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Reducing hidden hunger beyond the Millennium Development Goals: *lowering phytic acid in maize for food and nutrition security*

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Introduction and background

- Maize is an important cereal crop in sub-Saharan Africa
- However, maize is associated with poor nutritional value due to an anti-nutritional factor called phytic acid which binds minerals, reducing their absorption (Coulibaly et al, 2011).

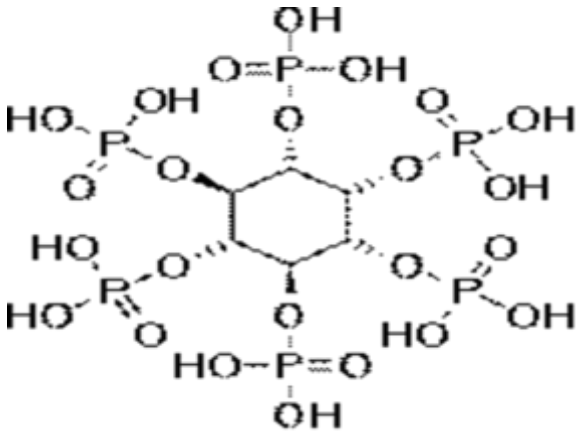


Fig. 1: Phytic acid (PA) structure

- This leads to micronutrient deficiency causing hidden hunger (FAO, 2012)
- Several nutrition-based interventions have been introduced in South Africa but there is limited success reported in reaching rural poor households (Pillay et al,2013).
- An agricultural-based intervention targeting rural poor households needs to be investigated.

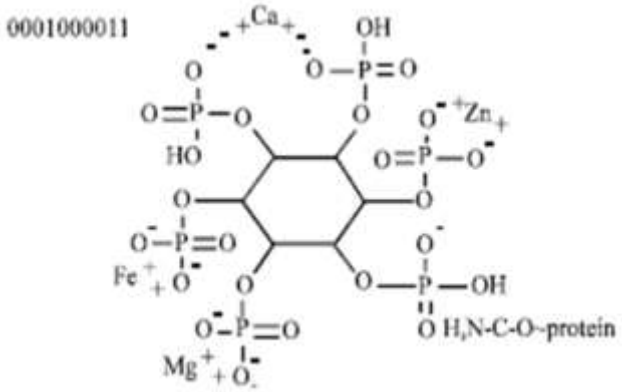


Fig. 2: PA structure bound minerals

Problem statement

- 70% of rural HH in sub-Saharan rely on agriculture
- Maize in Africa is ranked second after cassava (Hoisington and Melchinger, 2005)
- However, maize has limited nutritional value
- Literature shows that traditional maize processing method have a potential to lower phytic acid content and increase bio-availability of minerals (Raes et al, 2014)
- Little is known if consumers are aware of the nutritional benefits of using maize traditional processing methods
- There is a risk of losing the traditional maize processing methods due to modernisation
- There is still limited accessible nutrition-based interventions to improve rural household food and nutrition security.
- There is a need to find a maize variety with low phytic acid

Research objectives

- To reduce the phytic acid content in maize
- To determine if the households were aware of the nutritional benefits of using the various traditional processing **(TPs)**methods on maize-based foods

Materials and methods

- Molecular marker assisted selection (MAS) was used to breed the *lpa* genes from a temperate line (CM32, non-adapted) into a tropical line (LP16) – high yielding line; adaptive to South African conditions **BUT** it has high phytic acid content
- 61 F9 maize progeny lines were derived from the F2 cross LP16 x CM32 using MAS
- The progeny lines were assayed for phytic acid content
- Seeds were sent for DNA analysis for *lpa* genes
- To detect the *lpa*1-1 gene, the Rotor-Gene 6000 real time rotary analyser was used

Quantitative: Phytic acid determination

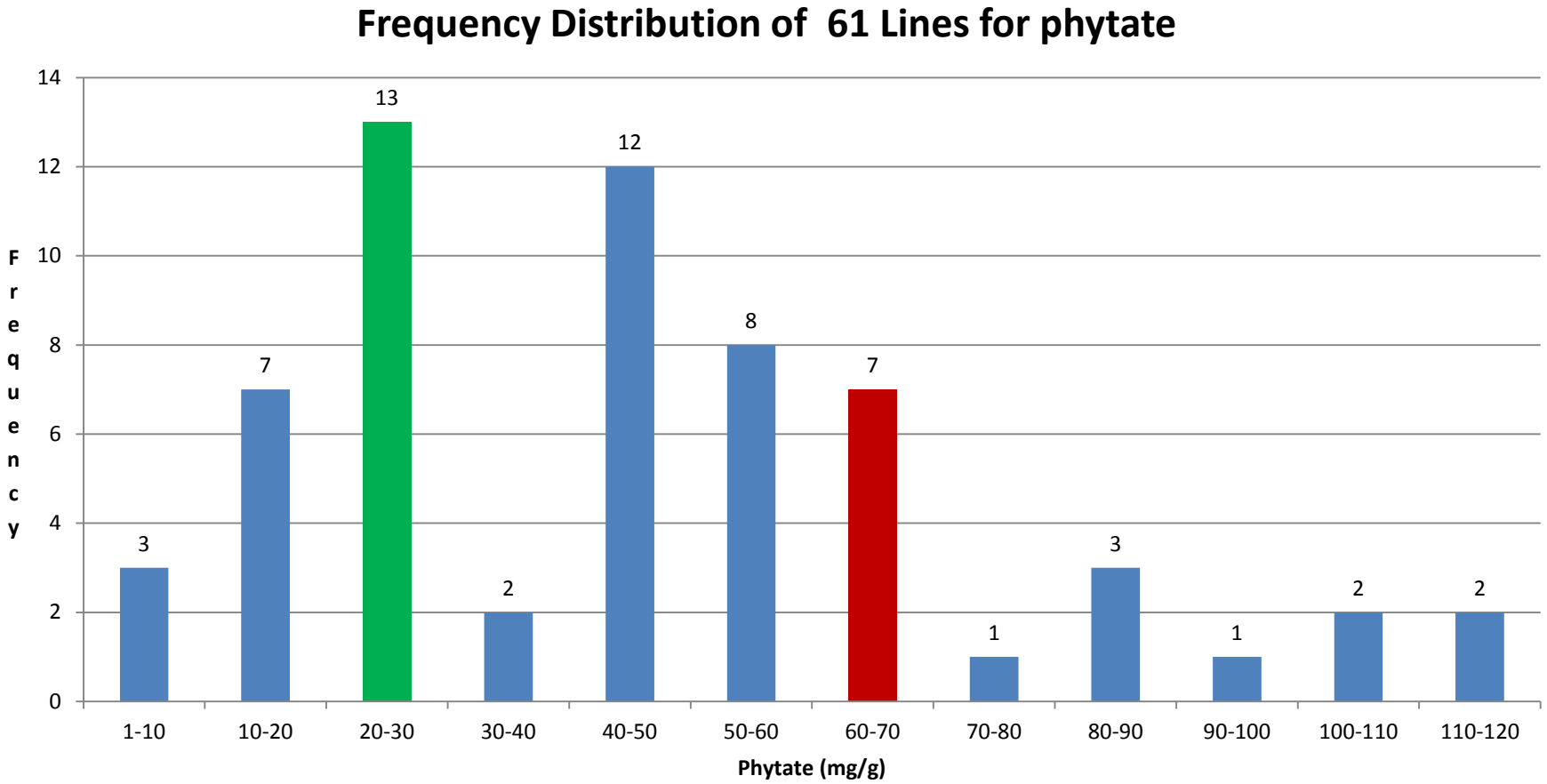
The Colorimetric Method	Chemicals used
weighing of maize sample	1 gram of maize was weighed
mineral extraction	TCA (tri-chloroacetic acid)
removal of impurities	Iron chloride
precipitation of minerals	Sodium hydroxide
washing step	Hot distilled water
dissolve the precipitate	Hot nitric acid
Colour observation in a spectrophotometer	Addition of potassium thiocynate

Qualitative approach

- **Study area:** Ntambanana is 160km north of Durban and can be accessed via the R34 from Empangeni
- **Sampling technique: 43** Random purposive sample of smallholder farmers

- **Exploratory research design:**
  - Consumer Profiling
  - Participatory Rural Appraisal *(PRA)* - a series of 6 Focus Group Discussions

Maize line variation



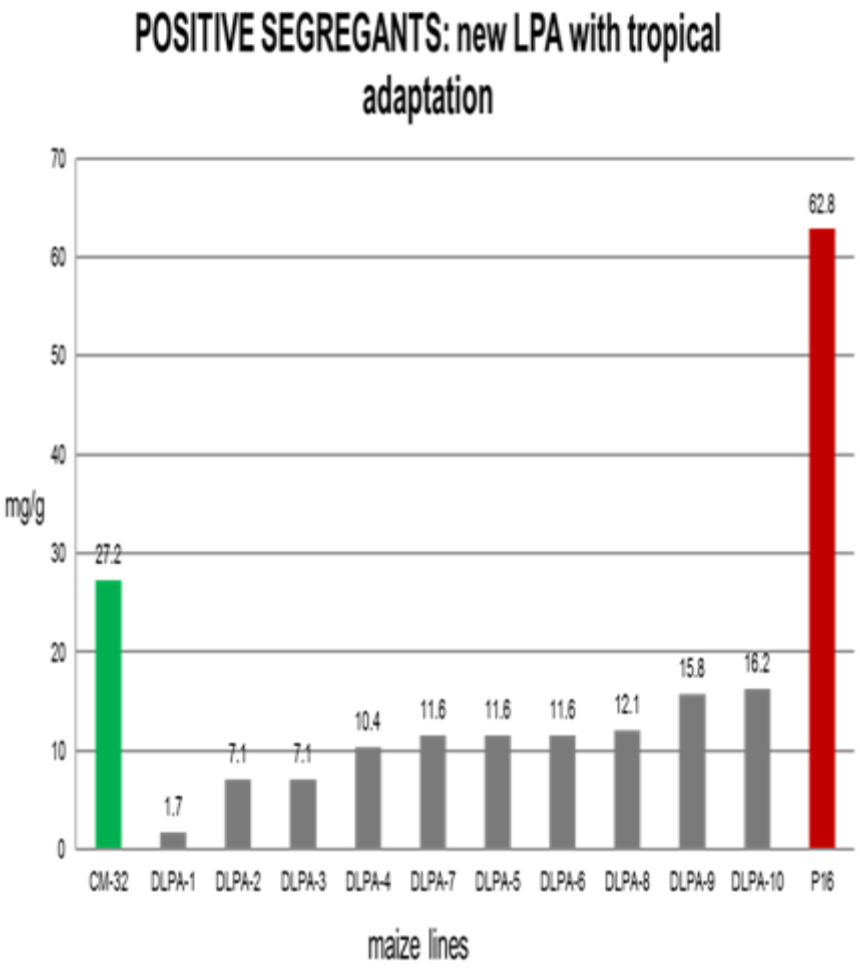
CM32 — Positive control

LP16 — Negative control

Maize lines

Top ten LPA lines

Inbred	Phytate (mg/g)	Rank
CM-32 (US,temperate)	**27.2**	**Positive Control**
DLPA-1	1.7	1
DLPA-2	7.1	2
DLPA-3	7.1	3
DLPA-4	10.4	4
DLPA-7	11.6	5
DLPA-5	11.6	6
DLPA-6	11.6	7
DLPA-8	12.1	8
DLPA-9	15.8	9
DLPA-10	16.2	10
P16 (ZW, tropical)	**62.8**	**Negative Control**



Demographic profile of the participants

- Ages ranged between 20 and 80 years with an average of 5years in farming maize.
- Planting land varied from 7, 2 metre - 5 hectors.
- About 75% of both backyard gardens and fields land was dedicated to maize, cocoyam (amadumbe) and other vegetables shared the remaining land portion.
- The backyard gardens were mainly used as the household source of food while the fields were used to generate livelihoods through the co-operative groups.

Awareness towards the use of traditional maize processing practices

- **Limited nutrition knowledge**: Maize was perceived to be nutritious *because various dishes could be made from it, could be eaten any time and consumed by all family members*
- Disappearing maize traditional processing methods amongst the youth

Maize Traditional Processing Methods

TPs	Maize-based food	Most used method	Assumed benefits	Key benefit
Soaking	Incwancwa Stambu (Samp)	**	*'The sour taste is nice and it does not spoil faster'* *'Soaking samp makes it to cooks faster but we do this only if we are going to cook it using a stove, cooking on fire it does not need soaking'*	*Aerobacteria* ,*Pseudomonas* and also *Bacillus* are activated ,they contain phytase which degrades PA
Fermentation	Isinkwa sombila (Corn bread) Amahewu (Fermented maize beverage)	*****	*'The process is good for maturing the food items'*	Activate the phytase enzyme and also *Lactobacillus* which brings down PA level
Milling	Incumbe (Sour maize porridge) Stambu	****	*'It gives maize meal, samp or even maize flour to make different maize dishes'*	The pounding breaks the germ releasing it to be hydrolysed
Roasting	Izinkobe (Steamed maize kernels)	**	*'Gives a different flavour to the maize kernels'*	Releases the pericarp, and gem is easily accessible
Use as complementary foods	Amahiyoyo (beans mixed with maize)	****	*'It's enjoyable when these foods are mixed'*	Help enhance the activation of the enzymes that breaks down PA

***** *Represents the frequency of the method used*

Cont...

- Maize TPs methods were mainly used to improve the maize-dish sensory attributes: *'kubamnandi kunambitheke futhi kudleka ngezindlela eziningi ezahlukene* (it improves the flavour, taste and give variety)'
- to preserve cultural heritage from generation to generation: '*Yisiko lethu esalishiyelwa ngobabomkhulu* (it is our tradition shared with us by our grandparents);'.

Conclusion

- Hidden hunger continues to be a challenge not because of lack of food available but the quality of foods being produced and accessible to communities.
- Unfortunately, other meaningful traditional practices are slowly disappearing.
- Several food and nutrition security interventions have not been successful especially because they are not agricultural-based.
- Other under- investigated micronutrient interventions affect the colour of maize hence low consumer acceptability is reported
- Low phytic acid maize does retain the maize colour to white and it is a cost-effective intervention

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- Labour and time will be saved for rural woman, in terms of soaking the porridge because it is a traditional way to decrease phytic acid level in maize
- The Low Phytic acid maize could contribute positively towards improving the nutritional status of the most vulnerable groups

Recommendations

- Further studies on the nutritional assessment of the low phytic acid maize
- Investigate the perceptions and acceptability of low phytic acid maize & food products
- Education and training to raise awareness & to change negative perceptions/attitudes if they exist

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