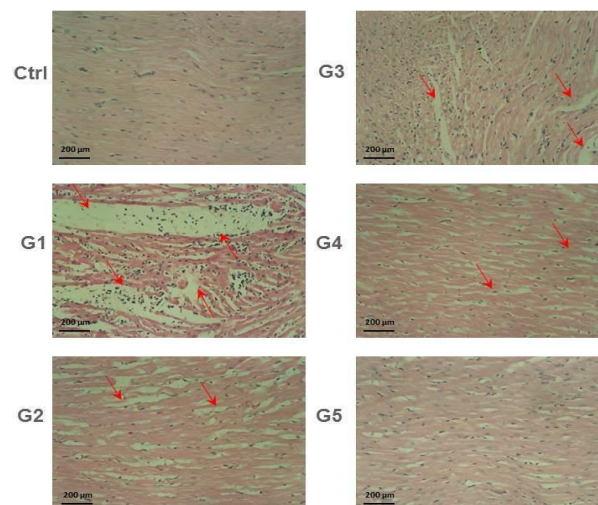


Potential for iron enriched yeast in recovery of rats from iron deficiency

M. Aref Kyyaly – Chris Powell
El-Shahat Ramadan



Baker's yeast in bread

The primary roles of baker's yeast in bread making are:

- To increase the volume of the dough by evolving carbon dioxide as a result of alcoholic fermentation of sugars in the dough.
- To bring about a change in structure and texture in the dough as a result of stretching caused by formation of carbon dioxide bubbles.

Additional roles include:

- Contribution to the flavour of bread.
- Contribution to the nutritional status of bread

Iron deficiency

- Iron deficiency is the most common nutritional deficiency
 - Especially in developing countries
 - Significant public health problem among children and women of childbearing age worldwide
- The most obvious manifestation of iron deficiency in humans is anemia
- There are 2 types of iron in the diet; haem iron (protein associated) and non-haem iron
- The absorption of non-haem iron varies greatly from 2% to 100%
 - Influenced by different factors (iron status in body, solubility of iron salts)
- Haem iron is not affected by ingestion of other nutritional components
 - Constant absorption rate of 20-30%
 - The haem molecule is absorbed intact and the iron is released in the mucosal cells

Aims of this work

- Preparation of iron-enriched baker's yeast by supplementation of growth media with iron.
- Determination the impact of ingesting iron-enriched baker's yeast on anemia in experimental rats



Experimental design

Preparation of iron enriched yeast by cultivation
with different concentrations of iron salt



Analysis of the effect of iron enrichment on baking properties



Feeding anemic rats on diet supplemented with iron
enriched yeast



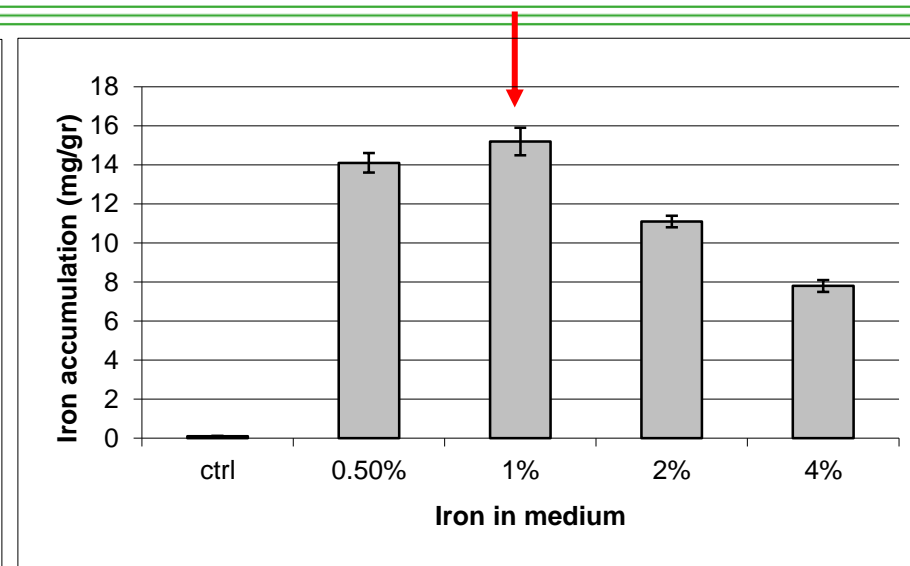
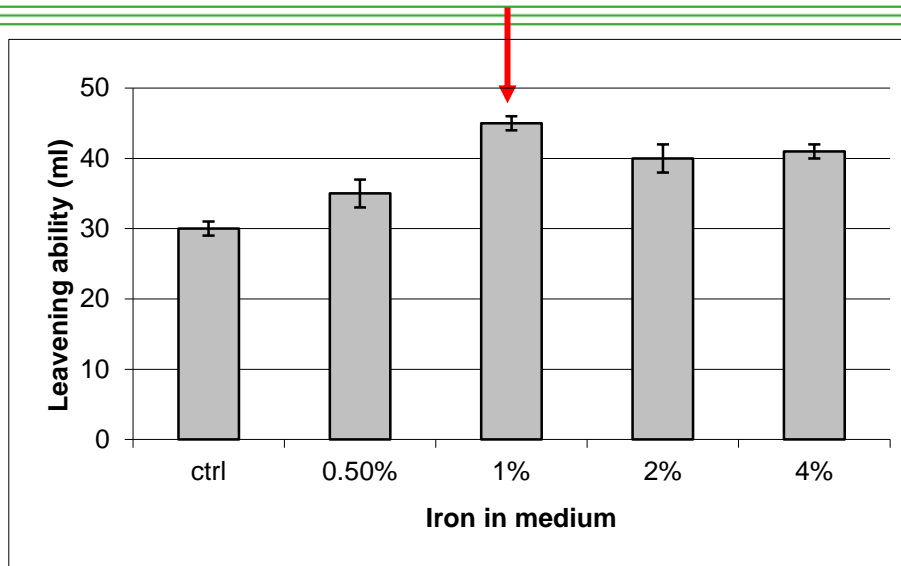
Evaluation of this treatment compared to 'classic' treatment (inorganic salts)

Determination of iron bioavailability
Analysis of blood and histological parameters

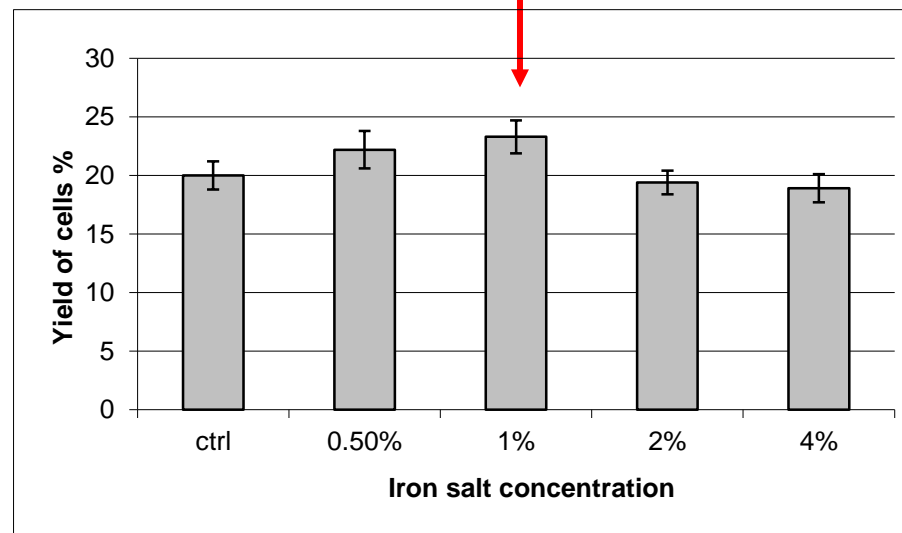
Iron enrichment of yeast and its use as feed in treatment of anemia

A-preparation of iron enriched yeast

- Different iron salts were used to determine best salt for growth based on yield of cells.
 - Iron(III) Sulphate
 - Iron (III) Chloride
 - Ammonium Iron (III) Citrate
- Yeast cells were grown in presence of different concentrations of iron to determine
 - The effect of iron concentration on the yield of cells
 - Leavening ability
 - Iron accumulation in yeast



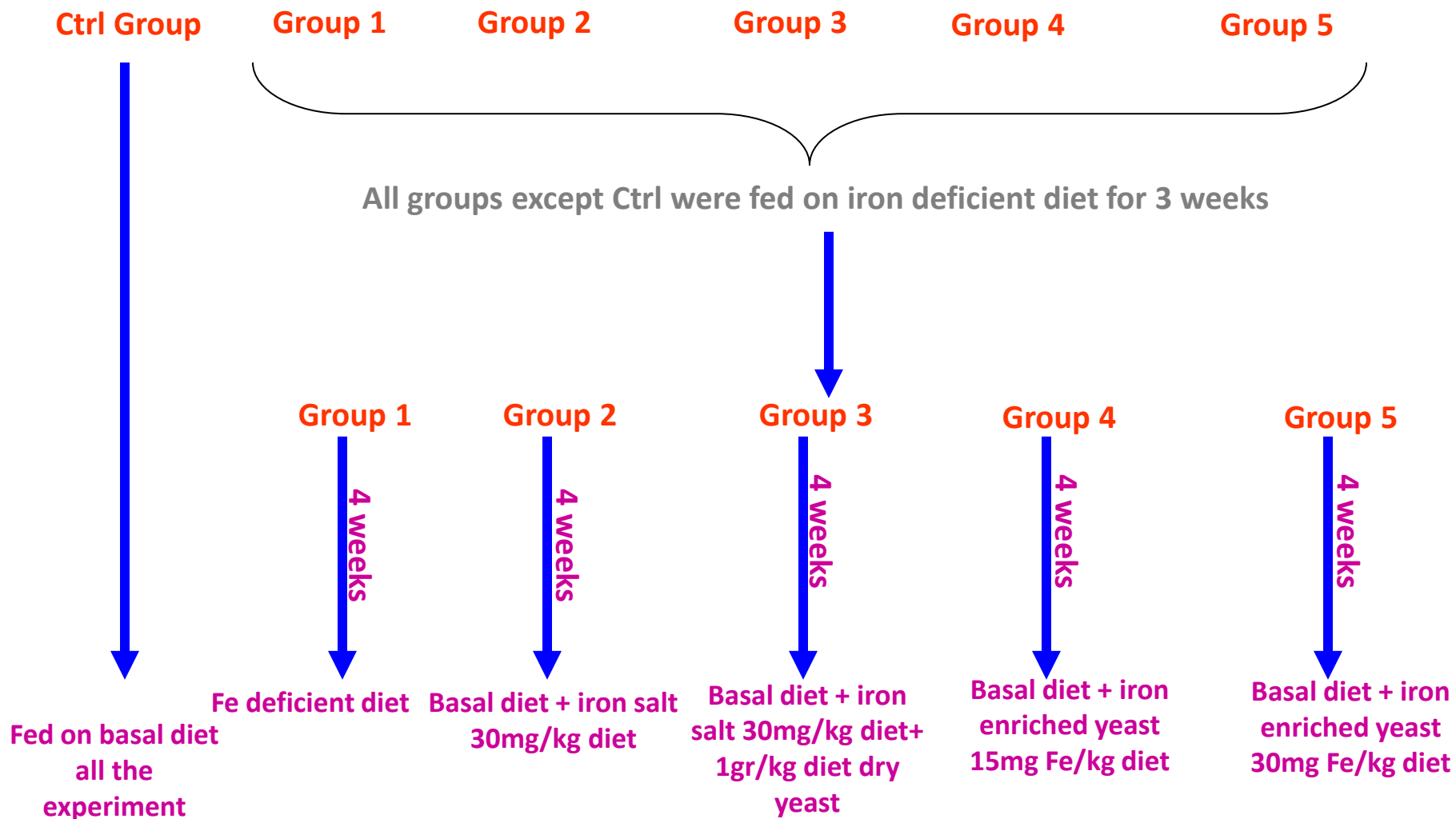
Baking property



Iron content
in yeast

Yield of cells

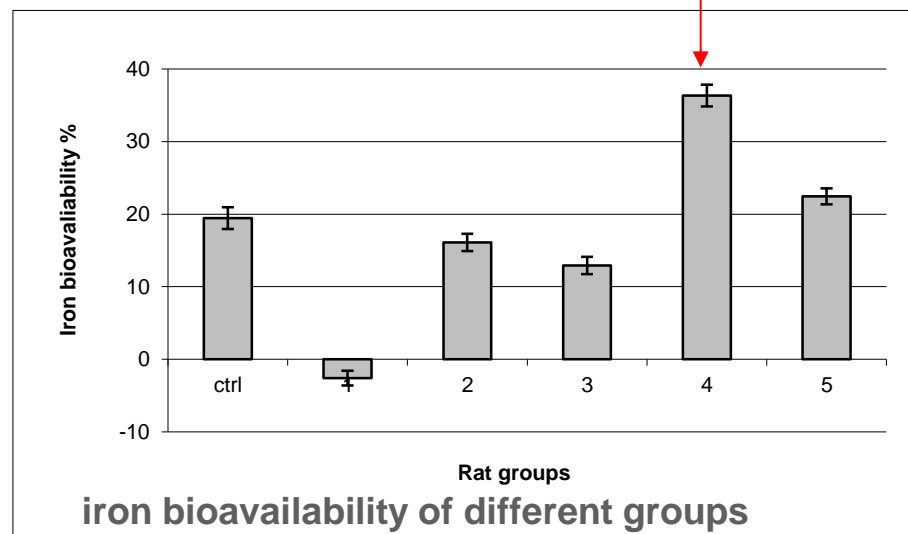
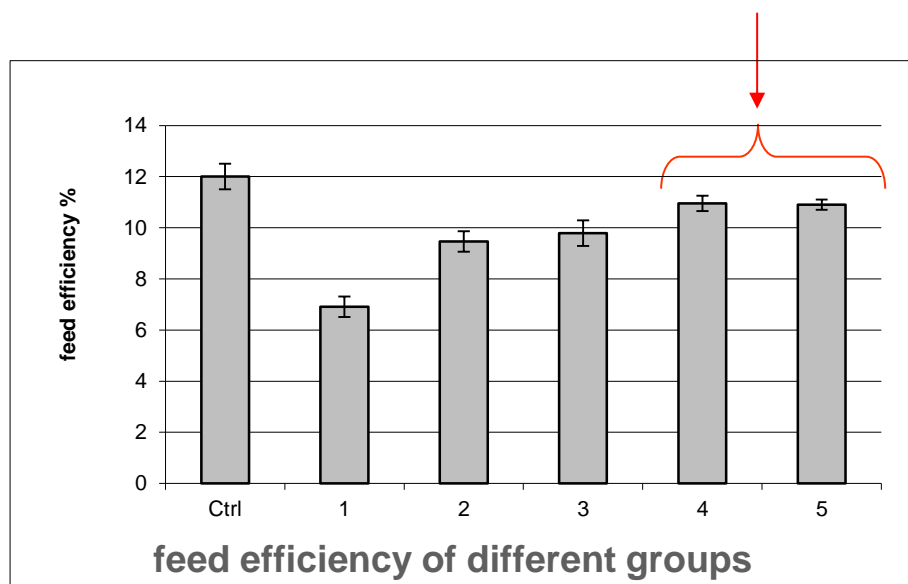
B-feeding on iron enriched yeast



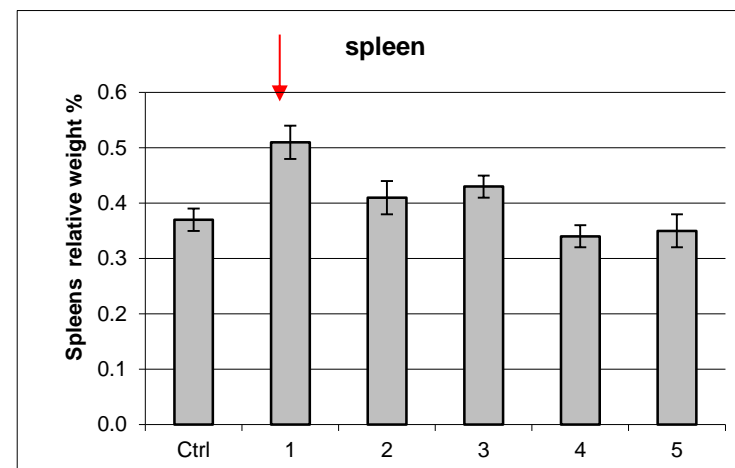
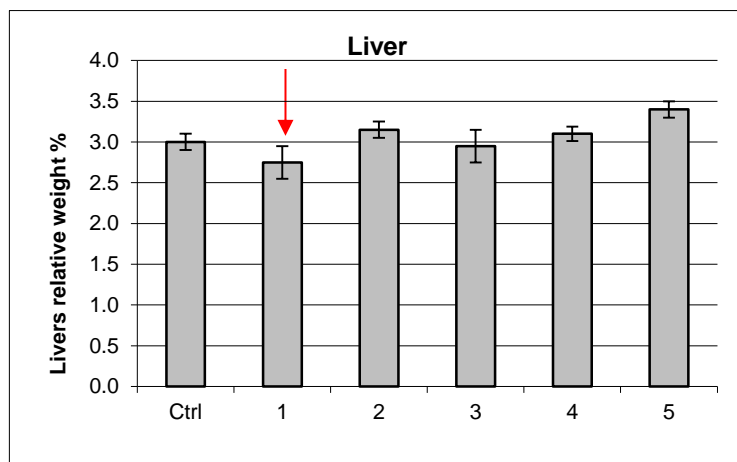
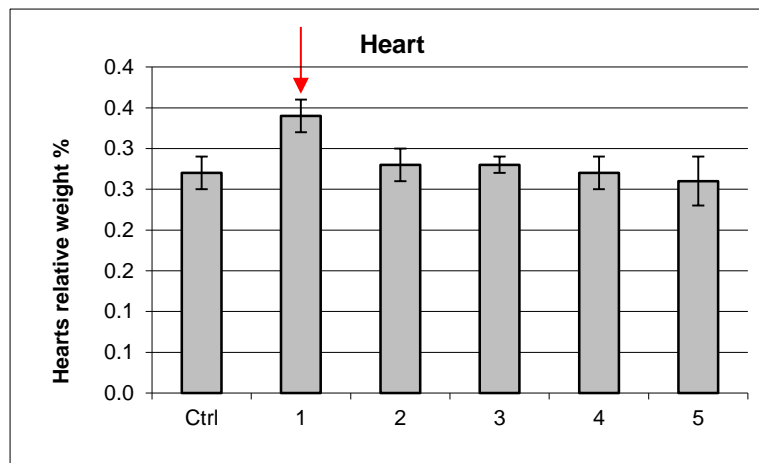
Food efficiency and iron bioavailability of rats in different treatments

- Feed efficiency: A measure of an animal's **efficiency** in converting **feed** mass into body weight
- Feed efficiency % = Body weight increase / total food intake
- Iron bioavailability is the extent to which iron is absorbed from the diet and used for normal body functions.
 - A function of the relationship between body weight and total haemoglobin content

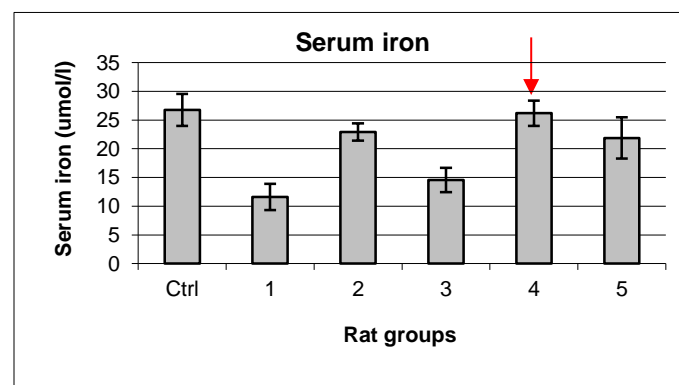
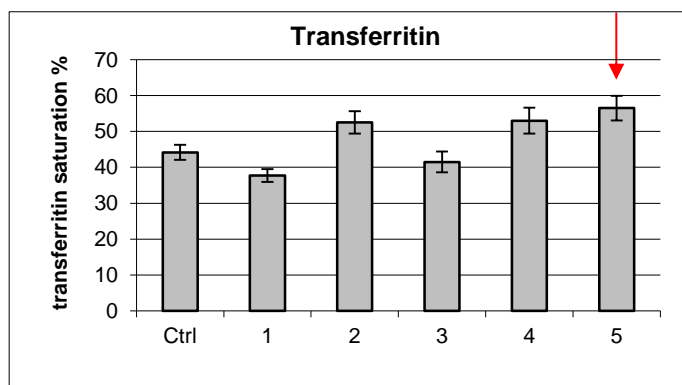
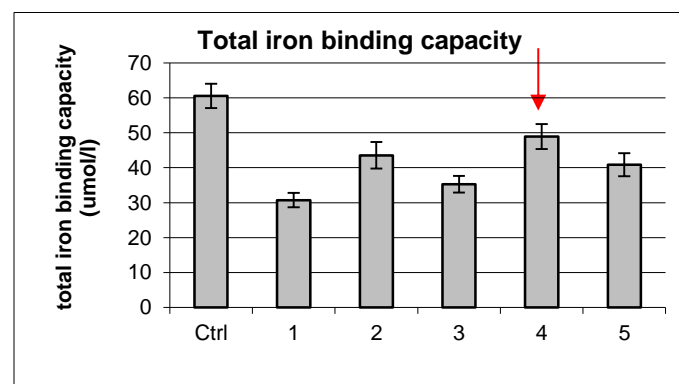
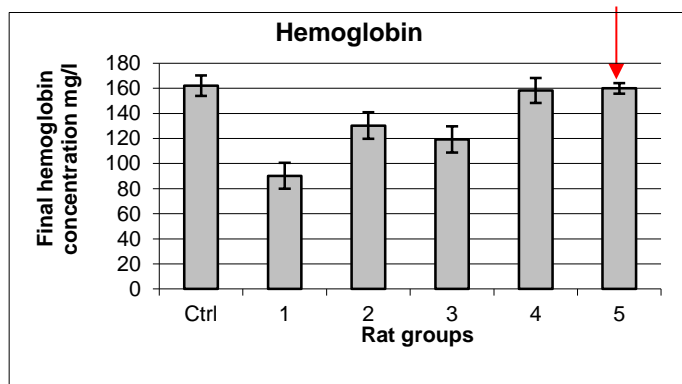
Food efficiency and iron bioavailability of rats in different treatments



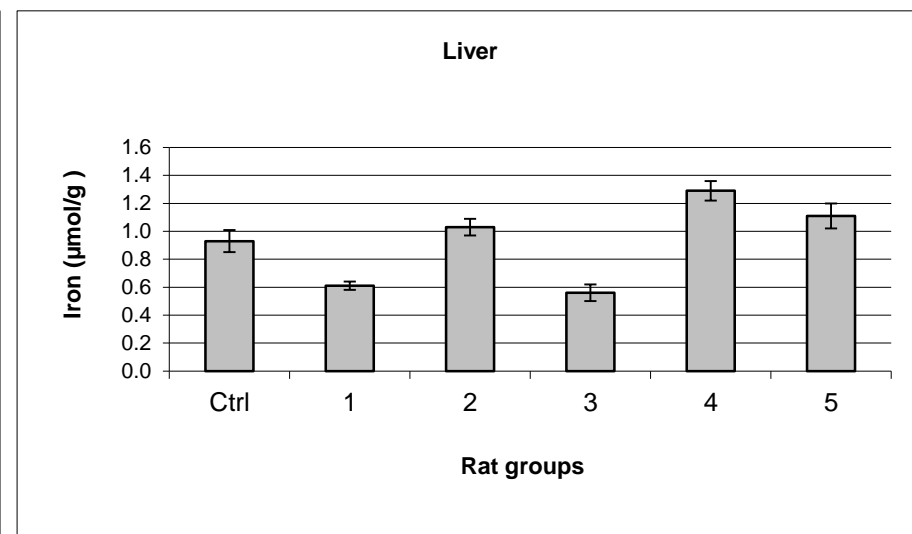
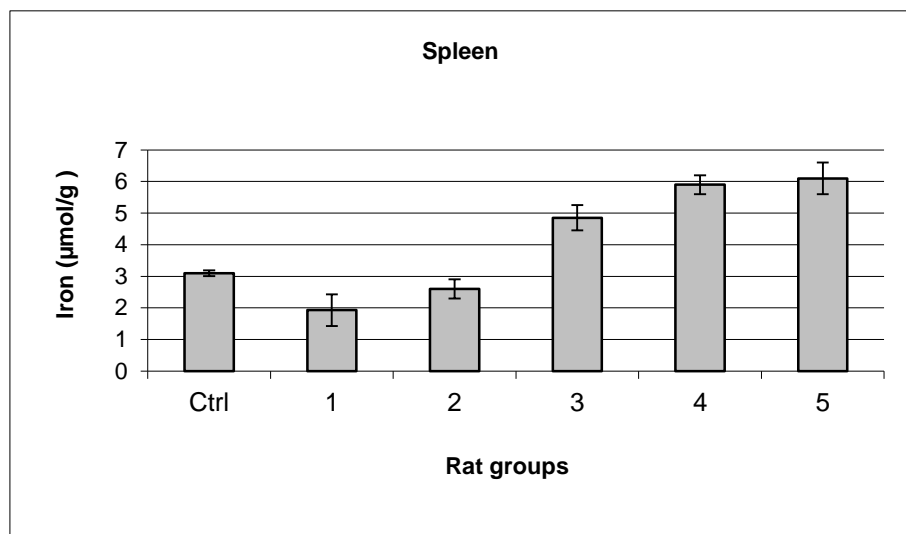
Relative weight of organs from rats within each test group



Analysis of blood parameters from rats within each test group

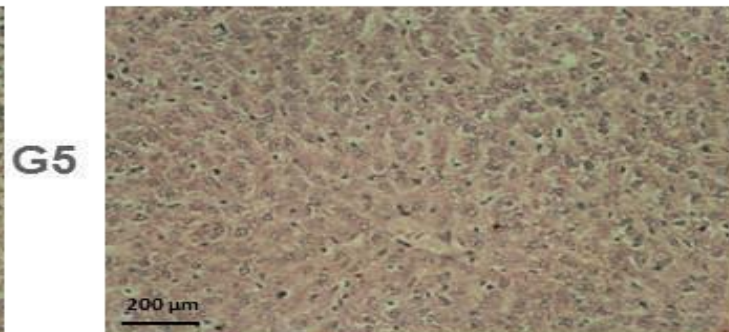
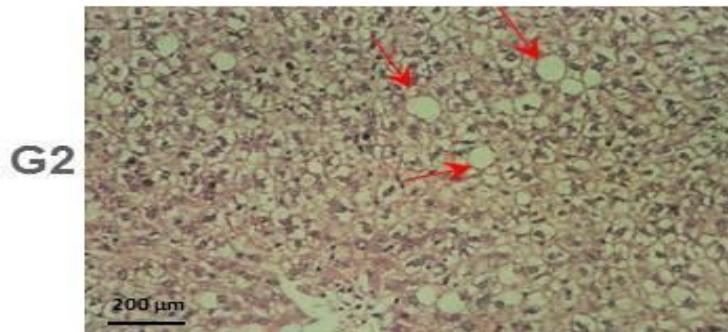
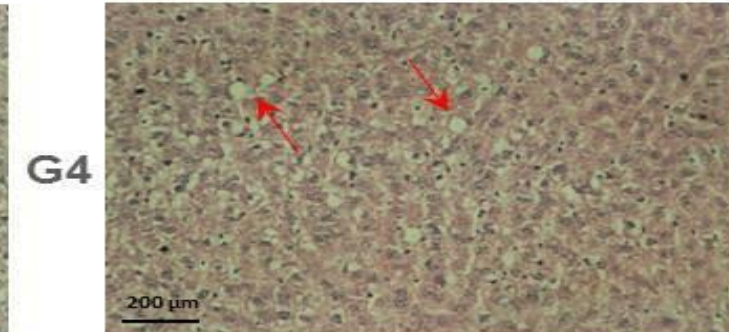
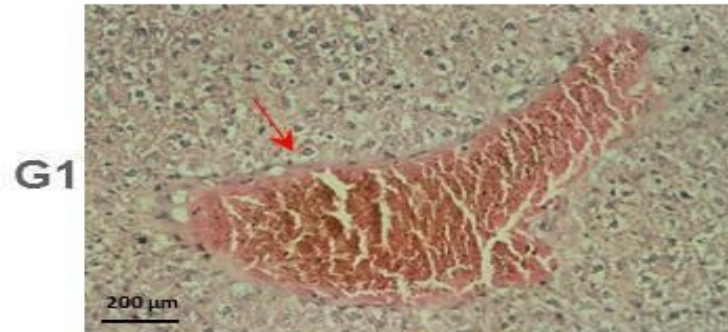
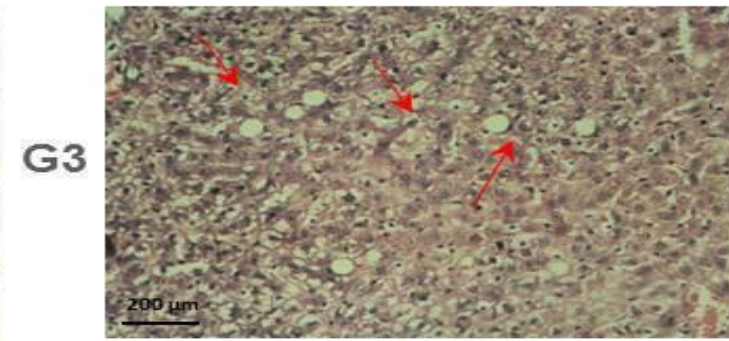
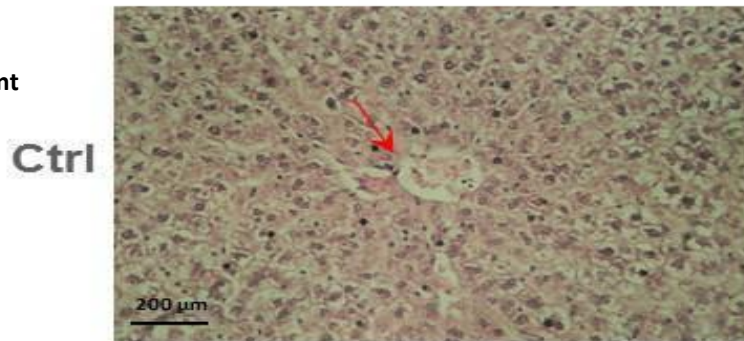


Iron accumulation in tissues



Rat liver sections from each sample group

- Ctrl: Basal diet all experiment
- G1: Iron deficient diet all experiment
- G2: Basal (inorganic)treatment
- G3: Basal treatment + dry yeast
- G4: enriched yeast 15 mg/Kg diet
- G5: enriched yeast 30 mg/Kg diet



Images reflect H&E staining in each instance

Rat heart sections from each sample group

Ctrl: Basal diet all experiment

G1: Iron deficient diet all experiment

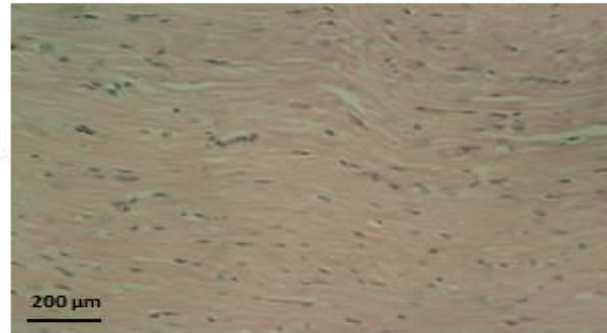
G2: Basal (inorganic)treatment

G3: Basal treatment + dry yeast

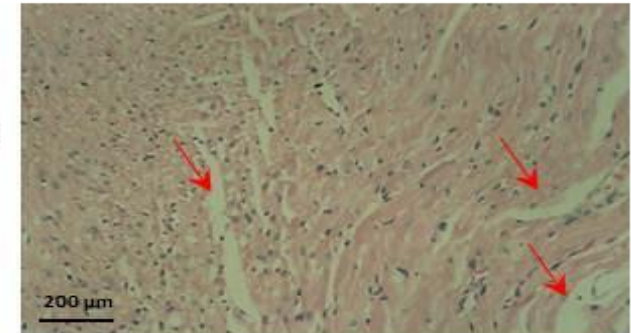
G4: enriched yeast 15 mg/Kg diet

G5: enriched yeast 30 mg/Kg diet

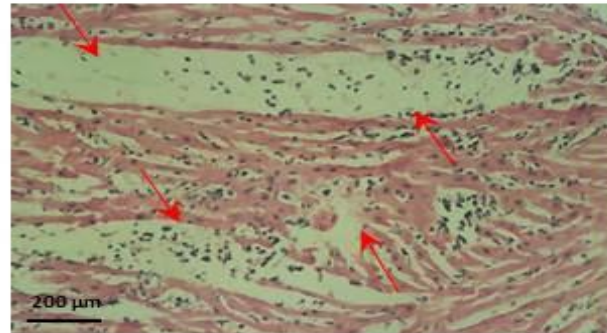
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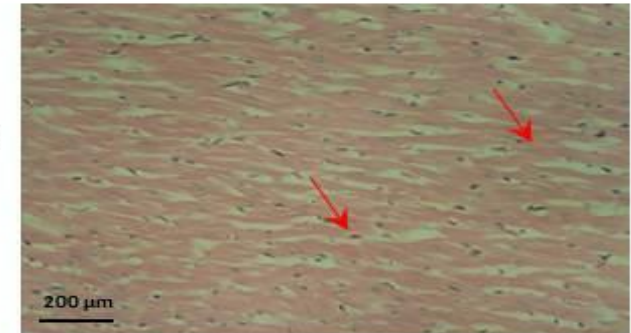
G3



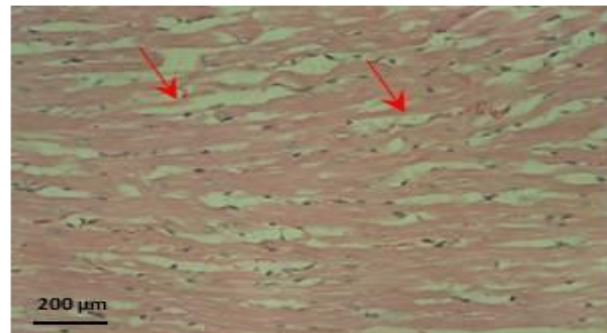
G1



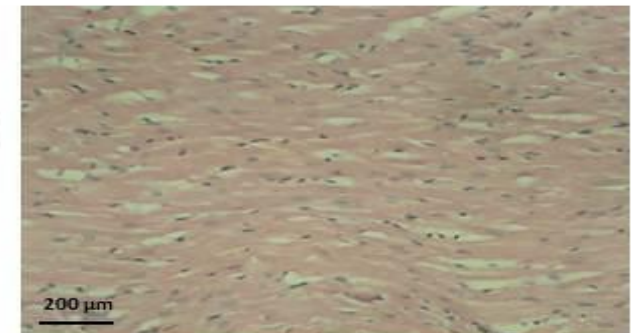
G4



G2



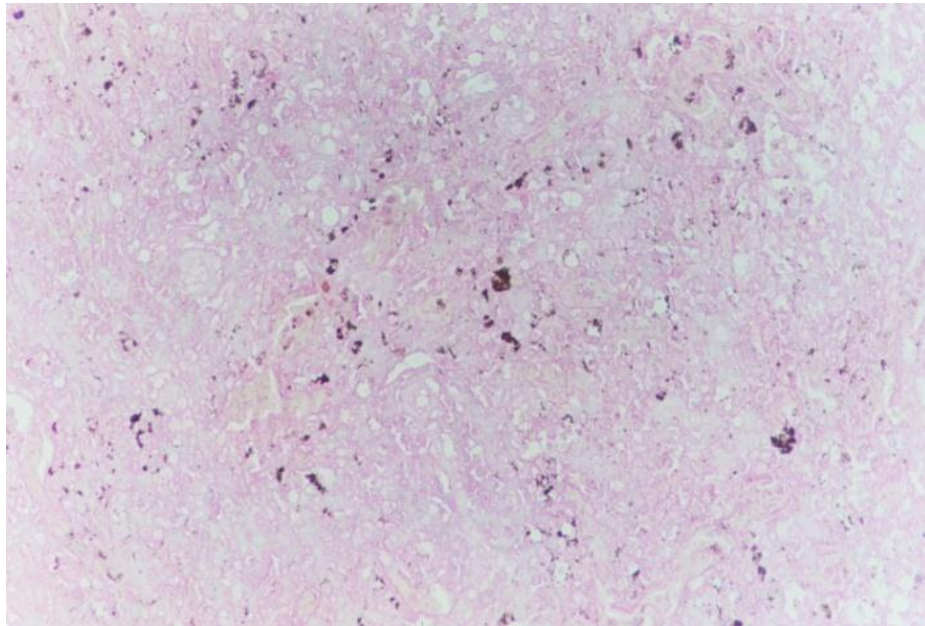
G5



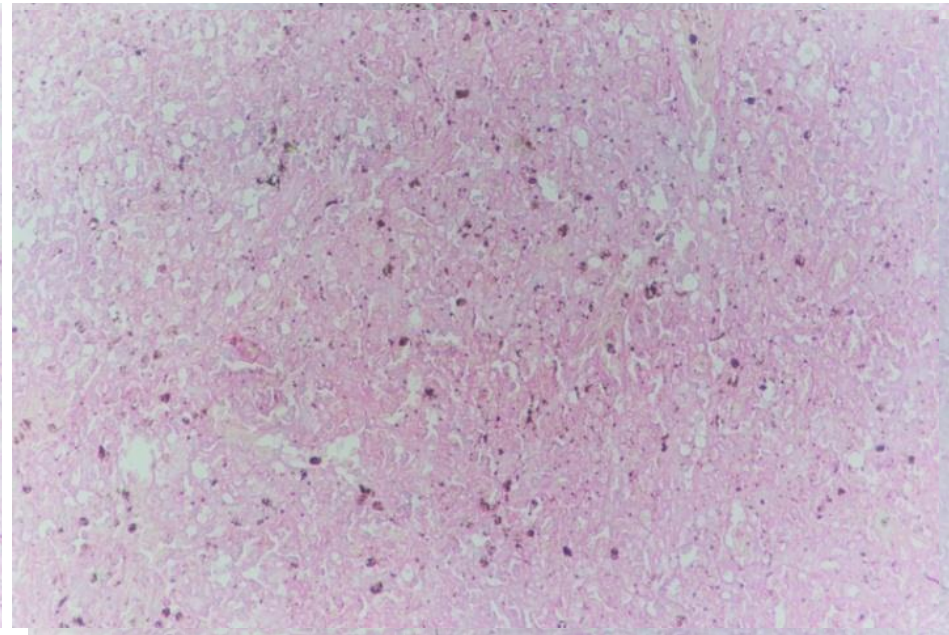
Images reflect H&E staining in each instance

Rat spleen sections from each sample group

- The spleen functions as a biological store of iron in the body
- Dark spots indicates iron disposition in the spleen tissue of rats



ctrl



G2

Images reflect Prussian Blue staining in each instance

Conclusions

- Yeast iron enrichment was successfully achieved:
 - Using 1 % Ammonium iron(III)Citrate
 - Without effecting dough rising power
- Iron enriched diets led to:
 - Improved blood parameters
 - Feed efficiency
 - Iron bioavailability
 - Histological parameters
- Feeding anemic rats with organic iron via ingestion of enriched yeast led to:
 - Greater improvement over non-organic supplements for all parameters
 - Data was similar for supplementation with organic iron at both 15 and 30 mg Fe/Kg

Further investigations – Current work at UON

- Analysis of the potential for applying the enrichment process using an industrial growth medium (molasses)
- The effect of iron enrichment on the cellular protein profile in a range of baker's yeast strains
- The effect of iron enrichment on loaf properties (leavening, odour and taste)
- The potential for iron-enriched bread as a protectant and/or treatment for iron deficiency.

Acknowledgments

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Cairo University, Egypt, where this work was initiated

