

# ADDING NUTRITIONAL VALUE TO LENTILS (*LENS CULINARIS* MEDIK.)



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# Iron (Fe)



Most abundant mineral on Earth and the most abundant trace mineral in the body

**Iron deficiency = most common nutrient deficiency in world**

# Fe and its Deficiency



Anemia



Decreased aerobic performance



Thermoregulation disorders

Major consequences of iron deficiency

*(Hope, et.al., 2008)*



Fatigue



Maternal and child mortality



Immunes system alterations



Altered cognitive functions

# Causes of Fe Deficiency

➤ Nutritionally unbalanced food supply



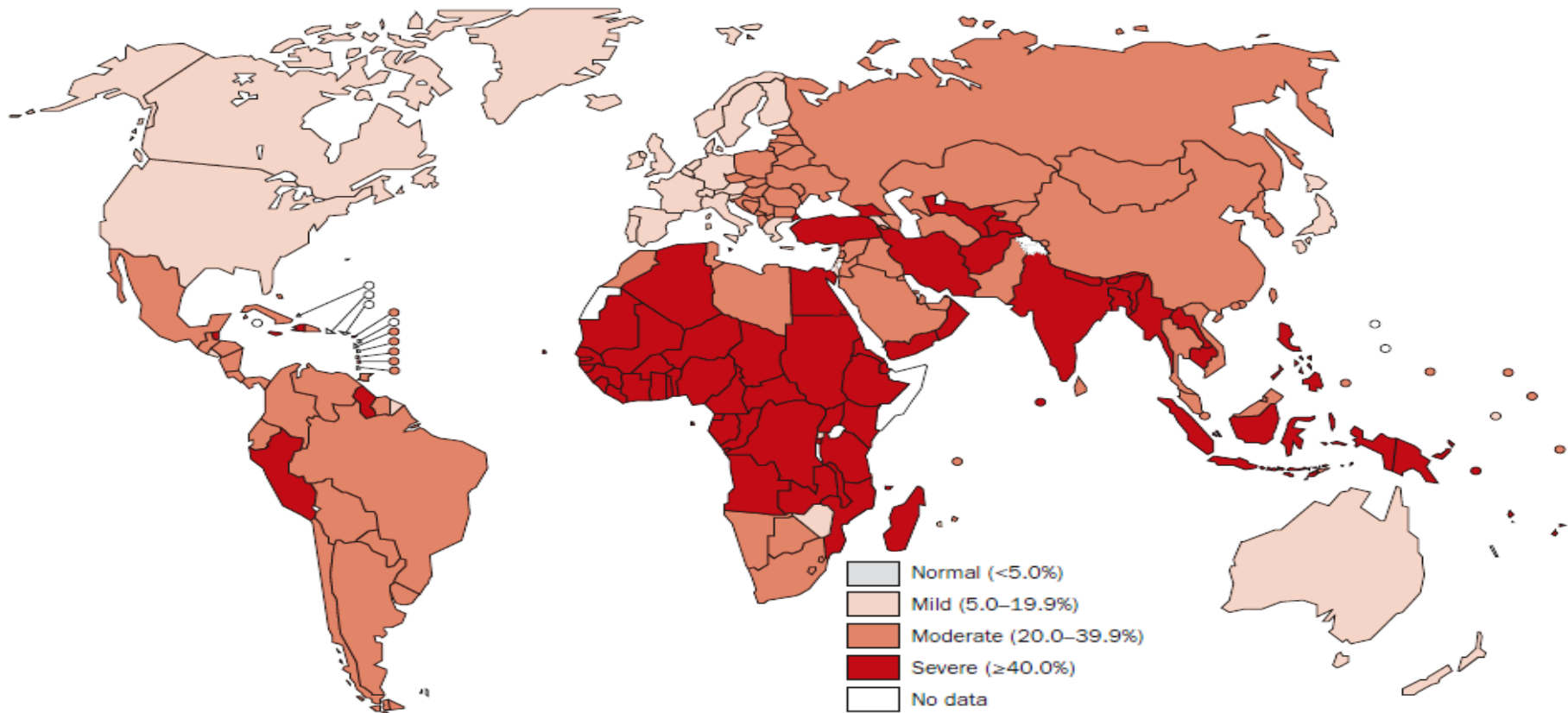
➤ Food habits



➤ Socio-economics (poverty)



# Anemia Prevalence Worldwide



Ref.: [http://whqlibdoc.who.int/publications/2008/9789241596657\\_eng.pdf?ua=1](http://whqlibdoc.who.int/publications/2008/9789241596657_eng.pdf?ua=1)

>60% preschool aged children and > 40% pregnant and non pregnant women in South east Asia and Africa are suffering from Fe deficiency anemia, [*World Health Organization, 2008*]

# Lentil (*Lens culinaris* Medik.) – a carrier of iron

- ❑ Lentil is the sixth most important pulse crop
- ❑ Good source of protein, fiber, minerals, vitamins, and antioxidants
- ❑ Excellent source of micronutrients (Zn, **Fe**, and Se) [*Thavarajah et al. 2011*]
- ❑ **Saskatchewan** is the world's largest lentil producer and exporter



# Lentil – a carrier of iron

## Fortification

The practice of *deliberately increasing the content* of an essential micronutrient, i.e. vitamins and minerals,“ (WHO and FAO, 2005)

Study I: Identification of the optimum Fe fortificant for dehulled lentils

Study II: Sensory evaluation

Study III: Bioavailability test for fortified lentil samples

# Investigation of Fortification of Lentils

## Study I: Identification of the optimum Fe fortificant for dehulled lentils

### **Hypothesis:**

It is possible to fortify iron in de-hulled pulses in a biologically and culturally meaningful way

### **Objectives:**

- a) Determine the most suitable iron fortificant for de-hulled lentils based on cost, ease of fortification and
- b) Determine the optimal processing technology to fortify iron in de-hulled lentils based on current processing practices



# Investigation of Fortification of Lentils

## Materials and Methods:

- Lentil genotype (CDC Maxim)



- Selection of dehulled lentil product type for fortification



Polished football



Polished splitted



Unpolished football



Unpolished splitted

# Selection of appropriate method for fortification

Fortified Lentil Samples

Polished football  
directly soaked in  
Fe solution



Polished football  
rinsed after adding  
Fe solution



Polished football  
oven dried before  
adding Fe solution



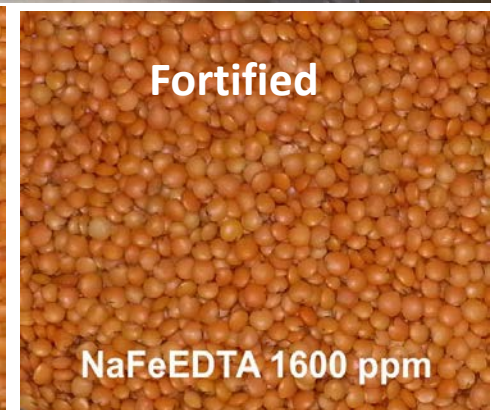
Polished football  
rinsed before adding  
Fe solution



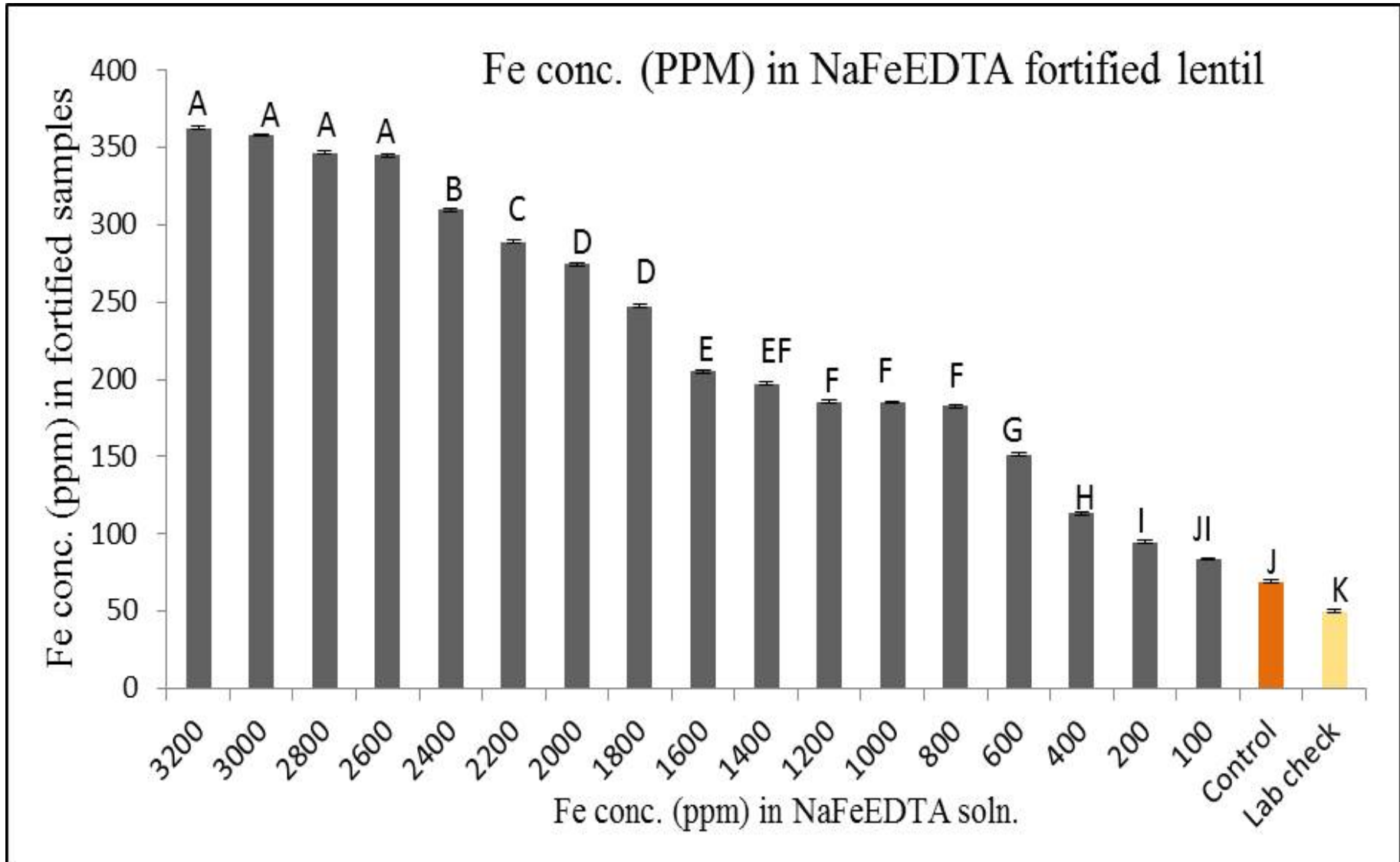
**Polished football**

## Selected method for adding Fe solution

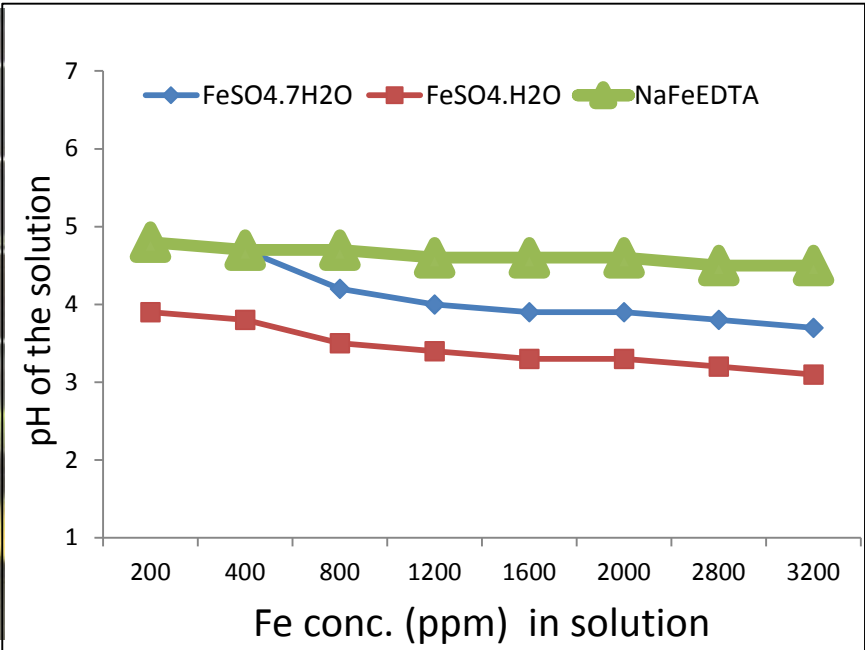
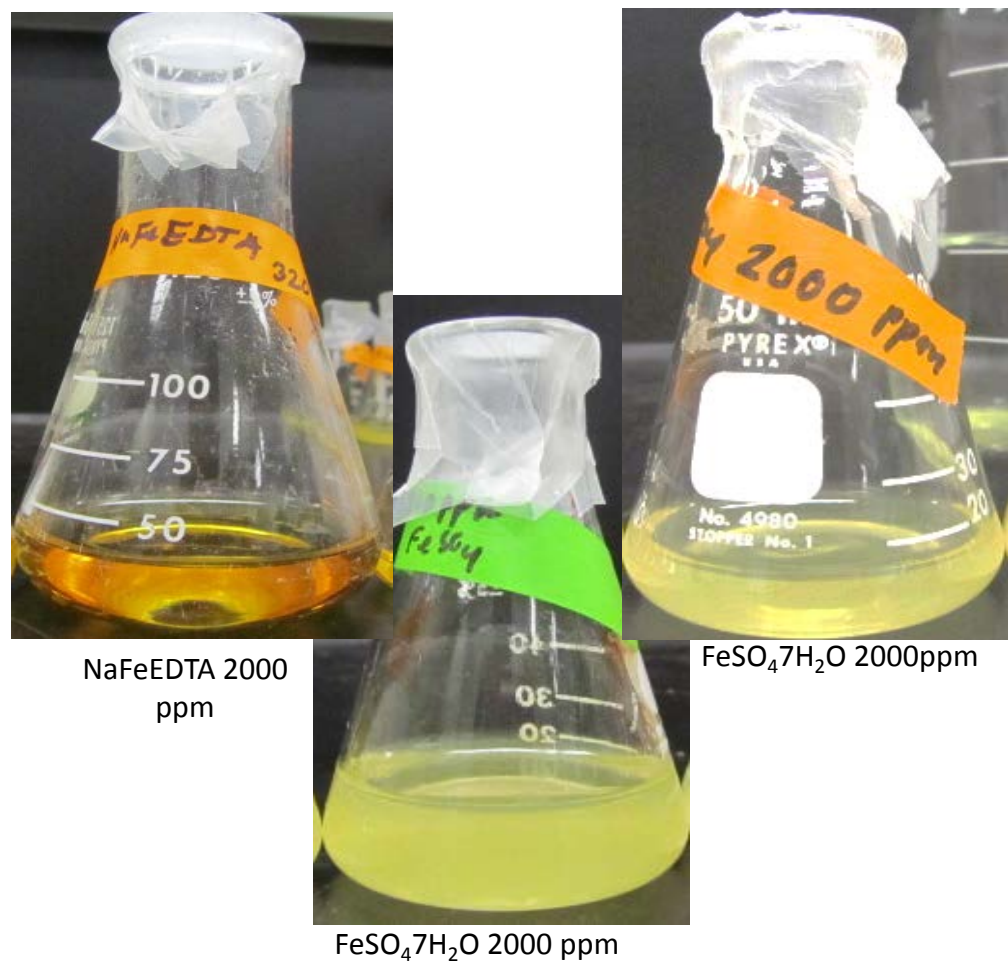
- Small sprayer (16 oz. clear fine mist spray bottle)
- 250 watt electric bulb
- Seventy five Degree temperature
- Barnstead Thermolyne M49235 Bigger Bill Orbital Shaker
- Duration: 10 minutes
- 10 ml/100g of dehulled lentil



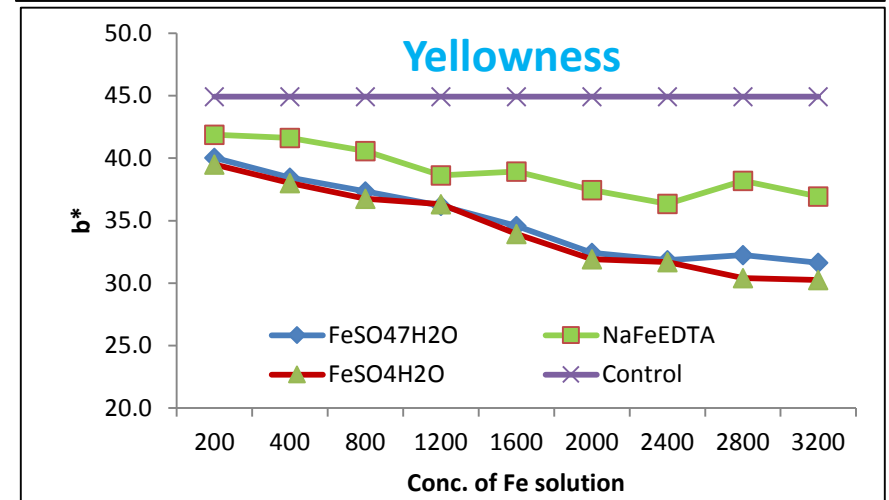
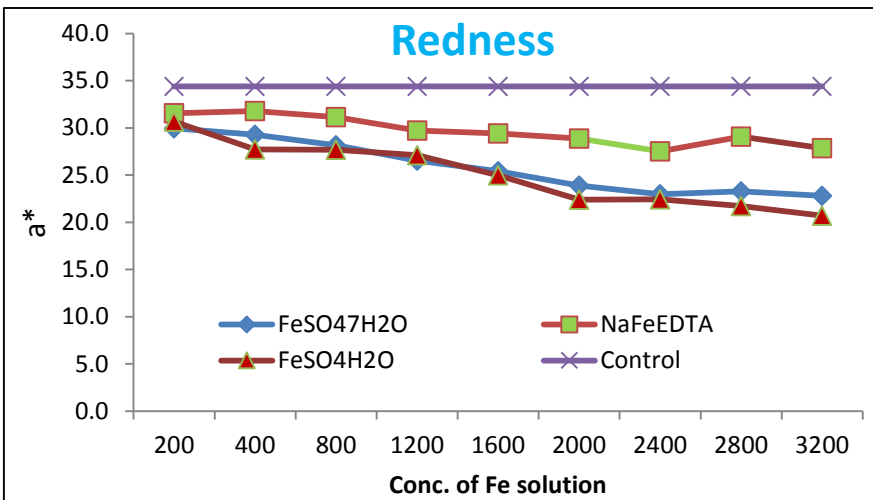
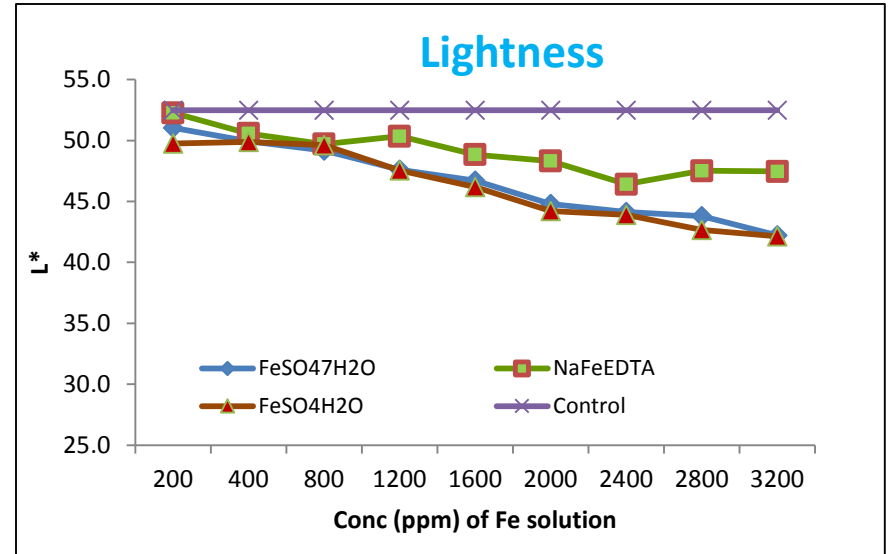
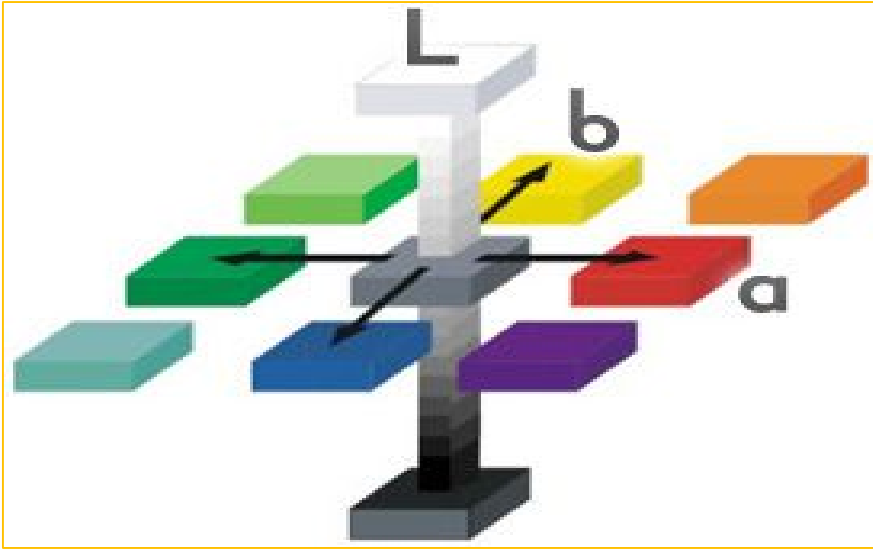
↑ Dose of Fe solution ↑ Fe conc. in seed



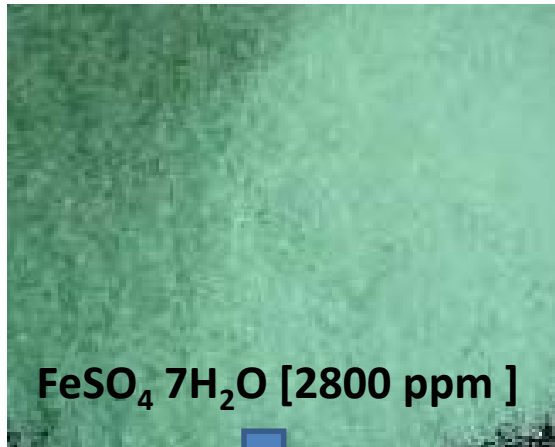
# pH decrease with the increase of doses ↓



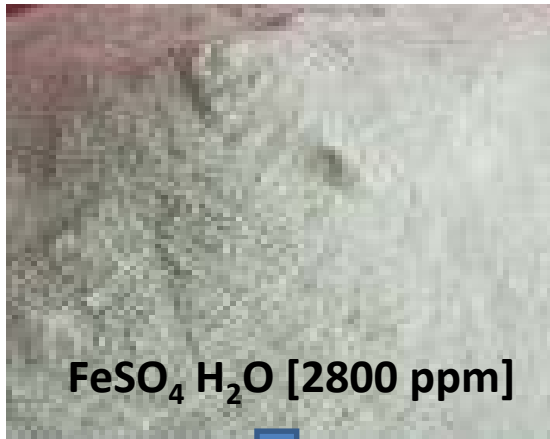
↑ Doses of fortificants ↓  $L^*$ ,  $a^*$  and  $b^*$  score



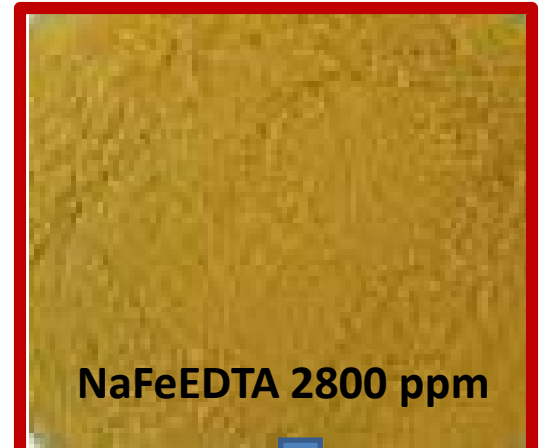
# Outcome from this study



$\text{FeSO}_4 \cdot 7\text{H}_2\text{O}$  [2800 ppm]



$\text{FeSO}_4 \cdot \text{H}_2\text{O}$  [2800 ppm]



NaFeEDTA 2800 ppm

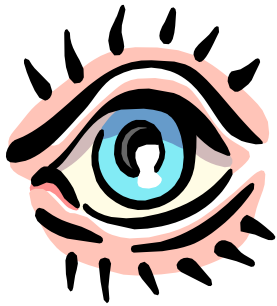


NaFeEDTA fortified lentil showed better performance in context to appearance and odor

# Study II: Sensory evaluation

“A scientific discipline used to evoke, measure, analyze and interpret those responses to products that are perceived by the senses of sight, smell, touch, taste and hearing.”

*Stone, H and Sidel, JL. 1993. Sensory Evaluation Practices. 2nd ed. Academic Press: San Diego.*





# Sensory Evaluation for ?

➤ It reduces



➤ It ensures a cost-efficient delivery of new products with high consumer acceptability



# Human observers are good measuring instruments

- People can sometimes detect odorants at levels lower than what can be detected by an instrument
- Instruments can not measure liking

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**Objective: Determine sensory acceptability of fortified lentils – appearance and taste**

# Sensory evaluation

## University of Saskatchewan



45 Panellists were recruited from staff and students at **U of S** (2 replications)

## Bangladesh



98 consumers were selected

**Scale: A 9 point hedonic scale :**

[9=like extremely;

7=like moderately;

5=neither like nor dislike;

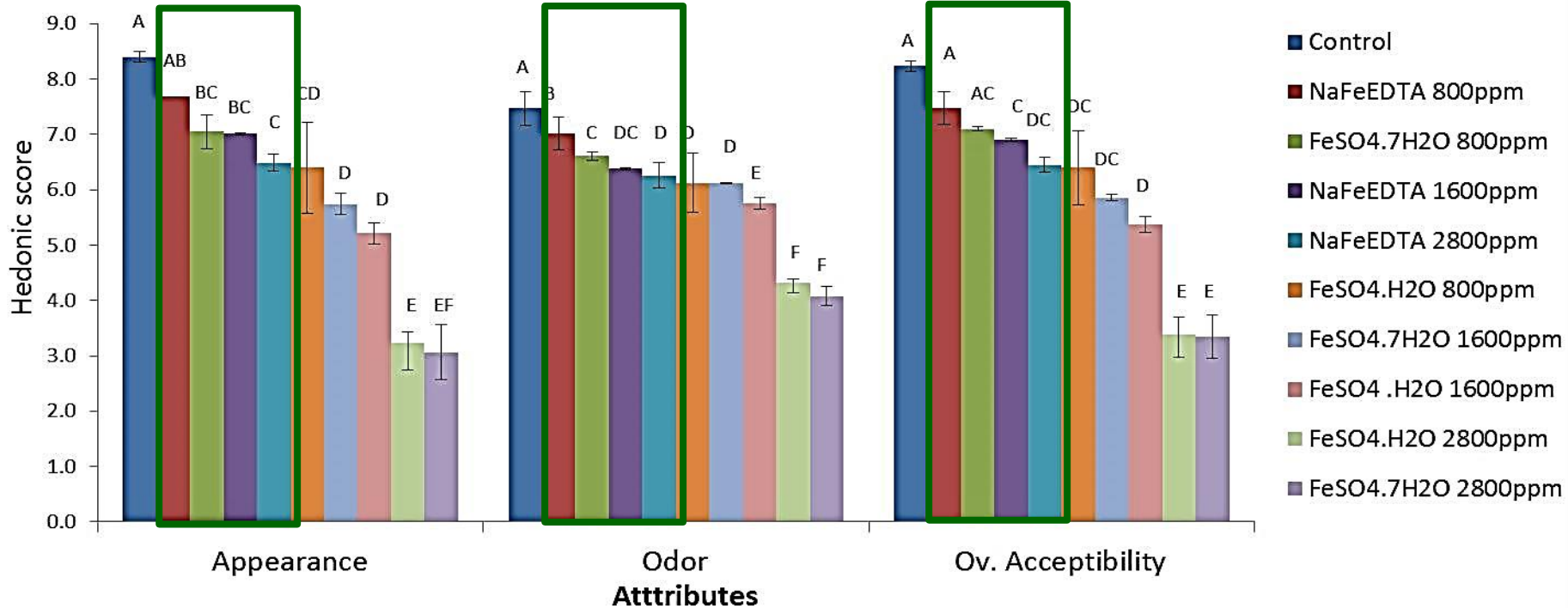
3=dislike moderately and

1=dislike extremely]

### Attributes

Uncooked	Cooked
Appearance	Appearance
Odour	Taste
Overall Acceptability	Odour
	Texture
	Overall Acceptability

# Sensory evaluation of uncooked fortified lentil samples - Saskatoon

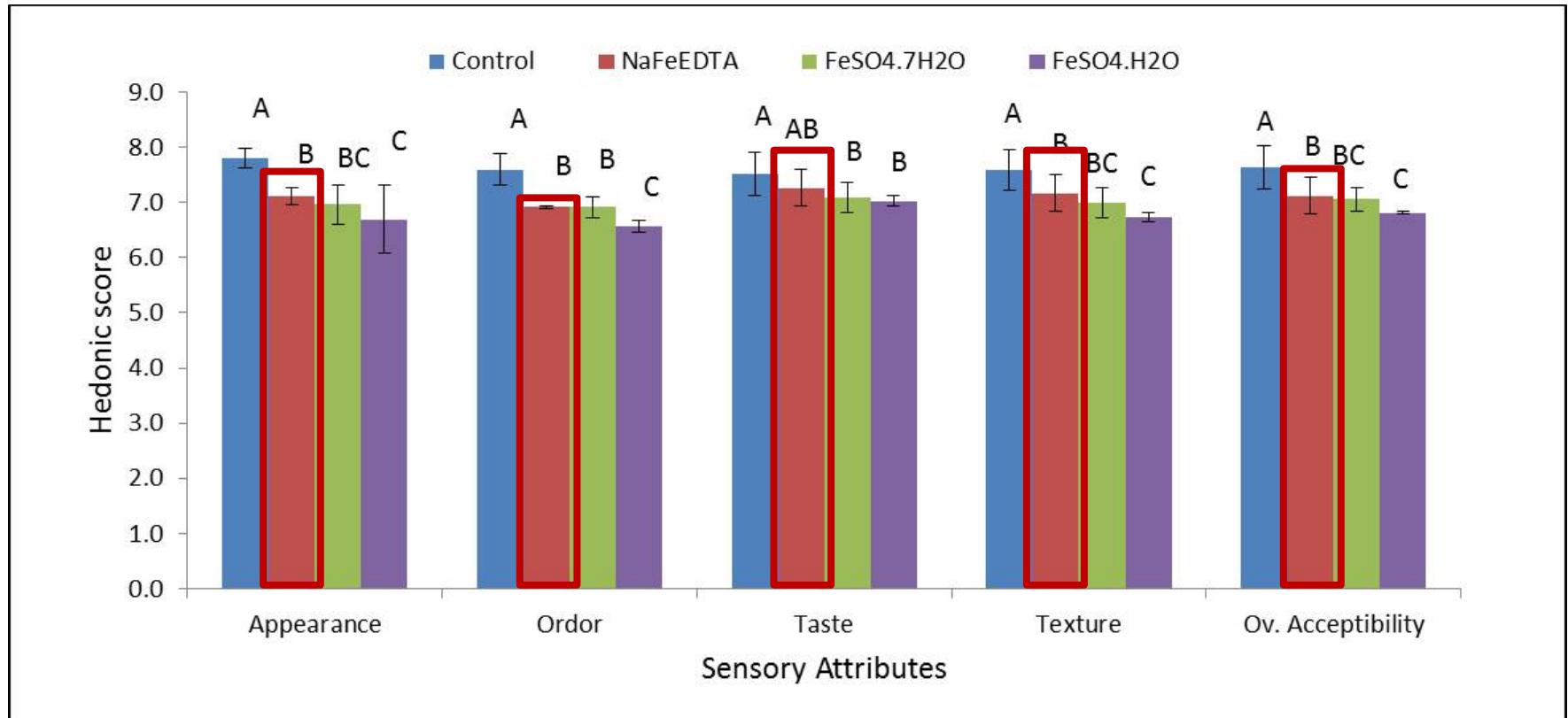


NaFeEDTA fortified lentil samples scored higher and accepted by panellist

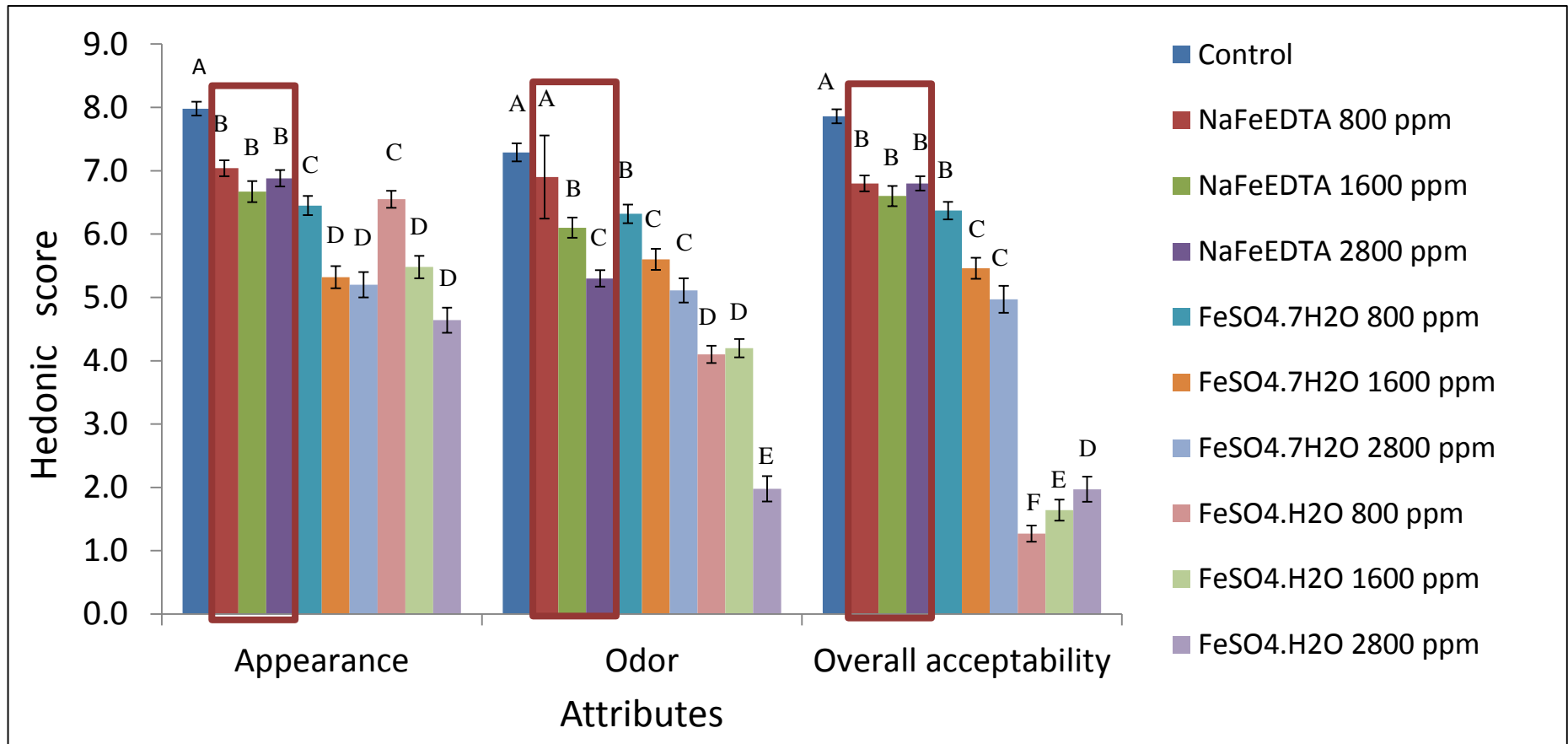
# Sensory evaluation for cooked fortified lentil samples - Saskatoon



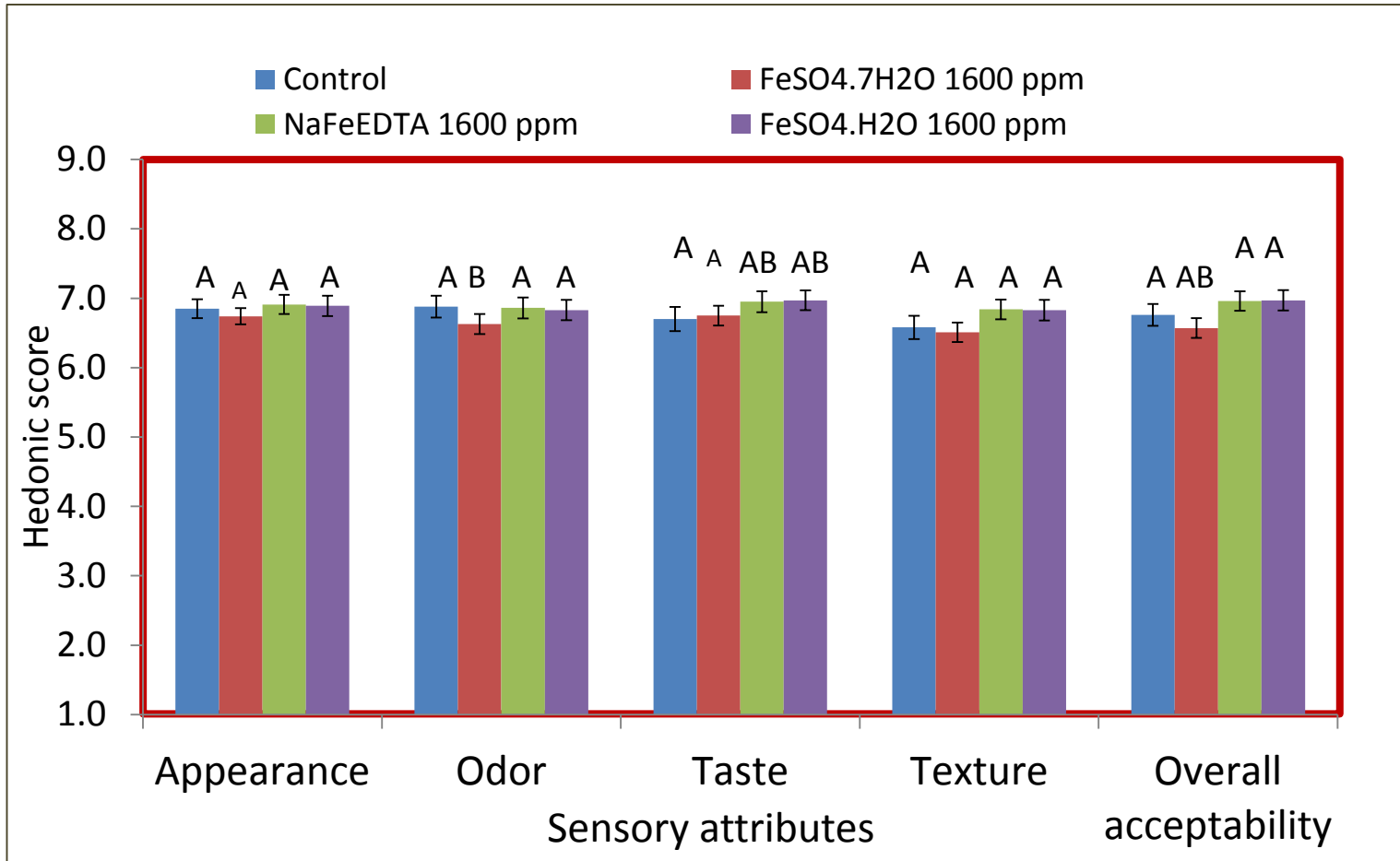
4 cooked samples (fortified with 1600 ppm Fe)



# Sensory evaluation in for uncooked samples - Bangladesh



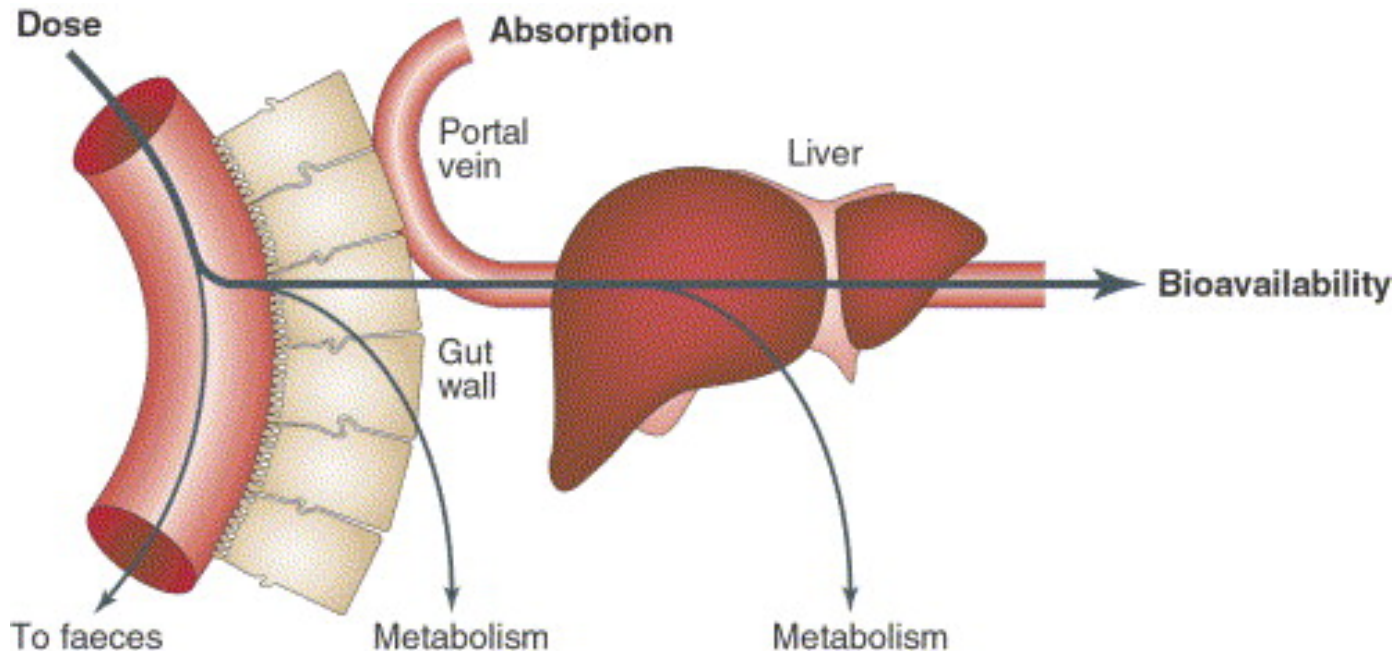
# Sensory evaluation for cooked samples - Bangladesh



# Bioavailability test for fortified lentil samples

**Bioavailability** - is a post-absorption assessment of how much of a nutrient that has been absorbed becomes functional to the system

Source: <https://www.tamu.edu/faculty/.../Lecture%2009%20Bioavailability.ppt>



Source: <http://plantbaseddietitian.com/tag/dr-howard-jacobson/>



## Objective

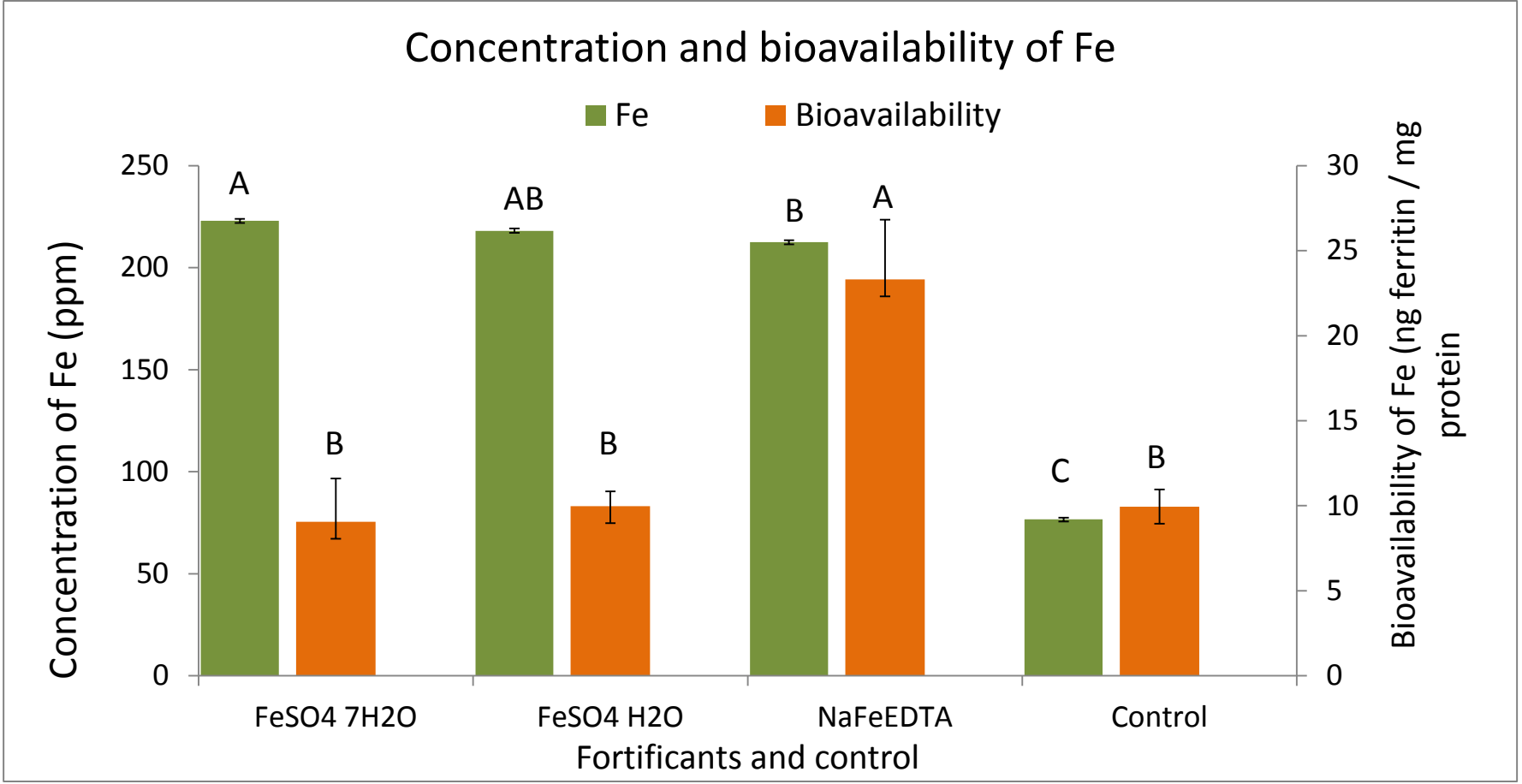
Determine the iron concentration and bioavailability of fortified lentils under relevant meal preparation methods

**Bioavailability** can vary according to:

- Individual nutritional status
- Other foods eaten
- Form of the mineral
- Presence of other minerals

# Fe absorbed from NaFeEDTA fortified lentil

Concentration and bioavailability of Fe



Laboratory: Dr. Raymond Glahn, USDA-ARS, Ithaca, New York using an *in vitro* digestion/Caco-2 cell culture bioassay (Glahn, 2009).

# Findings from the study

- Lentil can be used as a potential vehicle for Fe fortification
- NaFeEDTA is the most suitable iron fortificant for de-hulled lentils based on cost, ease of fortification, color change and others
- Fe-fortified lentils will provide significant health benefits to vulnerable populations

# Acknowledgements

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## Committee members:

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Dr. Carol J. Henry



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Chan

UofS CSFL Crews, BRAC University, Bangladesh  
Fellow graduate students



# Thank you for your attention

