Biological Effect of some Herbs in Improvement of Anemia in Rats

Zwain, B. A.

PhD Nutrition, Clinical Nutrition Fellowship, Cairo University Hospitals

* **Corresponding Author:** *Zwain, B. A. Email: bassemzwain@hotmail.com*

ABSTRACT

The potential health benefits of Safforn (Crocus sativus), Ginger (zingiber officinale) and Cumin (Cuminum cyminum) powder as functional food supplement to improve iron absorption as well as to treat anemia associated with deficiency in iron intake were evaluated in rats. Four experimental groups were fed on diet supplemented with 5% of tested herbs and 1%iron gluconate for 4 week versus the control rats group fed on basal diet free in iron as positive control group and the group fed on basal diet as negative control. At the end of the experiment, rat groups fed herbs supplemented diets were characterized by the level of serum iron, measured levels of hemoglobin, hematocrit and ferritin. Liver functions was assessed by estimation of plasma concentration of enzymes activities of aspartate amino transferase (AST), alanine amino transferase (ALT), uric acid, creatinine, MDA level, GSH and GSSG activity. Results showed significant increasing in the level of serum iron, in addition, there were variable increases in the measured levels of hemoglobin, hematocrit and ferritin in herbs fed groups as compared with the positive control group. In addition, there was an improvement in case of tested herbs at the level of 5% for the above parameters as compared to positive control group. These data suggested that saffron followed by ginger, herbs mixtures and cumin powder could improve tested parameters and iron bioavailability when incorporated in daily diets and therefore, could be considered as a very effective food supplement to prevent and treat anemia.

Key Words: *Anemic rats, plant, iron absorption, liver; kidney functions.*

INTRODUCTION

Iron-deficiency anemia is another global nutritional problem occurring as a complication of nutritional and absorption disorders and is observed frequently over ages (**Makrides *et al.*, 2003**). Iron-deficiency anemia has been strongly related with many human diseases including immune disorders ***(*Kim *et al.*, 2002*)***, chronic inflammation, restriction of physical performance, neurological impairment and cognitive deficits ***(*Kriger and Schroeder, 2001*)***.

Most anemias are caused by a lack of nutrients required for normal erythrocyte synthesis, principally iron, vitamin B12, and folic acid. Others results from a variety of conditions such as hemorrhage, genetic abnormalities, chronic diseases states, or drug toxicity. The anemia that result from an inadequate intake of iron, protein, certain vitamins (B12, folic acid, pyridoxine, and ascorbic acid), copper, and other heavy metals are frequently called nutritional anemia. **(Kordek, 2007).**

Anemia is a decrease in number of red blood corpuscles (RBCs) or less than the normal quantity of hemoglobin in the blood. It can include a decrease oxygen-binding ability of each hemoglobin molecule due to deformity or lack in numerical development as in some other types of hemoglobin deficiency. **(Panninx et al., 2013).**

Anemia can affect the quality of your life by lowering your energy level, making you feel tired and making it difficult to go about your daily activities. In addition, anemia is much more easily prevented than corrected. A liberal intake of iron the formative years can go a long way in preventing iron-deficiency anemia. Diet is of the utmost importance in the treatment of anemia. Almost every nutrient is needed for the production of red blood corpuscles, hemoglobin and the enzymes, required for their synthesis. In addition, herbal drugs are useful in the treatment of various disorders and supports traditional and medicinal value in the society **(Mittal *et al*., 2011).**

Plant and plant products are being utilized as a source of medicine since long. Plant extracts are used as phytotherapeutics and

are still a large source of natural antioxidants. Natural antioxidants were strengthen the endogenous antioxidant defense from ROS ravage and restored the optimal balance by neutralizing the reactive species. Particularly, flavonoids and phenolics are considered as potential therapeutic agents. A wide range of ailments and is widely distributed in the plant kingdom and, therefore, an integral part of the diet, with the significant amount reported in herbs, vegetables, fruits and beverages (**Thaker *et al.*,2012,**).

Saffron is a flowering plant in the crocus family where *Crocus sativus Linn* (family: *Iridaceae*) it's scientific name, it is widely used as spice and as a coloring and flavoring agent in the preparation of various foods and cosmetics. It is native to Iran and Greece. It is now cultivated largely in Southern Europe. The stigmas of the plant are mainly used for therapeutic purposes(**Abdullaev, 2002**). The stigmas of the plant are used for the treatment of a variety of disorders traditionally. (**Yu *et al.*, 2007)**. Saffron is also a protective agent against chromosomal damage, a modulator of lipid peroxidation, antiseizure, reducing blood pressure and also used in treatment of psoriasis (**Kolanjiappan *et al.*, 2012**).

Ginger or ginger root is the rhizome of the plant *Zingiber officinale,* consumed as a delicacy, medicine, or spice (**Utpala *et al.*, 2006).** Ginger cultivation began in South Asia. Ginger contains up to three percent of a fragrant essential oil whose main constituents are sesquiterpenoids, with (-)-zingiberene as the main component. Ginger has a sialagogue action, stimulating the production of saliva, which makes swallowing easier (**Kumar *et al.*, 2011).**

Cumin (*Cuminum cyminum*), is a small annual herbaceous plant that is a member of the aromatic plant family (*Umbelliferae*). It is a native of the Eastern Mediterranean countries and Upper Egypt, but is now cultivated in Morocco, Iran, Turkey, India, China and the Americas. The seeds of the plant are used to add flavor to spicy dishes. They are also used as an appetite stimulant and to ease several stomach disorders. Cumin seeds contain possess numerous

phytochemicals that are known to have antioxidant, carminative and anti-flatulent properties. The active principles in the cumin may increase the motility of the gastro-intestinal tract as well as increase the digestion power by increasing gastrointestinal enzyme secretions (**Peter, 2001 and Raghavan, 2007)**. This spice is an excellent source of minerals like iron, copper, calcium, potassium, manganese, selenium, zinc and magnesium. Magnesium serves as a host of many functions including heart health and aiding the absorption of calcium and iron. It also contains very good amounts of B-complex vitamins such as thiamin, vitamin B-6, niacin, riboflavin, and other vital anti-oxidant vitamins like vitamin E, vitamin A and vitamin C. The seeds are also rich source of many flavonoid phenolic anti-oxidants such as carotenes, zeaxanthin, and lutein **(Sowhagya *et al*., 2018).**

Aim of study

Therefore, the study examined tested herbs feeding on some biological parameters of anemic rats.

MATERIAL AND METHODS

Plants:

Safforn (Crocus sativus), Ginger (zingiber officinale), and Cumin (*Cuminum cyminum*) powder were obtained from the local markets of Cairo governorate. Gluconate iron were purchased from El-gomhoria Company Formed-Preparations Chemicals and Medical Equipment's, Dokki, Egypt. All herbs were grinded into soft herb by using Electric grinder to give a powder and kept in dusky Stoppard glass bottles in a cool and dry location until use according to **Russo (2001).**

Animal:

Thirty adult female Sprague-Dewily albino rats weighing 140 ±10g were selected from the Institute of Medical Insect Research, Dokki, Egypt. All rats were fed on basal diet prepared according to (**Reeves et al, 1993)** and some modification**.** Rats were housed individually in stainless steel cages with grated stainless steel floors under healthy environmental conditions (in room maintained at 25 – 30°C with about 50% relative humidity and lighted on a daily photoperiod of 12 h light and 12 h dark). Then were

allocated to the various experimental diets for 7 consecutive days for adaptation and the experimental period for 4 weeks. During the conditioning period and throughout the trial food and deionized water were provided ad libitum.

Induction of anemia:

After this adaptation period, determinate hemoglobin (Hb) in all rats and were fed on high fiber diet (20%) for two week then rats fed on essential diet free from iron (anemic diet) for two weeks to get anemic according to **Bushnell, (1992).** Blood was collected from eye vein of each rat to assess the Hb to ensure they had anemia.

Biological the experiment:

After that, rats are divided into 5 groups, each group which consists of 6 rats as follows:

Group (1): Rats fed on basal diet free from iron as an anemic control group.

Group (2): Anemic rats fed on anemic diet and 1% iron gluconate (**Connor and Benkovic, 1992)**

Group (3): Anemic rats fed on anemic diet with 1% iron gluconate and 5% saffron.

Group (4): Anemic rats fed on anemic diet with 1% iron gluconate and 5% ginger.

Group (5): Anemic rats fed on anemic diet with 1% iron gluconate and 5% cumin (**Duke, J. 2007)**.

During the period of the experiment, all rats were weighed once a week and the consumed diets were recorded everyday (daily feed intake). At the end of the experiment, biological evaluation of the experimental diets was carried out by determination of body weight gain (BWG) and feed efficiency ratio (FER) according to **(Chapman *et al*., 1959)**, using the following formulas:

BWG= (Final weight – Initial weight) / Initial weight

FER= Body weight gain (g)/ feed intake (g)

Feed intake was also calculated daily.

The end of the experimental periods (28 days), rats were scarified and anesthesia at fasting state. Part of the blood was taken to determine the level of serum glucose and other portion of blood samples was collected and allowed to coagulate at room temperature; other portion of blood was added to it, EDTA (ethylene diamine tetracetic acid) and centrifuged at

3000 r.p.m for 15 minutes. Serum was carefully aspirated and transferred into clean covet tubes and stored frozen at -20°C until the time of analysis.

Biochemical analysis

Serum Alkaline phosphatase (ALP) was determined according to the procedure of **(Belfield and Goldberg, (1971)).** Aspartate aminotransferase (AST) and or Alanine aminotransferase (ALT) were carried out according to the method of **Henry (1974)** and **Yound (1975)** respectively**.** Creatinine was determined according to kinetic method of **Henry (1974).** The intensity of this red color formed is proportional to the uric acid concentration in the sample according to **Schultz (1984).**

Blood was collected by eye vein every week during the experimental period to determine hemoglobin was according to **Jacobs *et al*. (2001*)*** and Hematocrit was measured using a heparinized tube according to **Mc-Inory** procedure ***(*1954*)***. Using the serum samples obtained on the final day of the experiment, serum and total iron binding capacity (TIBC) were determined by means of commercial assay kits (Sigma Diagnostic, St. Louis) according to **Cavill's** method ***(*1986*)*..** Malondialdehyde estimated by the thiobarbituric acid assay method of **Beuge and Aust (1978)**, reduced glutathione was estimated by the method of **Moron *et al.* (1979)** and serum GSSG was estimated by the method of **Reitman and Frankel (1957**).

Statistical analysis

Data were analyzed using one-way analysis of variance (ANOVA) followed by the student t-test for significant difference. Statistical significant difference was defined as $P < 0.05$ **(Snedecor and Cochran 1976)**.

RESULTS AND DISCUSSION

Data in table (1) showed the effect of tested herbs on feed intake (FI), body weight gain (BWG) and feed efficiency ratio (FER) of rats with anemia. For body weight gain (BWG), it could be observed that both of control groups were significantly lower than the other groups. Feed intake (FI), it could be observed that there is a high significant changes between groups fed on 5% saffron and the other groups. In case of feed

efficiency ratio (FER), there is no significant changes among group3 and group5 same effect was recorded between groups 2 and 4. The finding of this study reports that treatment with tested herbs improved the weight gain compared to untreated anemic rats and anemic rats with iron gluconate. Induction of anemia is associated with the characteristic loss of appetite and body weight, which is due to the decreasing of oxygen, which carried to the cells of body and decreased the bioactivity of human. Saffron and ginger are a good source of vitamin B complex, ascorbic acid, zinc, cucurbitacins, saponins, fucosterols and compesterols, polyphenolics and flavone-C-glycoside and contain iron, which helped to reverse the feed intake and weight loss of anemic rats **(Utpala *et al*., 2006 and Kolanjiappan *et al*., 2012).**

Data shown in table (2) indicated that all of the assessed serum iron were significantly ($P \leq 0.05$) increased as affected by saffron, ginger and cumin intake when tested herbs intake level was 5%. In addition, all serum levels of hemoglobin and ferritin were increased. Hematocrit of herbs groups were significantly higher than that of both of control rats groups in different levels while, total iron binding capacity (TIBC) in the herbs groups were significantly lower than that of both control groups. The primary cause of anemia was considered the feeding on iron-deficient diet (malnutrition) for a long period (2 weeks) through the adaptation-feeding course before incorporation of herbs together with normal load of iron into the experiment diets. The hemoglobin concentration decreased constantly during the feeding period of iron-free diets in all the rat groups. It was evident that iron deficiency contributed to this anemia, because typical signs of iron-deficiency anemia such as decreases in hemoglobin and serum iron concentrations, and increases in total iron binding capacity were observed **(Panninx *et al*., 2013).** The primary cause of anemia was considered the feeding on iron-deficient diet (malnutrition) for a long period (3 weeks) through the adaptation-feeding course before incorporation of lactoferrin together with normal load of iron and calcium into the experiment diets. The hemoglobin concentration decreased constantly

during the feeding period of iron-free diets in all the rat groups. **(Janz *et al.*, 2013).**

Several authors have reported that iron mal-absorption is mainly caused by some of the food constituents, which can be inhibitors of iron absorption and may contribute to the high prevalence of iron deficiency found. Data indicated that ginger, saffron feeding prevented the development of anemia and improved hemoglobin, the hematocrit and both serum, and bone iron contents in a dose-dependent manner. The final hemoglobin concentration and hematocrit in the rats fed lactoferrin were significantly higher than those in the rats fed the control diet. It has been reported that there was a high positive correlation between serum iron concentration and iron absorption **(Kim and Atallah 1993). Buchowski *et al.* (2019)** reported a correlation between hemoglobin efficiency ratio (HRE) and apparent absorption of iron. Feeding saffron -containing diet appears to increases in total iron binding capacity as shown in our results. It seems that the effect of the ingested doses of saffron were enough to stimulate iron absorption in the experimental rat groups with significant (P<0.05) different effect according to the ingested dose.

Data in table (3) showed the effect of tested herbs on liver enzymes (AST, ALT and ALP) of anemic rats. AST, ALT and ALP were in normal range for all groups. Although there are variations in value between them. The normal range of values for AST is about 5 to 40; ALT is 7 to 56 and ALP is 44 to147 units /litter of serum **(Hasan et al., 2018).** For AST, the results showed negative control group was significantly lower than the tested groups while, there is no changes between G4 and G2. In addition, there is no significant changes between G3 and G5. For ALT and ALP, it could be observed that both of control groups were significant with the other groups while there is no significant changes among G3, G4 and G5. Serum enzymes including **AST, ALT** and ALP are used in the evaluation of hepatic disorders. An increase in these enzyme activities reflects active liver damage or inflammatory hepatocellular disorders (**Kota and Tahashildar, 2015**). The concentration of the

enzymes released reflects the severity of the damage. AST is enzymes normally present in the liver, heart, muscles and blood cells. They are located within hepatocytes. So when liver cells are damaged or die transaminases is released into the bloodstream, where they can be measured they are therefore the index of liver injury **(Haram *et al.*, 2011**). The hepatocellular damage indicated by increased activity of AST in serum was observed in this study. Supplementation of the saffron restored the AST activity.

In accordance with these findings, ir**on deficiency anemia** (IDA) is associated with a number of pathological gastrointestinal conditions other than inflammatory bowel **disease**, and with **liver** disorders. It has a significant role in the alteration of liver functions since the activities of **AST, ALT** and ALP were significantly higher or lower than normal values. On the other hand, treatment with glibenclamide, caused significant regulation in the activities of these enzymes, showing the protective effect of the extract **(Saha *et al.*, 2011)**. Phytochemical screening of the saffron, ginger and cumin revealed the presence of fucosterol and compesterols flavonoids, cucurbitaceous, saponins and polyphenolics, triterpenoids and C-flavone glycosides and ellagitannins. Many in vitro and in vivo studies revealed that it possesses antioxidant and hepatoprotective properties. However, as per available studies, there is no systematic work available to test the effect of tested herbs on anti- tubercular drug induced hepatotoxicity in rat. Many in vitro and in vivo studies revealed that it possesses antioxidant and hepatoprotective properties **(Yu *et al.*, 2007; Sowhagya *et al.*, 2018 and Kumar *et al.*, 2016)**.

Table (4) showed the effect of tested herbs on kidney functions of anemic rats. Anemic rats without additives had the highest-level value of creatinine followed by anemic rats with 1% iron gluconate. There is no significant change between G4 and G5. For uric acid, it could be observed that both of control groups were significantly higher than the others while there is no significant change among the anemic rats with tested herbs.

The highest effect was detected in anemic rats with ginger. Anemia induced kidney damage and its recovery by herbal drugs were assessed by alteration in the clinically important biochemical variables such as serum creatinine, blood urea nitrogen (BUN), serum uric acid which were found to be significantly increased in anemic rats **(Dhakar *et al*.,2012)**. **Abdullaev (2002)** found that the ethanolic extract of saffron showed significant prevention of elevated levels of serum acid phosphatase (ACP) and bilirubin and improved the level of albumin. The activity was due to presence of sterols (*campesterol and fucosterol*).

Table 5 represents the levels of MDA, GSH, and GSSG in anemic rats. Group 1 as a anemic rats without additives showed a substantial (7.4 ± 1.24) increase in the level of MDA when compared to the other groups. Anemic rats treated with tested herbs significantly showed decreasing in the level of MDA when compared to group 2 (anemic rats with 1% iron gluconate). There is no significant among groups 4, 5. Group I showed a significant (2.1 ± 0.54) decrease in the level of GSH when compared to the others. Groups treated with herbs significantly increase the level of GSH as compared to both controls. Anemic rats (group 1) revealed a significant increase (205.3 ± 72.5) in the activity of GSSG when compared to the other groups. Groups treated with herbs led to significantly decrease in the activity of GSSG when compared to both control groups. Saffron group was the highest group was affected. Lipid peroxidation and the resultant perturbation of the structural integrity of the plasma membrane have long been considered to be capable of initiating the hemolytic response **(Hochstein, 2018)**, though how the generalized destruction of membrane lipids could stimulate a selective macrophage response was not clear. The most recent reports that lipid peroxidation in nucleated cells correlates with the accumulation of Phosphatidyl-serine (PS) on the outer leaflet of the lipid bilayer. ROS production was associated with extensive binding of oxidized and denatured hemoglobin to the membrane cytoskeleton. Thus, phenyl hydrazine induced hemolytic injury seems to be derived from oxidative alterations to red blood

corpuscles membrane lipids **(McMillan *et al.*, 2015)**.

In the present study, increased lipid peroxidation products, as MDA were observed on phenyl hydrazine, intoxicated rats. Supplementations of saffron restored the MDA content suggested that reduced the oxidative damage.

In the present study, a marked decrease in the concentration of GSH was observed in phenyl hydrazine intoxicated rats when compared to control rats. Administration of the ginger significantly increases the levels of GSH in phenyl hydrazine intoxicated rats. Enzymes catalyze specific biochemical reactions in the body.

Changes in their levels and of cellular damage, the intracellular concentration of the enzymes and the mass properties alter the functional ability of an organism. The diagnosis of organ disease/damage is aided by measurement of a number of non-functional plasma enzymes characteristic of that tissue or organ. The amount of enzyme released depends on the degree of the affected tissue.

Herbal medicine is increasingly gaining greater recognition from the public and medical profession due to greater advances in the understanding of the mechanisms by which herbs positively influence health and quality of life. Several plant products are known to exhibit creditable medicinal properties for the treatment of various ailments and need to be explored to identify their potential application in prevention and therapy of human ailments. Keeping in view the present study has evaluated the anti-anemic activity of sprouted seeds of *ginger*, was chosen to induce hemolytic anemia. Supplementation of the ginger improve the Hb content (**Vyshtakaliuk et al., 2019**).

CONCLUSION

The results of the present study accomplished that the saffron, ginger, cumin and their mixture improve anemia in the presence of iron gluconate This result supports at least partially the traditional use of saffron, ginger, cumin and their mixture in the treatment of anemia. Further investigations are needed to understand the mechanism involved in the

anti-anemic action of saffron, cumin.

REFERENCE

Abdullaev FI (2002):

Cancer Chemopreventive and Tumoricidal Properties of Saffron (Crocus sativus L.). *Exp. Biol. Med.,* 227(1): 20–25.

Belfied A and Goldberg DM (1971):

Alkaline phosphatase colori-metric method. *J. Enzyme,* 4 (12): 561.

Beuge JA and Aust SD (1978):

The Thiobarbituric acid assay. *Methods in Enzymol*.,52:306–307.

Buchowski MS; Mahoney AW and Kalpalathika MPV (2019):

Nonheme iron absorption, apparent iron absorption and hemoglobin regenera-tion efficiency in anemic and normal rats fed with dietary heme moreover, nonheme iron at various levels. *Nutr. Res.* 9:773-783.

Bushnell F K 1992:

A guide to primary care of iron-deficiency anemia, Review Nurse *Pract.* 17(11):68, 71-4.

Cavill I; Jacobs A and Worwood M (1986):

Diagnostic methods for iron status. *Annu. Clin. Biochem.,* 23, 168.

Chapman DG; Castilla R and Champbell JA (1959):

Evaluation of protein in food. I.A. Method for the determination of protein efficiency ratio-Can. *J. Biochemistry. Physiology,* 37: 679-686**.**

Connor JR and Benkovic SA (1992):

Iron regulation in the brain: Histochemical, biochemical, and molecular considerations. *Ann. Neurol.,* 32: S51-S61.

Dhakar; Katare R; Kumar Y; Umesh P and Pawar KR (2012):

In vivo assessment of bioactivity of *Trichosanthesdioica Roxb* for the management of haemolytic anemia. *International*

Journal of Pharm. Tech. Research, 4(2):689-699.

Duke J (2007):

The Green pharmacy Herbal Handbook: Your Comprehensive Reference to the Best Herbs for Healing. Emmaus, PA: Rodale, 115-116. Ecol., 54: 685-696.

Hasan M; Tamanna N; Haque A (2018):

Biochemical and histopa-thological profiling of Wister rat treated with Brassica napus as a supplementary feed, *Food Science and Human Wellness* 7, 77–82

Haram K; Nilsen ST and Ulvik RJ (2011):

Iron supplementation in pregnancy—evidence and controversies. *Acta. Obstet. Gynecol. Scand*., 80:683–688.

Henry RJ (1974):

Clinical Chemistry Principal and Techniques. 2nd. *Harper and Publisher*. New York.

Hochstein P (2018):

Perspectives on hydrogen peroxide and drug-induced hemolytic anemia in glucose-6-phosphate dehydrogenase deficiency. *Free Radical Biol Med.*, 5:387–92.

Jacobs DS; Oxley DK and Demotte WR (2001):

Laboratory Test Handbook ".Lexi-Comp. INC.

Janz TG; Johnson RL; Rubenstein SD (2013):

Anemia in the Emergency Department: Evaluation and Treatment. *Emergency Medicine Practice*, **15** (11): 1–15; quiz 15–6.

Kim M and Atallah M T (1993):

Intestinal solubility and absorption of ferrous iron in growing rats are affected by different dietary pectin's. *J. Nutr*. 123:117-124

Kim SH; Kim HY; Kim WK and Park OJ (2002):

Nutritional status, iron-deficiency-related indices, and immunity of female

athletes. *Nutrition*, 18(1): 86-90.

Kolanjiappan K; Manoharan S and Kayalvizhi M (2012):
Measurement of erythrocyte lipids, lipid peroxidation, antioxidants and osmotic fragility in cervical cancer patients. *Clinica. Chimica. Acta*., 326(1-2):143-149.

Kordek R (2007):
Student's Book for Students and Medicals. *Via Medica; Gdansk, Poland*, 52-57.

Kota K and Tahashildar J (2015):
Attenuation of oxidative stress in Alloxan-induced diabetic rabbits by ethanolic extract of the fruit of *Lagenaria siceraria. Journal of Chemical and Pharmaceutical Research*, 7(12):682-688.

Kriger J and Schroder C (2001):
Iron, brain and restless leg syndrome. *Sleep Med. Rev.*, 5 (4): 277-286.

Kumar D; Kaushal K; Chandrul; Deepak S; Hariom S; Shikha P and Abhishek M (2016):
Pharmacognostic evalution and phytochemical screening of some herbs. *Journal of Pharmaceutical Research*, 5 (5):1373-1383.

Kumar G; Kathie L and Rao K VB (2011):
A review on pharmacological and phytochemical properties of Zingiber officinale Roscoe (Zingiberaceae), *Journal of Pharmacy Research*, 4(9): 2963-2966.

Makrides M; Crowther CA; Gibson RA; Gibson RS and Skeaff CM (2003):
Efficacy and tolerability of low-dose iron supplements during pregnancy: a randomized controlled trial. *Am. J. Clin. Nutr.*, 78(1):145-53.

Mc-Inory (1954):
A micro hematocrit for determining the packet cell hemoglobin concentration on capillary blood. *J. Clin. Path*. 7:32.

McMillan DC; Powell CL; Bowman ZS and Morrow JD (2015):

Lipids versus proteins as major targets of pro-oxidant, direct-acting hemolytic agents. *Toxicol. Sci.,* 88:274–283.

Mittal MB; Abhay RS; Yadunath MJ and Vilasrao JK (2011):

An intervention on iron deficiency anemia and change in dietary behavior among adolescent girls. *Int. J. Pharm. Pharm. Sci.,* 3:40–42.

Moron MS; Dsepierre JW and Manerwik KB (1979):

Levels of glutathione, glutathione reductase and glutathione-S-transferase activities in rat lung and liver. *Biophysica. Acta.,* 582: 67–68.

Panninx BW; Guralnik JM; Onder G; Ferrucci L; Wallace RB and Pahor M (2013):

Anemia and decline in physical performance among older persons. *Am. J. Med.,* 114:114–120.

Peter KV (2001):

Handbook of herbs and spices Vol. 1. Woodhead *Publishing Limited Abington Hall, Abington Cambridge, England*.

Raghavan S (2007):

Handbook of spices, seasonings, and flavorings. 2nd Ed. CRC Press, *Taylor and Francis Group, Boca Raton.*

Reeves PG; Nielsen FH and Fahey GCJ (1993):

AIN-93 purified diets for laboratory rodents: final report of the American Institute of Nutrition ad hoc writing committee on the reformulation of the AIN 76A rodent diet. *J. Nutr., 123:1939–1951.*

Reitman S and Frankel SA (1957):

Colorimetric method for the determination of serum Glutamic oxaloacetic and glutamic pyruvic transa-minase. *Am. J. Clin. Pathol.,* 25:56–63.

Reznikoff P and Goebel F (2016):

"The Use of Ferrous Gluconate in the Treatment of Hypochromic Anemia". *Journal of Clinical Investigation*, 16 (4): 547–54.

Russo E (2001):

"Hand book of Psychotropic Herbs A scientific Analysis of Herbal Remedies for Psychiatric conditions". *The Hearth Herbal press, Inc.*

Saha P; Selvan VT; Mondal SK; Mazumder UK and Gupta M (2011):

Antidiabetic and anti-oxidant activity of methanol extract of *Ipomoea reptans Poiraerial* parts in streptozotocin induced diabetic rats. *Pharma-cology Online*, 1:409-421.

'Schultz A (1984):

Uric Kaplan A. Clin Chem. Mosby Co. St. Louis Toronto. *Princeton*, 1261-1266 and 418.

Snedecor GW and Cochran WG. (1976):

Statistical Methods. 6th Edn. Ames, *Iowa states Univ. Pres*s: 298.

Sowhagya HB; Rao BVS and Krishnamurthy N (2018):

Evaluation of size reduction and expansion on yield and quality of cumin (Cuminum cyminum) seed oil. *J. Food Engg*., 84: 595-600

Thaker RU; Vyas BA; Joshi SV; Patel PK and Shah DR (2012):

Effect of dehydrated water extract of fruits of *opuntia ficus indica* on experi-mentally induced hemolytic anemia in rats. Int. J .Pharm .Res. Dev., 4:185–191.

Utpala P; Johny AK; Parthasarathy VA; Jayarajan K and Madan MS (2006):

Diversity of ginger cultivation in India - a GIS study. *Journal of Spice and Aromatic Crop*, 15 (2):93-99.

Vyshtakaliuk AB and Zobov VV (2019):

Antianemic activity of water-soluble Na, Ca, Fe-polygalacturonate. *Bull. Exp. Biol. Med.,* 150:45–47.

Yu HS; Lee SY and Jang CG (2007):

Involvement of 5-HT1A and GABAA receptors in the anxiolytic-like effects of *Crocus sativa* in mice. *Pharmacology Biochemistry and Behavior,* 87(1):164-170.

Yound DS (1975):

Determination of GOT. *Clin. Chem*., 22 (5): 21.

Table (1) Effect of tested herbs on feed intake (FI), body weight gain (BWG) and feed efficiency ratio (FER) of anemic rats.

Groups	Body weight g/d	Feed intake g/d	Feed efficiency ratio g /g
Anemic control (G1)	**9.2 ± 0.12** [f]	**5.8 ±1.33** [e]	0.057 ±0.003 [b]
Anemic rats + 1% iron gluconate **(G2)**	**11.7 ±0.13** [e]	**7.7 ±1.22** [d]	0.054 ±0.002 [c]
Anemic rats + 1% iron gluconate+ **5%** saffron **(G3)**	**18.7 ±1.90** [b]	**11.1 ±0.12** [a]	0.060 ±0.001 [a]
Anemic rats + 1% iron gluconate+ **5%** ginger **(G4)**	**16.5 ±0.12** [c]	**10.9 ±0.48** [b]	0.054 ±0.001 [c]
Anemic rats + 1% iron gluconate+ **5%**cumin **(G5)**	**14.5 ±2.11** [d]	**8.7 ±1.67** [c]	0.060 ±0.002 [a]

Means under the same column bearing different superscript letters are different significantly ($p<0.05$)

Table 2: **Effect of tested herbs on serum iron concentration and hemoglobin indices of anemic rats**

Groups	**Serum Fe (µg/dl)**	**Serum ferritin (µg/L)**	**TIBC (µg/dl)^2**	**Hemoglobin (g/dl)**	**Hematocrit (%)**
Anemic control (G1)	59.11 ± 4.55 ^{d}	49.55 ± 2.25 ^{b}	444.10 ± 6.20 ^{a}	9.11 ± 1.10 ^{c}	**27.35 ± 0.15 ^{b}**
Anemic rats + 1% iron gluconate **(G2)**	66.30 ± 2.10^c	50.10 ± 0.36^b	389.5± 33.50^b	9.35 ± 1.11^b	**28.05± 3.01^b**
Anemic rats + 1% iron gluconate+ **5%** saffron **(G3)**	89.25 ± 4.10^a	62.30 ± 0.10^a	330.6 ± 25.55^c	11.15 ± 2.36^a	**33.45 ± 2.11^a**
Anemic rats + 1% iron gluconate+ **5%** ginger **(G4)**	80.30 ± 2.12^b	60.12 ± 0.15^a	321.7 ± 10.50^c	10.35 ± 1.10^a	**31.15 ± 4.47 ^{a}**
Anemic rats + 1% iron gluconate+ **5%**cumin **(G5)**	74.30 ± 4.12^c	55.12 ± 3.85^b	329.9 ± 15.54^c	10.05 ± 2.11^b	**30.15 ± 2.28 ^{b}**

Means under the same column bearing different superscript letters are different significantly (p<0.05). *TIBC: Total iron-binding capacity.*

Table (3) Effect of tested herbs on serum liver enzymes (AST, ALT and ALP) of anemic rats.

Groups	AST (U/L)	ALT (U/L)	ALP (U/L)
Anemic control (G1)	**21.4 ±2.04** [d]	**26.6 ±6.05** [e]	114 ±1.13 [c]
Anemic rats + 1% iron gluconate **(G2)**	**27.3 ±2.31** [c]	**29.5 ±1.43** [d]	132 ±2.36 [b]
Anemic rats + 1% iron gluconate+ **5%** saffron **(G3)**	**34.9 ±0.12** [b]	**38.7 ±2.13** [b]	143 ±1.13 [a]
Anemic rats + 1% iron gluconate+ **5%** ginger **(G4)**	**28.8 ±5.13** [c]	**33.9 ±6.34** [c]	141 ±0.22 [a]
Anemic rats + 1% iron gluconate+ **5%**cumin **(G5)**	**36.1 ±3.46** [b]	**40.4 ±4.88** [a]	144 ±0.16 [a]

Means under the same column bearing different superscript letters are different significantly (p <0.05)

Table (4) Effect of tested herbs on serum kidney functions of anemic rats

Groups	Creatinine **(mg/dl)**	Uric acid **(mg/dl)**
Anemic control (G1)	**2.32 ±0.98** [a]	3.9 ±3.17 [a]
Anemic rats + 1% iron gluconate **(G2)**	**1.61 ±0.01** [b]	3.3 ±1.23 [a]
Anemic rats + 1% iron gluconate+ **5%** saffron **(G3)**	**0.90 ±0.03** [c]	2.0 ±0.07 [b]
Anemic rats + 1% iron gluconate+ **5%** ginger **(G4)**	**0.62 ±0.11** [d]	1.61 ±1.27 [b]
Anemic rats + 1% iron gluconate+ **5%**cumin **(G5)**	**0.65 ±0.36** [d]	1.64 ±0.85 [b]

Means under the same column bearing different superscript letters are different significantly (p <0.05)

Table 5: **Effect of tested herbs on serum MDA level, GSH and GSSG activity of anemic rats**

Groups	**MDA (nmole/l)**	**GSH (mg/dl)**	**GSSG (IU/l)**
Anemic control (G1)	7.4 ± 1.24 [a]	2.1 ± 0.54 [d]	**205.3 ± 7.5** [a]
Anemic rats + 1% iron gluconate **(G2)**	6.78 ± 0.16 [b]	2.63 ± 0.05 [c]	**189.1 ± 10.6** [b]
Anemic rats + 1% iron gluconate+ **5%** saffron **(G3)**	4.21 ± 1.02 [d]	4.63 ± 0.67 [a]	**99.2 ± 4.8** [d]
Anemic rats + 1% iron gluconate+ **5%** ginger **(G4)**	4.8 ± 0.6 [c]	4.01 ± 0.4 [b]	**106.3 ± 6.2** [c]
Anemic rats + 1% iron gluconate+ **5%**cumin **(G5)**	4.99 ± 0.92 [c]	3.79 ± 0.67 [b]	**107.2 ± 4.08** [c]

Means under the same column bearing different superscript letters are different significantly (p<0.05)

التأثير البيولوجي لبعض الأعشاب في تحسين فقر الدم في الجرذان

باسم على زوين

زميل التغذية العلاجية – مستشفيات جامعة القاهرة

الملخص العربي

هدفت الدراسه الي تقييم الفوائد الصحية المحتملة من الزعفران والزنجبيل ومسحوق الكمون كمكمل غذائي وظيفي لتحسين امتصاص الحديد وكذلك لعلاج فقر الدم المرتبط بنقص تناول الحديد في الفئران. تمت تغذية خمس مجموعات من الفئران ثلاث مجموعات تجريبية على نظام غذائي مكمل بنسبة ٥٪ من الأعشاب المختبرة و ١٪ جلوكونات الحديد لمدة ٤ أسابيع مقابل مجموعة الفئران الضابطة التي تغذت على النظام الغذائي الأساسي الخالي من الحديد كمجموعة ضابطة إيجابية والمجموعة التي تغذت على النظام الغذائي الأساسي كمجموعة ضابطه سلبية. في نهاية التجربة تميزت مجموعات الفئران التي تغذت على أعشاب مكملة بمستويات الحديد في الدم ومستويات الهيموجلوبين والهيماتوكريت والفيريتين المقاسة. تم تقييم وظائف الكبد عن طريق تقدير تركيز البلازما لأنشطة إنزيمات الأسبارتات أمين ترانسفيراز (AST) ، ألانين أمينو ترانسفيراز (ALT)، حمض اليوريك ، الكرياتينين ، مستوى MDA ، نشاط GSH, GSSG, . أظهرت النتائج زيادة معنوية في مستوى الحديد في الدم ، بالإضافة إلى وجود زيادات متغيرة في المستويات المقاسة للهيموجلوبين والهيماتوكريت والفيريتين في مجموعات الأعشاب التي تم تغذيتها مقارنة بمجموعة السيطرة الإيجابية. أيضا ، كان هناك تحسن في حالة الأعشاب المختبرة عند مستوى ٥٪ للمعايير المذكورة أعلاه مقارنة بمجموعة السيطرة الإيجابية. تشير هذه البيانات إلى أن الزعفران متبوعًا بالزنجبيل ومسحوق الكمون يمكن أن يحسن المعايير المختبرة والتوافر الحيوي للحديد عند دمجه في الوجبات الغذائية اليومية ، وبالتالي ، يمكن اعتباره مكملًا غذائيًا فعالًا للغاية لمنع فقر الدم وعلاجه.

الكلمات المفتاحية: *الانيميا بالجرذان ، نباتات ، امتصاص الحديد ، وظائف الكبد والكلى.*