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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).
- 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.

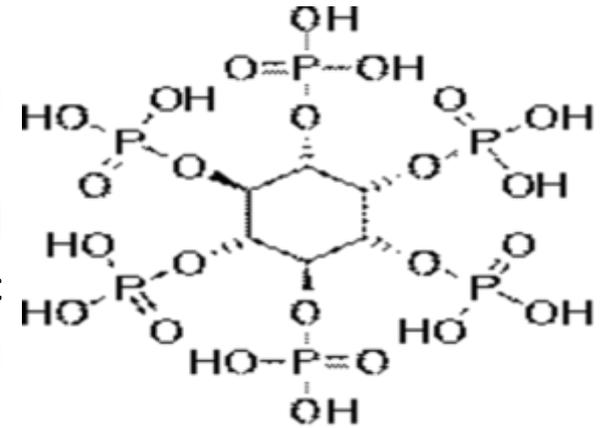


Fig. 1: Phytic acid (PA) structure

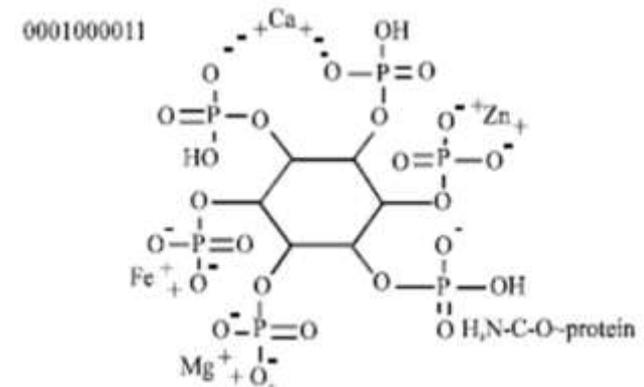


Fig. 2: PA structure bound minerals

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 *lpa1-1* gene, the Rotor-Gene 6000 real time rotary analyser was used

Quantitative: Phytic acid determination

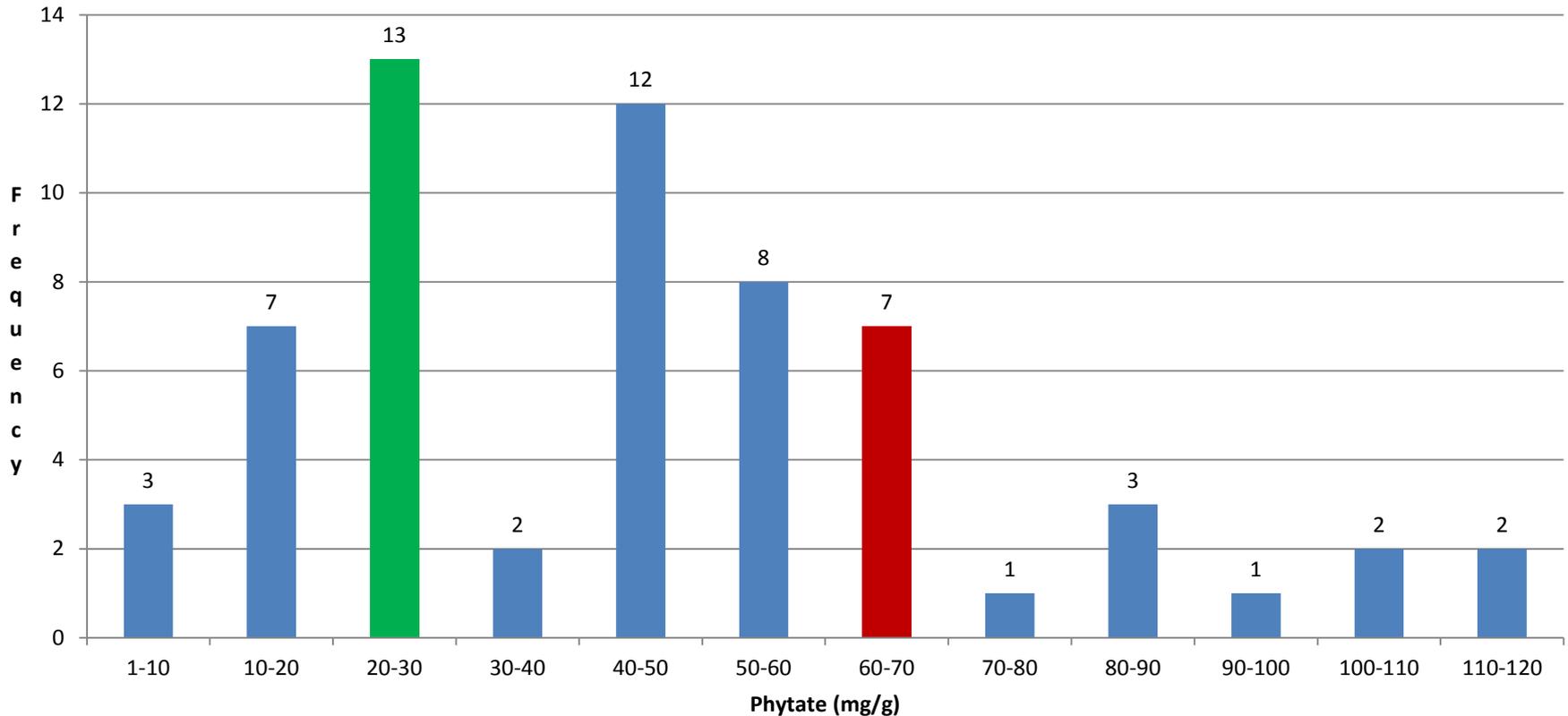
The Colorimetric Method	Chemicals used
weighing of maize sample	1 gram of maize was weighed
mineral extraction	TCA (tri-chloroacetic acid)
removal of impurities	Iron chloride
precipitation of minerals	Sodium hydroxide
washing step	Hot distilled water
dissolve the precipitate	Hot nitric acid
Colour observation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

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

Frequency Distribution of 61 Lines for phytate



CM32

Positive control



LP16

Negative control

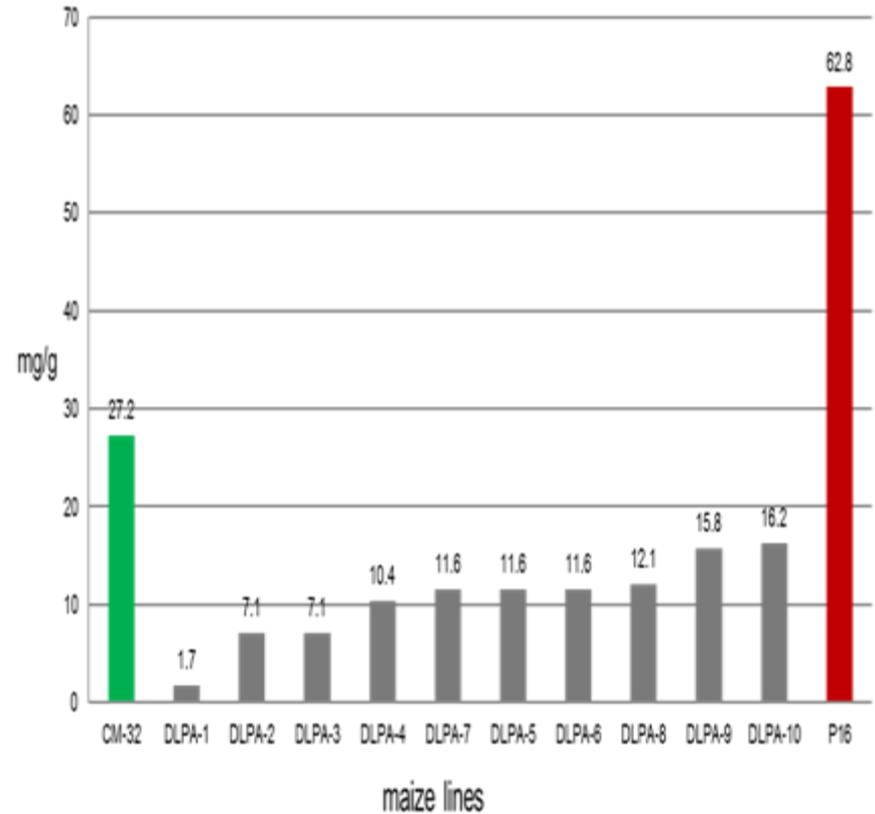


Maize lines

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

POSITIVE SEGREGANTS: new LPA with tropical adaptation



Demographic profile of the participants

- Ages ranged between 20 and 80 years with an average of 5 years in farming maize.
- Planting land varied from 7, 2 metre - 5 hectares.
- 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)	**	<i>'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'</i>	<i>Aerobacteria ,Pseudomonas and also Bacillus are activated ,they contain phytase which degrades PA</i>
Fermentation	Isinkwa sombila (Corn bread) Amahewu (Fermented maize beverage)	*****	<i>'The process is good for maturing the food items'</i>	<i>Activate the phytase enzyme and also Lactobacillus which brings down PA level</i>
Milling	Incumbe (Sour maize porridge) Stambu	****	<i>'It gives maize meal, samp or even maize flour to make different maize dishes'</i>	<i>The pounding breaks the germ releasing it to be hydrolysed</i>
Roasting	Izinkobe (Steamed maize kernels)	**	<i>'Gives a different flavour to the maize kernels'</i>	<i>Releases the pericarp, and gem is easily accessible</i>
Use as complementary foods	Amahiyoyo (beans mixed with maize)	****	<i>'It's enjoyable when these foods are mixed'</i>	<i>Help enhance the activation of the enzymes that breaks down PA</i>

* 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

Cont...

- 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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