

# MICRONUTRIENT POWDERS: DOES THE ANTI-NUTRIENT CONTENT AFFECT THE *IN VITRO* BIO-ACCESSIBILITY OF IRON AND ZINC?

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INTEGRATED  
**nutrition**  
CONFERENCE

## Background

- Iron (Fe) & Zinc (Zn): essential micronutrients for child growth & development, learning capacity, appetite & immunity.
- Foods richest in Zn are from animal sources; not often in CF diets because of limited availability & access & food taboos
- Complementary Foods (CFs) & diets are rich in starchy staples; cereals, tubers and legumes, with low levels of bio-available Fe & Zn.
- Plant sources of Zn contain anti-nutrients; phytic acid & tannins

## Problem Statement & Justification

- Malnutrition affects economic dev & productivity; improvements boost GDP growth by 11% annually (Horton & Steckle, 2013).
- One in every two children in Kenya is anaemic or Zn deficient due to sub-optimal dietary intake & poor nutrient bioavailability.
- Micronutrient Powders (MNPs) are recommended as a High Impact Nutrition Interventions (WHO, 2011).
- Scarce information on the **bioavailability** of Fe & Zn in local CFs fortified with MNPs.

# Micronutrient powders



**VINYUNYIZIO VYA MADINI KWA CHAKULA**  
*Uongezeaji wa sacheti moja ya vinyunyizio kwa chakula mara moja kila siku kunagfanya watoto wanye afya na nguvu*



## Jinsi ya kuongeza vinyunyizio kwa chakula

Ongeza sacheti moja ya vinyunyizio kwa chakula mara moja kila siku



Changanya vinyunyizio kwa kiasi cha chakula chenye mitoto anaweza kumaliza kwa lisho moja



Baada ya kuongeza vinyunyizio kwa chakula changanya vizuri



Usigawanye chakula kyenye kimeongezewa vinyunyizio kwa watu wengine



Usiweke chakula ambacho kimeongezewa vinyunyizio kwa muda wa zaidi ya dakika thelathini



*Tafadhali agize vifurusi! Ikiwa sacheti ya vinyunyizio ulihamwika kuwepa pipu au taha kiche kichome*

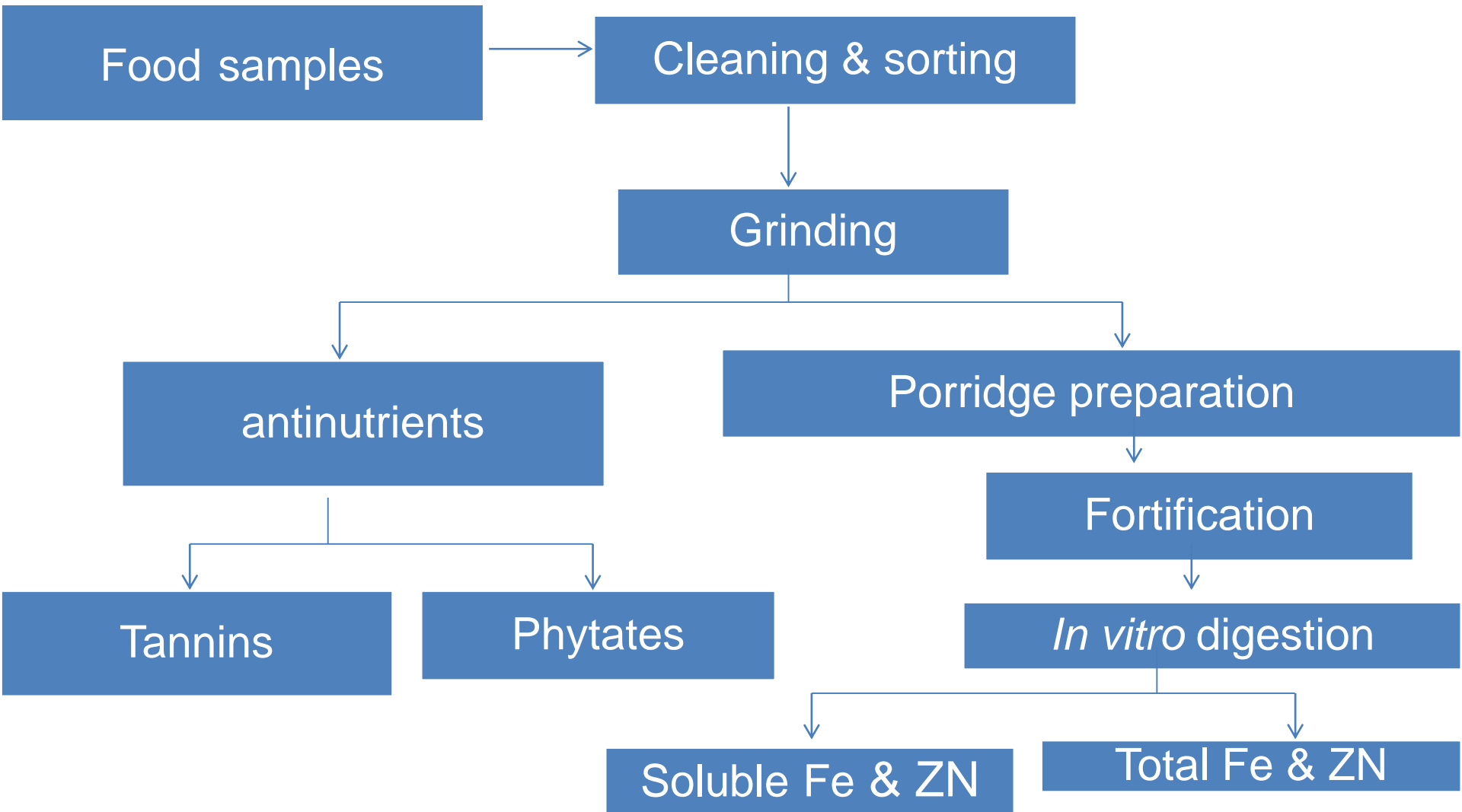


# Study Objectives

To:

- Compare the phytate & tannin content of selected local complementary foods (CFs).
- Establish the *in vitro* bio-accessibility of Fe & Zn in the MNP fortified CF porridges.
- To assess the relationship between anti-nutrient content and the micronutrient bioavailability of Fe & Zn.

# Methodology



## *In Vitro* Bioaccessibility Study

- Food Samples: Selected local foods; sorghum, finger millet, pearl millet, rice, potato, cassava & banana.
- Anti-nutrients: Determination method
  - Tannin - Follins-Dennis - UV-vis Spectro-photometry (Pearson, 1976).
  - Phytates- HPLC (Camire & Clydesdale, 1982).
- Enzymatic digestion - (Skibniewska, Kozirok, Fornal, & Markiewicz, 2002).
- *In vitro* Soluble fractions of Zn & Fe - Atomic Absorption Spectrophotometer (AAS Shimadzu-6200)-(AOAC, 1995; method 970.12).

# Results



## Tannin & Phytate content of CFs

	Tannin g/100g Mean±SD	Phytate g/100g Mean±SD
White Sorghum	0.20±0.02	0.73±0.07
Pearl millet	0.31±0.01	2.83±0.10
Finger millet	0.13 ±0.02	0.74±0.09
Maize	0.09±0.01	0.94±0.16
Cassava	0.06±0.01	0.74±0.11
Refined rice	0.05±0.01	0.11±0.04
Irish Potato	0.05±0.01	0.05±0.03
Banana	0.05±0.01	0.57±0.07

## Total & bio-accessible Fe & Zn in MNP fortified CF porridges<sup>dw</sup> (mg/100g)

	Total Fe	Soluble Fe (%)	Total Zn	Soluble Zn (%)
White Sorghum	20.2±1.1	0.3(1.2%)	15.3±1.3	2.2(14.1%)
Pearl millet	24.7±1.1	0.2(0.6%)	16.0±1.2	1.6(10.0%)
Finger millet	53.4±0.7	1.7(3.3%)	22.0±1.7	<b>3.4(7.3%)</b>
Maize	18.5±1.9	0.1(0.6%)	17.4±1.3	1.6(19.5%)
Refined rice	14.4±1.5	<b>3.0(20.7%)</b>	15.7±0.8	1.8(11.2%)
Cassava	18.8±0.8	0.8(4.3%)	14.1±1.0	3.3(23.6%)
Irish Potato	27.1±1.9	0.5(1.9%)	17.5±1.4	2.5(14.1%)
Banana	34.7±1.4	0.9(2.7%)	20.4±1.2	3.2(15.8%)

## Phytate (PA) mineral ratios

	PA/Fe	PA/Zn
White sorghum	<b>3.07±0.45<sup>†</sup></b>	4.72±0.34
Pearl millet	<b>9.70±0.10<sup>†</sup></b>	<b>17.40±0.69<sup>†</sup></b>
Finger millet	<b>1.17±0.12<sup>†</sup></b>	3.30±0.13
Maize	<b>4.29±0.28<sup>†</sup></b>	5.32±0.49
White rice	0.67±0.20	0.72±0.26
Cassava	<b>3.35±0.39<sup>†</sup></b>	5.19±0.46
Irish Potato	0.16±0.09	0.31±0.18
Banana	<b>1.39±0.23<sup>†</sup></b>	2.74±0.41

<sup>†</sup> Low bioavailability; **PA/Zn >15**(Gibson et al., 2006), **PA/Fe>1**(Hurrell & Egli, 2010)

## Relationship between Anti-nutrients content and Fe & Zn solubility (Pearson's correlation)

- Significant positive relationship between tannin content and zinc bio-accessibility ( $r = 0.405$ ,  $p = 0.008$ ).
- Iron bio-accessibility decreased significantly with increase in tannin content ( $r = -0.311$ ,  $p = 0.045$ ).
- Fe bio-accessibility decreased significantly ( $r = -0.385$ ,  $p = 0.012$ ) with increased phytate content.
- No significant relationship was observed between Zn bio-accessibility and phytate content ( $r = -0.072$ ,  $p = 0.652$ ).

## Conclusions

- Unrefined cereals (maize, sorghum & millets) contain high levels of phytates & tannins compared to tubers, banana & refined rice.
- *In vitro* bioaccessibility of Fe negatively correlated with Phytate and tannin content.
- *In vitro* bioaccessibility of Zn positively correlated with tannins and no significant relationship with phytate content.
- PA/Fe ratios adequate for potato & white rice but high in other products.
- PA/Zn ratios adequate for all products except pearl millet.

## Recommendations

- MOH & other development partners to embrace MNP home fortification strategy for improving the total Fe & Zn content of CFs.
- However, implementors of Home fortification programmes (MOH, NGOs, CBOs) should consider strategies of improving bioavailability of Fe in the MNP fortified cereal products.
- Product development by processors to embrace fermentation & other technologies for enhanced micronutrient bioavailability of cereal based CFs.

## Research gaps

Need to:

- Investigate effects of processing technologies e.g fermentation on Fe & Zn bioavailability in MNP-fortified local CFs.
- Develop predictive models for *in vitro* bioavailability of micronutrients to guide MNP fortification programs.
- Conduct evidence based studies (RCT) on efficacy of MNP fortification of local CFs on micronutrient status of children.

# Acknowledgement

- Funding scheme:
  - National Commission for Science, Technology and Innovation (NACOSTI)
  - CODESRIA
  - AAU Thesis writing Grant
  - KU research grants



THANK YOU