppm by Spectrophotometer method. The iron concentration in sample D1 (*Cicer arietinum*) is less than the concentration in

sample D2( *Vica faba*) and was also less than the concentration in sample D3 (*Vigna nmbellala*) as shown in Figure ( 2). However, the average iron Concentrations in the three samples are less than the standard ones found by Schuster and James (2008).

**Table (2) Concentration of iron in Legumes by AAS, Colorimetric and Spectrophotometric methods**

Sample location	Concentration of Fe ppm				
	AAS method	Colorimetric method	Spectrophotometer method	Average	Standard value
D1	3.11	3.54	3.07	3.240	62.0
D2	2.98	3.43	3.33	3.247	16.0
D3	3.19	3.23	3.65	3.357	32.0

D1: *Cicer arietinum*, D2: *Vica faba*, D3: *Vigna nmbellala*



**Fig (2)": Concentration of Iron (ppm) in Legumes plant samples**

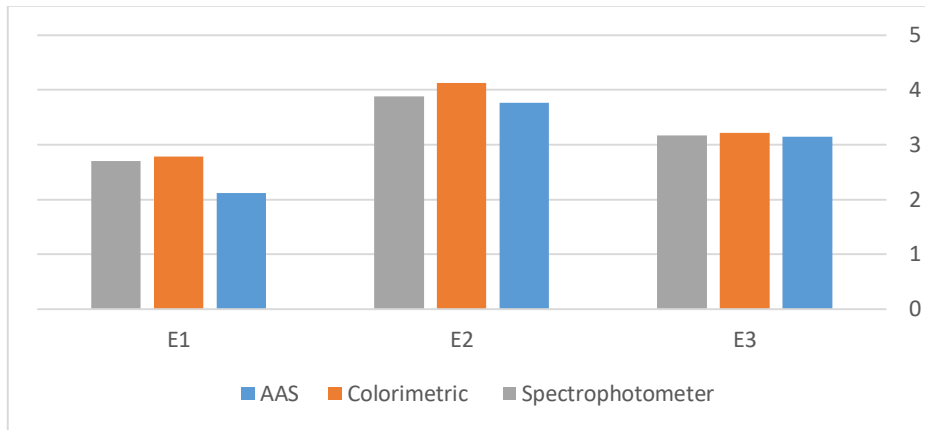
Iron in its ionized forms ( $Fe^{++}$ ,  $Fe$ ), constitutes an integrated part of a lot of different functional proteins. The most important functions are participation in oxygen transport in blood, oxygen storage in muscle tissues and oxidation of nutrients in the mitochondria. Iron is an essential part of cytochrome C and alpha-glycerol phosphate dehydrogenase, and early stages of iron deficiency may, therefore, cause disturbances in tissue metabolism before development of anemia. Thus, hemoglobin determinations are not very suitable for diagnosing early iron deficiency. The content of iron in roughages, apart from root crops, is usually sufficient to cover the requirement

of domestic animals which is met by about 50 mg/ kg feed dry matter. Iron deficiency is very often caused by a reduced absorption in the intestinal tract because of components in the feed forming complexes with iron of very low solubility or inhibitors reducing the absorption processes. The immune status of the organism and its resistance against infections depends on the iron supply. Iron deficiency inhibits the peroxidase activity and thus decreases the bactericide effect of the leucocytes. In spite of this, when exposed to infections the physiological mechanisms reduce the blood concentration of available iron. By this mode of action, the invading pathogens, needing iron like the host animals, will be restrained. The low content of iron in milk combined with a high content of iron binding lactoferrin, is ideal to protect newborn and milk fed young animals against intestinal infection ( [Nord Vet Med](#), 1984). The iron concentration of E1 (Chicken meat) is shown in Table (3) was found to be 2.12ppm, 2.78ppm and 2.70ppm when analyzed by AAS, Colorimetric method and Spectrophotometer method respectively. The average iron concentration in E2 (Beef meat) was 3.76 ppm when analyzed by AAS 4.13 ppm, when analyzed by Colorimetric method and 3.88 ppm by Spectrophotometer method. The iron concentrations in E3 (Sheep meat) sample were 3.15ppm, 3.22ppm and 3.17ppm when analyzed by AAS, Colorimetric method and Spectrophotometer method, respectively. From the results it is clear that sample E2 (Beef) contains a higher concentration of iron than sample E3 (Sheep meat) and sample E3 (Sheep meat) contains a higher concentration than the sample E1 (Chicken meat) as shown on Figure (3). However, the average iron concentration in the three samples is less than the standard value stated by [Nord Vet Med](#). (1984).

**Table (3) Concentration of iron in meats by AAS, Colorimetric and Spectrophotometric methods**

Sample location	Concentration of Fe ppm				
	AAS method	Colorimetric method	Spectrophotometer method	Average	Standard value
E1	2.12	2.78	2.70	2.533	13.0
E2	3.76	4.13	3.88	3.923	26.0
E3	3.15	3.22	3.17	3.180	19.0

E1: Chicken meat, E2: Beef, E3: Sheep meat



**Fig (3): Concentration of Iron (ppm) in meats animals samples**

The study showed that legumes contain the highest concentration of iron followed by meats. it also showed that seeds had the lowest concentrations of iron. The study also showed that there was no significant differences between the three methods of analysis (One-way ANOVA,  $p < 0.05$ ).

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## تقييم تركيز الحديد في البقوليات، البذور واللحوم بأسواق ودمدني، السودان

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## المستخلص

المغذيات الدقيقة عبارة عن عناصر ضرورية للتغذية البشرية وتشتمل على عنصر الحديد كعنصر ضروري لسلامة الإنسان وتوفر امدادات كافية من الحديد لمنع فقر الدم بسبب نقصه، هدفت الدراسة لتحديد تركيز الحديد في مجموعة متنوعة من الأطعمة باستخدام ثلاثة تقنيات حيث تم جمع تسع عينات من الأطعمة المختلفة من سوق ودمدني، ولاية الجزيرة، السودان وتم تحليل العينات بواسطة مطياف الامتصاص الذري، جهاز قياس الألوان، وجهاز قياس المطياف الضوئي. نتائج تركيز الحديد المقاسة بواسطة مطياف الامتصاص الذري في عينات القمح، الدخن، الذرة، الحمص، الفول المصري، اللوبيا العدسي، لحم الفراخ، لحم الأبقار، ولحم الضأن 1.97, 2.09, 2.00, 3.11, 2.98, 3.19, 2.12, 3.76, 3.15 جزء من المليون على التوالي. نتائج تركيز الحديد المقاسة بواسطة جهاز قياس الألوان في عينات القمح والدخن والذرة والحمص والفول المصري اللوبيا العدسي، لحم الفراخ، لحم الأبقار ولحم الضأن 2.01, 2.19, 2.07, 3.54, 3.43, 3.23, 4.13, 2.78, 4.13 جزء من المليون على التوالي. نتائج تركيز الحديد المقاسة بواسطة جهاز المطياف الضوئي في عينات القمح والدخن والذرة والحمص والفول المصري اللوبيا العدسي، لحم الفراخ، لحم الأبقار ولحم الضأن 1.88, 2.21, 1.90, 3.07, 3.33, 3.65, 2.70, 3.88, 3.17 جزء من المليون على التوالي. أظهرت الدراسة أن البقوليات تحتوي على أعلى تركيز من الحديد يليها اللحوم وأن تركيز الحديد كما أظهرت الدراسة أن البذور تحتوي على أقل تركيز من الحديد. أوضحت الدراسة أنه لا يوجد فرق معنوي بين طرق التحليل الثلاث وفقاً لاختبار (P<0,05) (One-way ANOVA).