

# Biofortification of pulse crops: whole food strategies to prevent micronutrient malnutrition

NDSU NORTH DAKOTA AGRICULTURAL EXPERIMENT STATION

Dil Thavarajah<sup>1\*</sup>, Casey R. Johnson<sup>1</sup>, Darshika Amarakoon<sup>1</sup>, Pushparajah Thavarajah<sup>1</sup>, Rebecca J. McGee<sup>2</sup>, Shiv Kumar<sup>3</sup>

<sup>1</sup>North Dakota State University, Harris Hall, 1250 Bolley Dr, Fargo, North Dakota, USA, 58108-6050.

<sup>2</sup>USDA Agriculture Research Service, Johnson Hall, Washington State University, Pullman, WA, 99164-6434, USA.

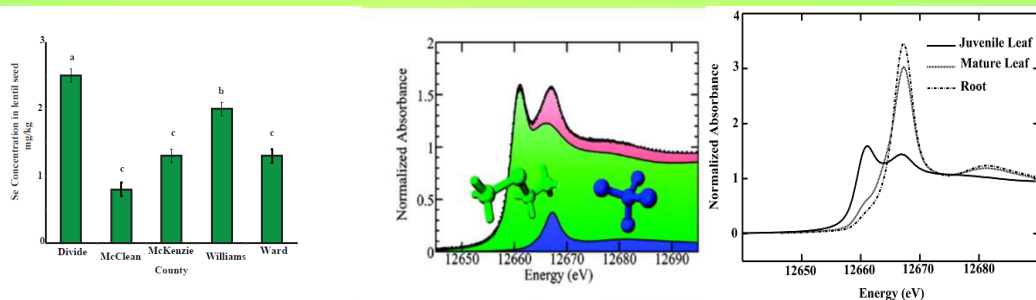
<sup>3</sup> International Center for Agricultural Research in the Dry Areas (ICARDA)/Rabat Office, PO Box 6299, Rabat-Institutes, Rabat, Morocco.

\*E-mail: dilrukshi.thavarajah@ndsu.edu

**Introduction:** Micronutrient malnutrition, mainly selenium (Se), iron (Fe), and zinc (Zn), and diet related obesity are major global health issues. The World Health Organization estimated 1.5 billion adults (age 20 and over) were overweight in 2008, and more than one of every ten adults worldwide were obese. Diets rich in refined carbohydrates increased calorie intakes and individual weight gains; however, whole food rich with complex and prebiotics carbohydrates could reverse this trend.

**Objective:** Our current research effort is to develop pulses as a possible whole food source to provide adequate daily Se, Fe, Zn, and prebiotic carbohydrate requirements through a 50g of single serving.

## Se concentration and forms in lentil seeds, leaf and root



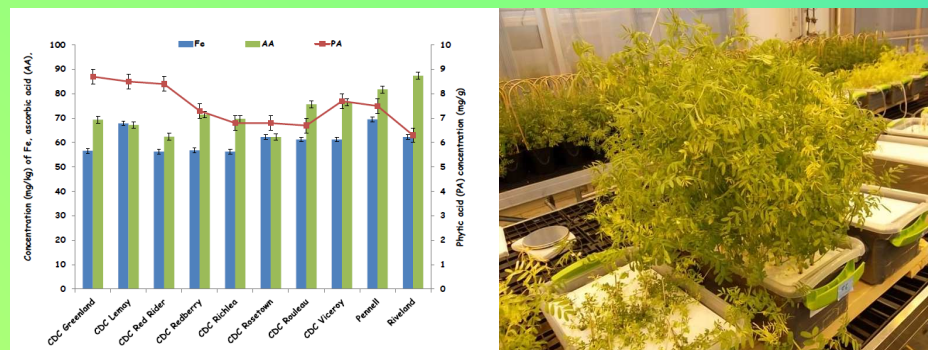
## References

1. D Thavarajah and P Thavarajah 2012. "Lentils (*Lens culinaris*L): a superior whole food solution to micronutrient malnutrition" In Micronutrients: Sources, Properties and Health Effects. Nova Science Publishers, Inc., NY, USA.
2. Thavarajah, D., Thavarajah, P., and Combs Jr, G. 2013. "Selenium in lentils (*Lens culinaris*L.) and theoretical fortification strategies" In "Handbook of Food Fortification and Health: From Concepts to Public Health Applications". Editor: Victor R. Preedy, King's College London, London, UK, Springer.



## Lentil genetic selection studies for Fe

NDSU NORTH DAKOTA STATE UNIVERSITY



## Lentil genetic selection studies for prebiotics

Market Class	Total Prebiotic Carbohydrate from 100g Serving (g)	Daily GOS Intake from 100g Serving (g)	Daily RS Intake from 100g Serving (g)
Extra Small Red	13.9	3.5	8.8
Small Red	12.3	3.9	6.9
Small Green	13.9	4.3	8.4
Medium Green	14.1	4.1	8.0
Large Green	13.3	4.4	7.4
Dark Green Speckled	13.5	4.0	8.2
Recommended Prebiotic Intake (g/day)	10 - 20g/day <sup>a</sup>	2 - 7g/day <sup>b</sup>	≤ 20g/day

## Key-results

- Lentils are rich in minerals: Se (500 - 2500  $\mu\text{g kg}^{-1}$ ), Fe (60 - 80  $\text{mg kg}^{-1}$ ), Zn (44 - 54  $\text{mg kg}^{-1}$ ), and with very low concentration of phytic acid (6 - 8  $\text{mg g}^{-1}$ ) and high in ascorbic acid.
- More than 90% of Se in lentils is organic Se
- The major prebiotic carbohydrates in pulses are fructans; a quarter-cup serving of lentils (30 g lentils by dry weight) could provide approximately 3.6 g of prebiotic carbohydrates.
- In addition to minerals and prebiotics, lentils are also rich source of beta carotene (1 - 5  $\text{mg kg}^{-1}$ ), bio-beneficial phenolics, and numerous folates.

