The Southern African Grain Laboratory NPC

Quality is our passion

Services and research to promote grain quality management

GRAIN SILO INDUSTRY - MINI SYMPOSIUM

CONTINUOUS IMPROVEMENT

IDEAS, BEST PRACTICE AND INNOVATION

WIANA LOUW

AUGUST 2014

PRODUCTION

BREEDING

RESEARCH

SAGL

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STORAGE

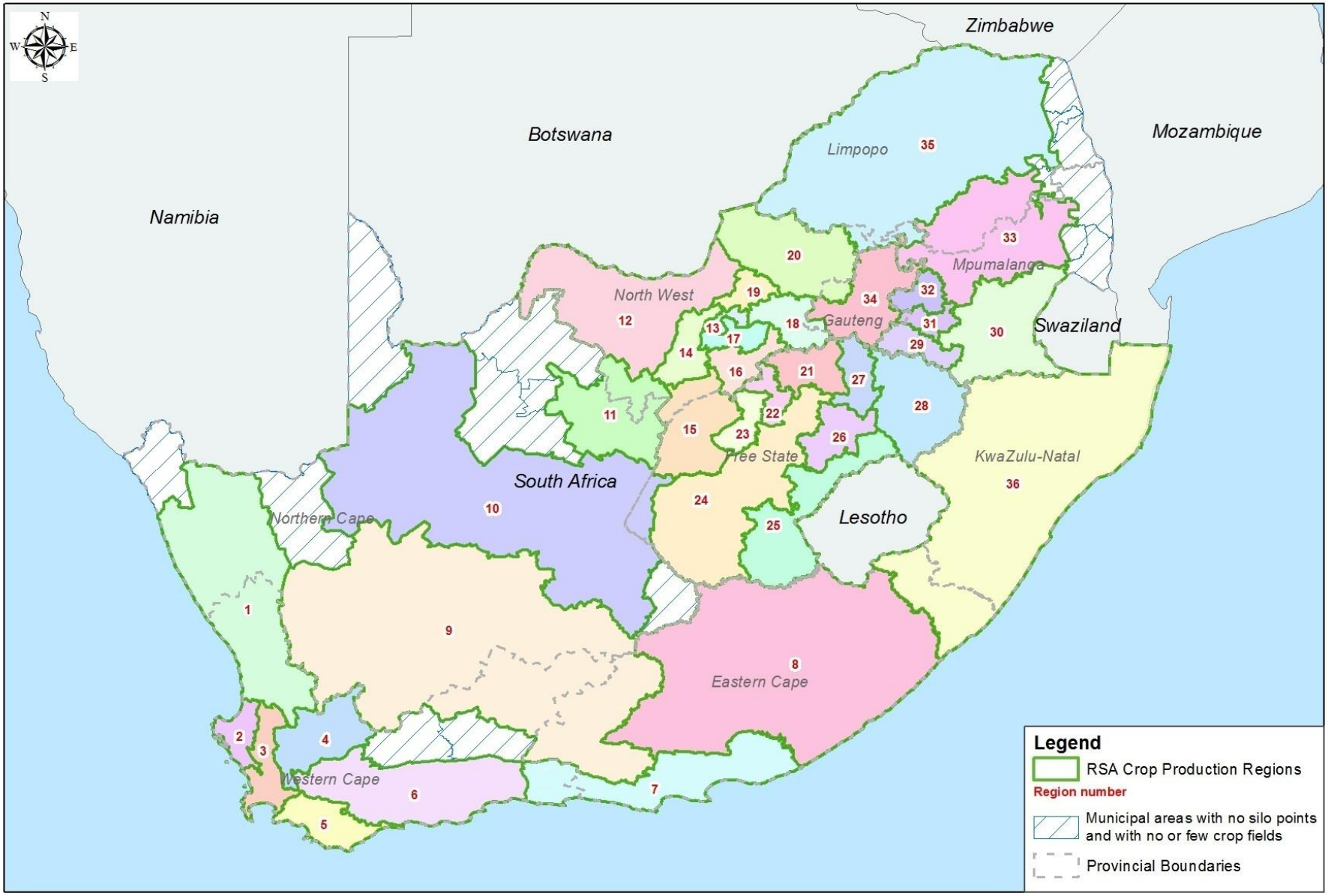
TRADING

PROCESSING:
BAKING, MILLING & ANIMAL FEED

What constitutes a high quality grain product for the different role-players in the grain value chain?

CROP QUALITY SURVEYS

RSA Crop Production Regions



Ring tests – A valuable tool for quality assurance in the grain value chain

What is a PT/Ring test?

Part quality assurance where a group of laboratories compare their results on the same test material

Why participate?

Participation is a requirement of certification and accreditation bodies and an integral part of any quality system

Benefits of participation

- ✓ Equipment verification
- ✓ Method optimisation
- ✓ Benchmarking against other laboratories/ analysts/graders
- ✓ Confirmation of accuracy

Interpretation of results

- ✓ Z-values - indication of a laboratory's proficiency
- ✓ A "perfect" z-value is **0.00**
- ✓ **<1.00** - outstanding accuracy and precision
- ✓ **<2.00** - satisfactory accuracy and precision
- ✓ Between **2.00 and 3.00** - questionable, require investigation
- ✓ z-values **> 3.00** - require intervention

Accurate measurements on grain and processed grain products ensure high quality grain products for each specific application for the different role players in the grain value chain

SAGL Ring Tests

Description	How many Ring Tests per annum	Interval	Number of Local Participants	Number of International Participants	International Participants	Total number of Participants
SAGL Annual Pre-Harvest Maize Grading Ring Test	1	Per Season	62	-	-	62
SAGL Colour Ring Test	6	Every 3 months	12	3	Lesotho, Namibia & Israel	15
SAGL Minolta Dry Colour Ring Test	6	Every 3 months	13	-	-	13
SAGL Maize Grading Ring Test	4	Quarterly	6	2	Lesotho & Namibia	8
SAGL Maize Meal Quality Ring Test	4	Quarterly	1	4	Botswana, Swaziland, Lesotho & Namibia	5
SAGL Vitamin Ring Test	4	Quarterly	3	1	Kenya	4
SAGL Wheat and Flour Ring Test	4	Quarterly	21	6	Ghana, Nigeria, Lesotho, Swaziland, Senegal & Namibia	27
SAGL Wheat Grading Ring Test	4	Quarterly	23	1	Namibia	24

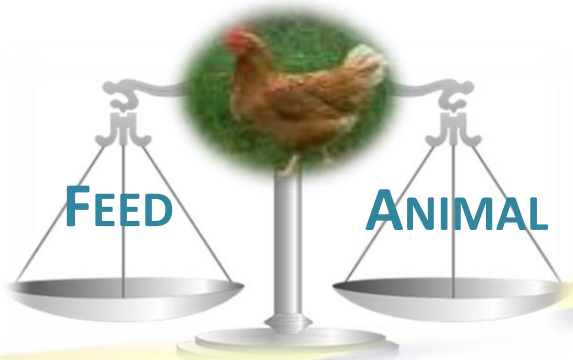
Livestock production requires feed mixtures that meet the nutritional requirements of animals for high levels of livestock performance and production

Wide variety of feedstuffs to be monitored

Continuous monitoring of amino acid composition required for feed formulation

Cost effective monitoring requires secondary measurement techniques like NIR

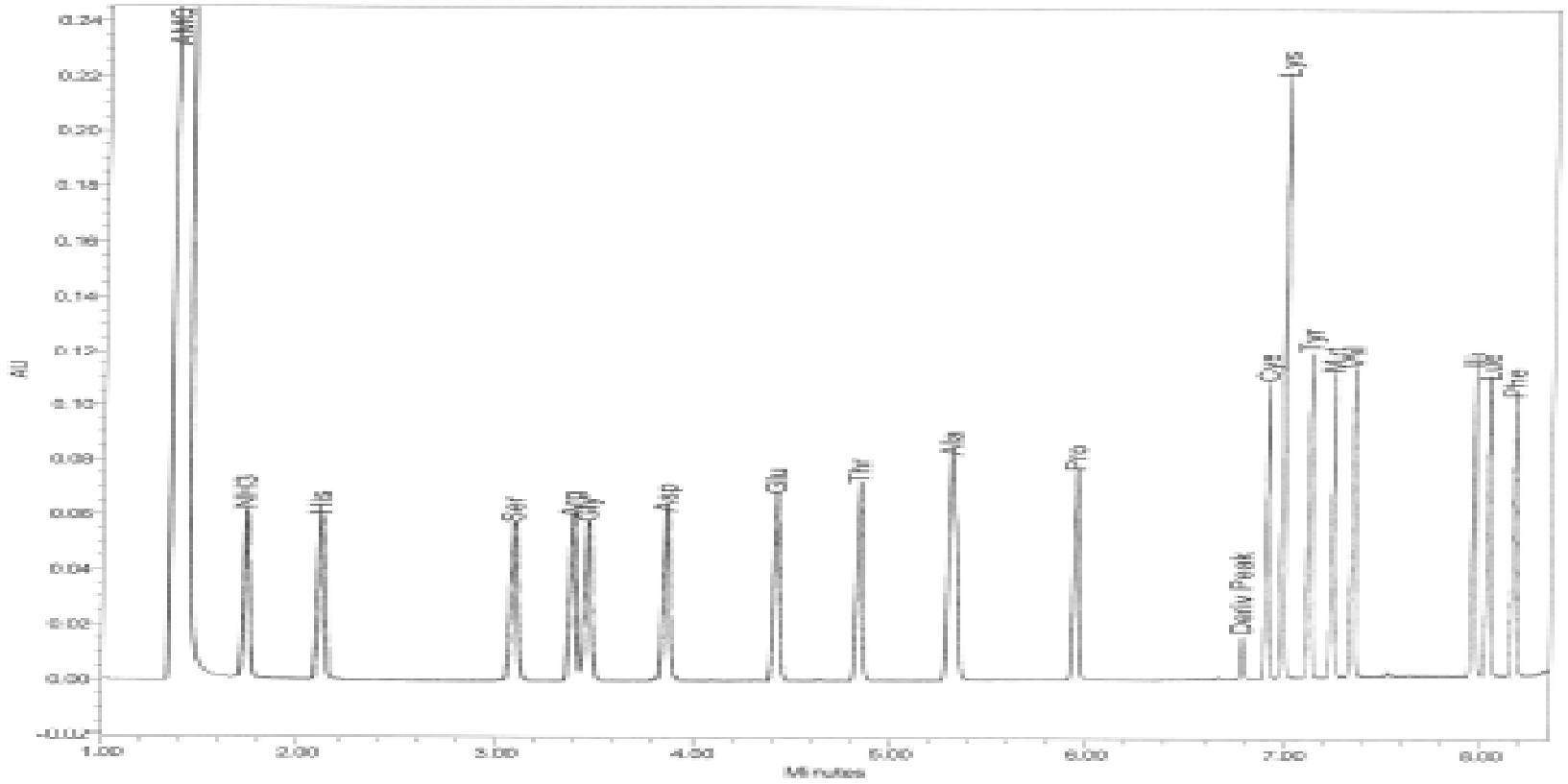
Calibrations built using chromatography as primary measurement technique



GRAINS AND OILSEEDS FOR ANIMAL FEED

- ROLE-PLAYERS IN THE ANIMAL FEED INDUSTRY ANALYSED MORE THAN 130 FEEDSTUFFS FROM AROUND THE WORLD USING CHROMATOGRAPHY AND BUILT NIR CALIBRATIONS
- PRODUCTS FROM SOUTH AFRICA INCLUDED IN THE CALIBRATIONS ARE:
  - MAIZE HOMINY FEED
  - FISH MEAL
  - SUNFLOWER MEAL
  - WHEAT BRAN

- ✓ CURRENT COLLABORATION TO INCLUDE MORE FEEDSTUFFS FROM SUB-SAHARAN AFRICA, E.G. MAIZE QUALITY CROP SURVEY SAMPLES



MILLING INDEX AS A PREDICTOR FOR MILLING PERFORMANCE

- ✓ MILLING INDEX CALIBRATION DEVELOPED USING MAIZE MILLING FRACTIONS PRODUCED DURING MILLING UNDER CONTROLLED LABORATORY CONDITIONS
- ✓ REFINEMENT OF THE CALIBRATION TO DIFFERENTIATE BETWEEN SIMILAR CULTIVARS WITH SMALL DIFFERENCES IN MILLING PERFORMANCE
- ✓ FOCUS ON CHEMICAL BASIS FOR MAIZE HARDNESS – HARD ENDOSPERM IS LINKED TO THE STRUCTURE OF THE PROTEIN LAID DOWN DURING THE DEVELOPMENT OF THE KERNEL
- ✓ HPLC USED FOR FINGERPRINTING OF THE ALPHA AND GAMMA-ZEIN FINGERPRINTS OF A RANGE OF MAIZE SAMPLES
- ✓ SAMPLE SELECTION FROM VERY SOFT TO VERY HARD

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Grain sorghum for bioethanol production

- Sorghum is an important drought resistant cereal crop originating from Africa
- Sorghum has the ability to grow in areas with marginal rainfall and high temperatures where most other cereals cannot be successfully produced
- Short growing season requirements, it is suitable for double cropping and crop rotation systems
- Sorghum can potentially give good alcohol yields provided that the processes are optimised

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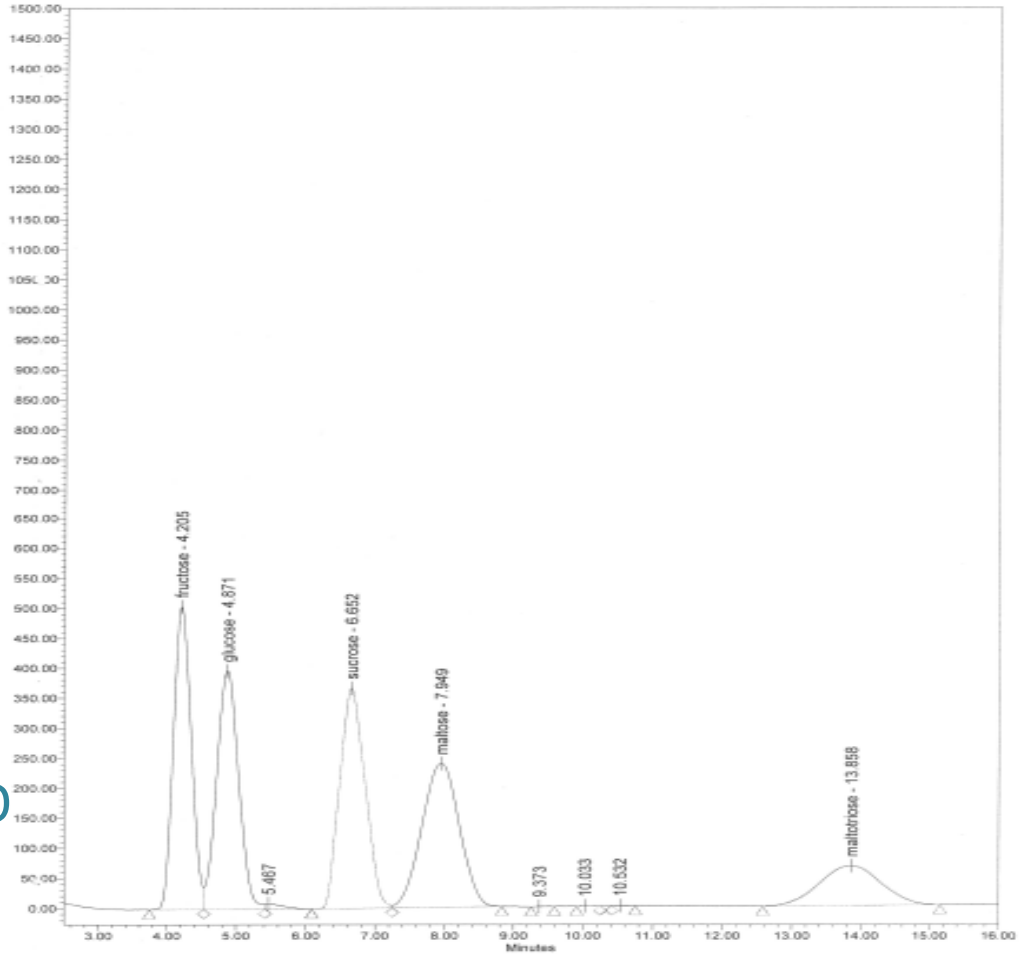
- ✓ Process of evaluating existing sorghum cultivars to select those most suitable for bioethanol production
- ✓ A quantitative laboratory-scale Dry Grind Bioethanol Process
- ✓ The hydrolysate analysed on High Performance Liquid Chromatography (HPLC) to determine the individual fermentable sugars

PARAMETERS INCLUDED IN THE EVALUATION

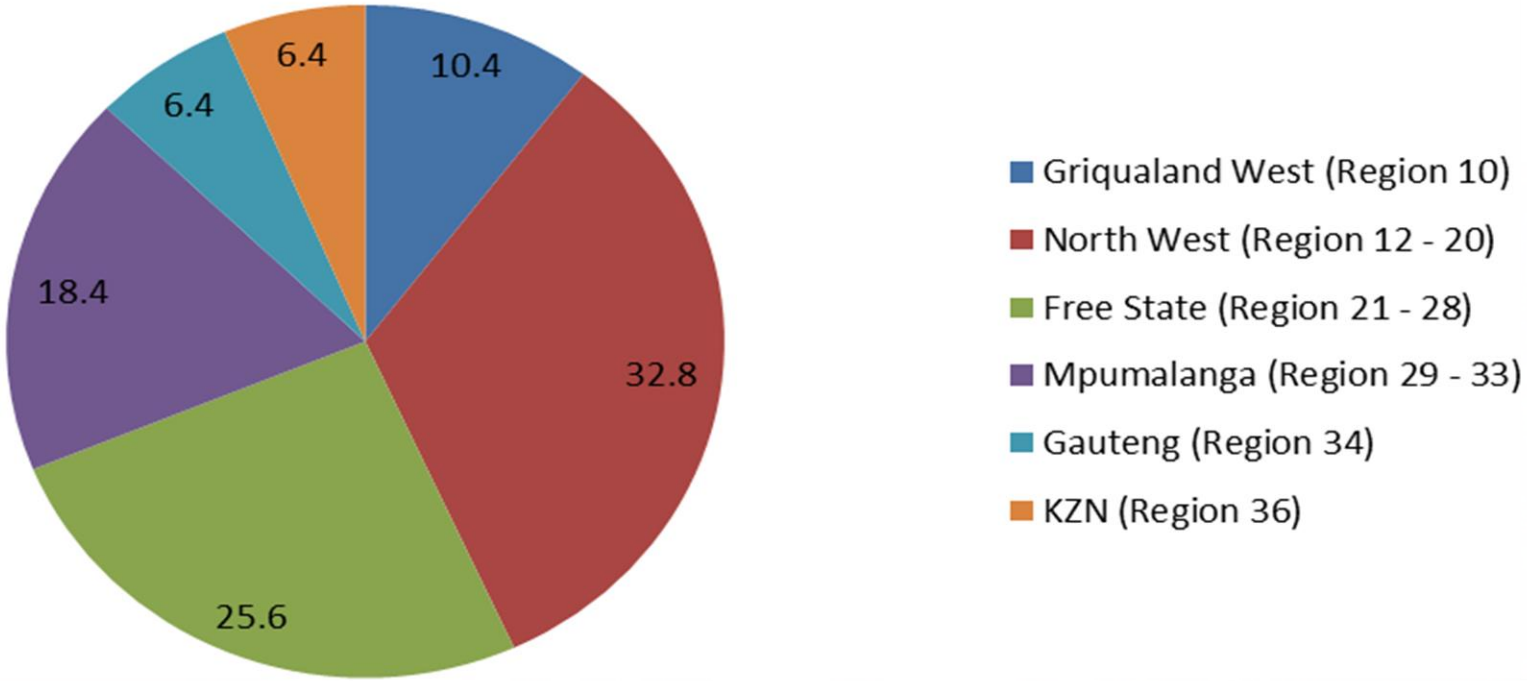
- ✓ MOISTURE
- ✓ HECTOLITRE MASS
- ✓ DEFECTIVE KERNELS
- ✓ THOUSAND KERNEL MASS
- ✓ STARCH CONTENT
- ✓ PROTEIN CONTENT
- ✓ TOTAL PHENOLIC
- ✓ TANNINS
- ✓ EXTRACTS - ° BRIX AND ° PLATO
- ✓ FERMENTABLE SUGARS



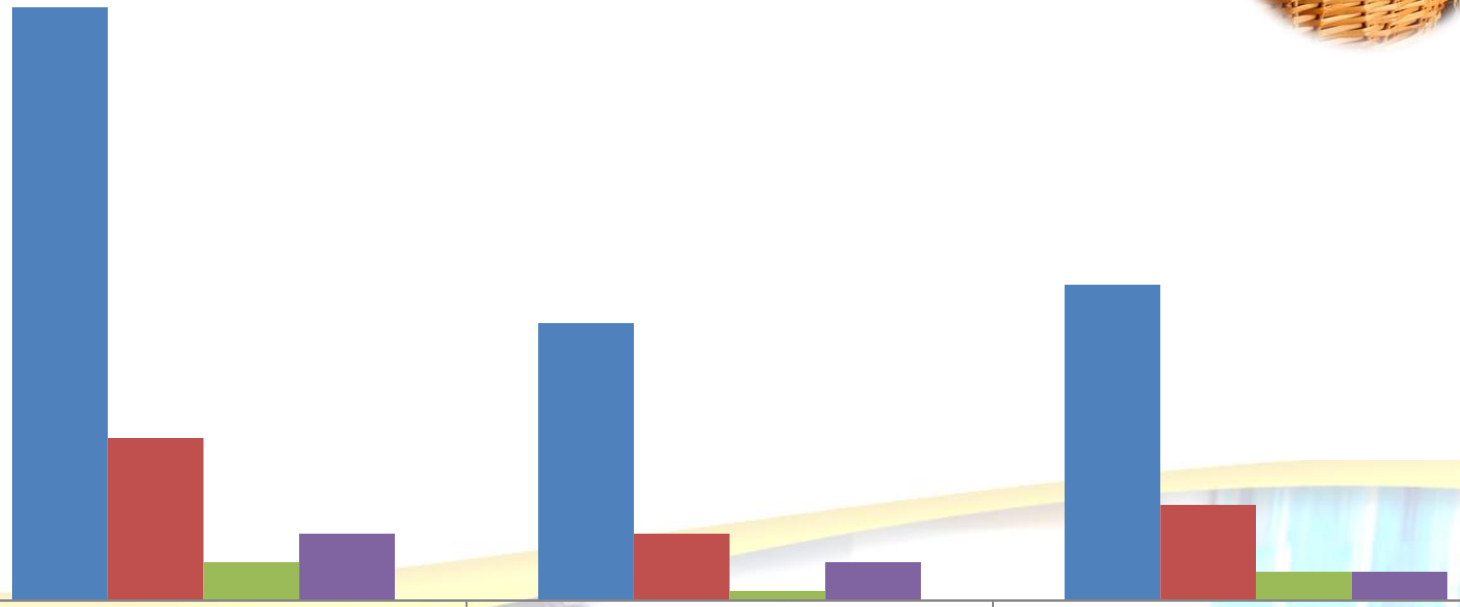
MYCOTOXIN MONITORING ON MAIZE

- ✓ THREE MAIN MAIZE PRODUCTION AREAS (80% OF THE TOTAL PRODUCTION):
  - ✓ **FREE STATE – 41%** (52% WHITE AND 48% YELLOW)
  - ✓ **MPUMALANGA – 26%** (34% WHITE AND 66% YELLOW)
  - ✓ **NORTH WEST – 13%** (74% WHITE AND 26% YELLOW)

Sample selection (%) from the different grain production regions in SA 2012/2013 season



NUMBER OF SAMPLES WITH MYCOTOXINS OUT OF A TOTAL OF 125 SAMPLES ANALYSED



	Total maize	White maize	Yellow maize
FUM (total)	62	29	33
DON	17	7	10
15-ADON	4	1	3
ZON	7	4	3

DEFECTIVE KERNELS WITHIN EACH MAIZE GRADE CORRELATED WITH MYCOTOXIN LEVELS

GRADING - GOVERNMENT GAZETTE

- 6.35 mm sieve – broken kernels and healthy kernels
- Defective kernels – possible link between visible defect and mycotoxin levels

ADDITIONAL SIEVE SIZES

- Two sizes smaller than 6.35 mm
- Two sizes bigger than 6.35 mm

FRACTION GRADING

- Broken and healthy/whole kernels above sieve
- Broken and healthy/whole kernels below sieve

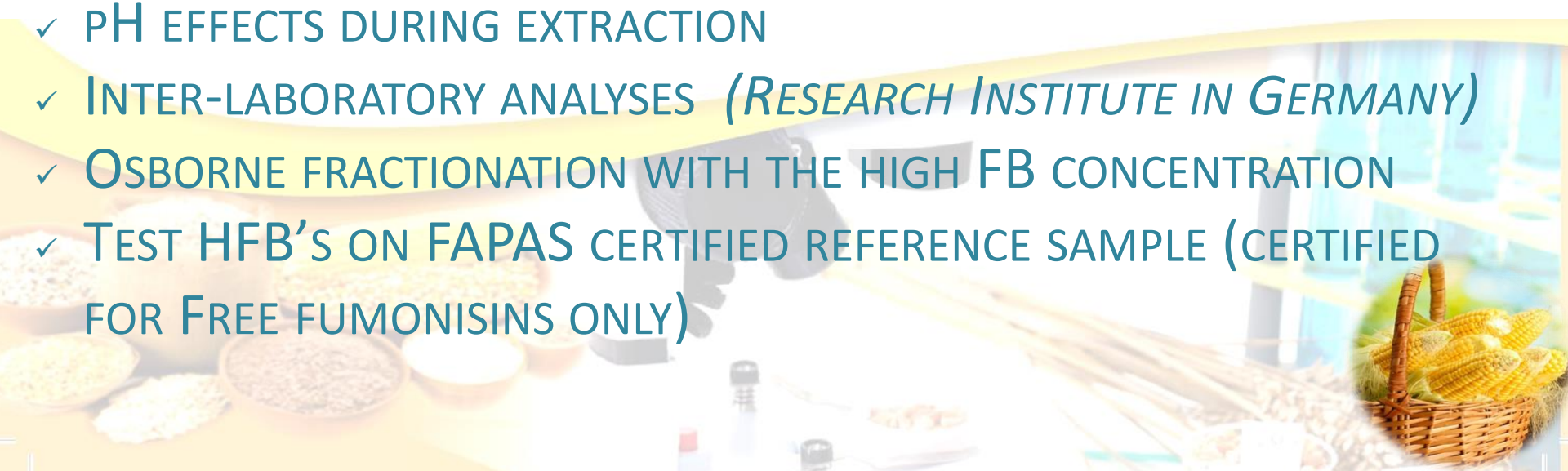
MYCOTOXIN ANALYSIS

- Multi-mycotoxin analysis using UPLC-MS/MS

Post Harvest occurrence of free, bound and masked Fusarium mycotoxins in the maize processing chain specific emphasis on fumonisins

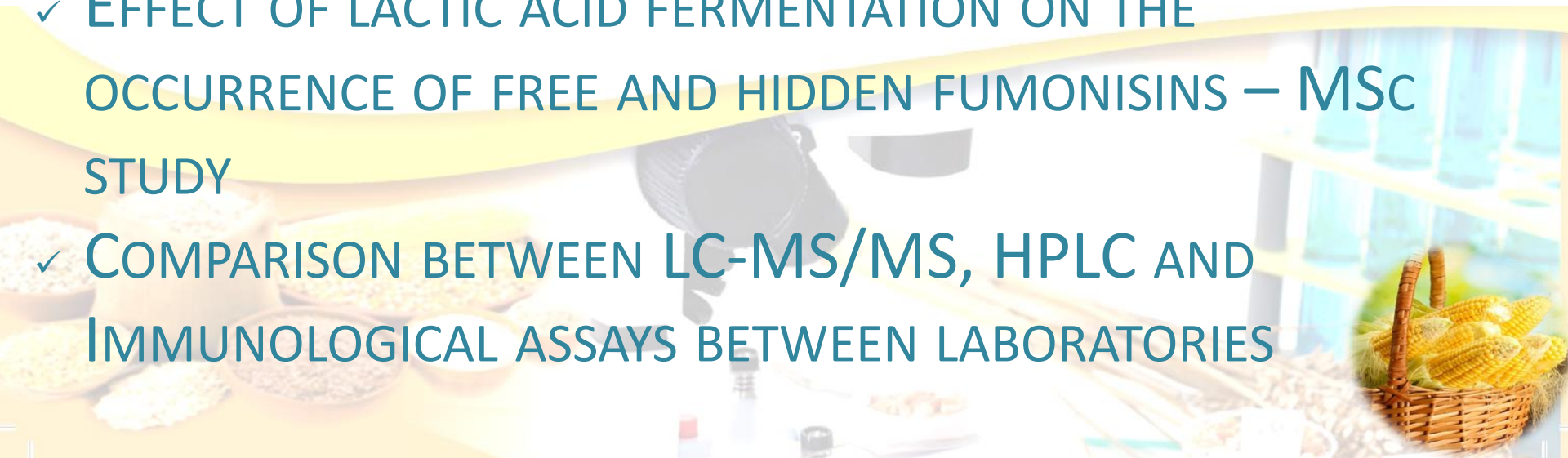
Validation

- ✓ LOD/LOQ
- ✓ Different extraction solvents
- ✓ Digestion and extraction times comparisons
- ✓ pH effects during extraction
- ✓ Inter-laboratory analyses *(Research Institute in Germany)*
- ✓ Osborne fractionation with the high FB concentration
- ✓ Test HFB's on FAPAS certified reference sample (certified for Free fumonisins only)



Post Harvest occurrence of free, bound and masked Fusarium mycotoxins in the maize processing chain specific emphasis on fumonisins

- ✓ Testing of raw and processed commercial samples
- ✓ Other methods to release bound fumonisins with a focus on In Vitro digestibility models – PhD study
- ✓ Effect of lactic acid fermentation on the occurrence of free and hidden fumonisins – MSc study
- ✓ Comparison between LC-MS/MS, HPLC and Immunological assays between laboratories



Fortification of cereal grains

- ✓ Micronutrient fortification of certain food matrices regulated in several countries
- ✓ Quality control of micronutrient concentrations in the final product is important
- ✓ Vitamin A in flour is analysed HPLC - dedicated laboratories, trained analysts at a relatively high cost

Fortification of cereal grains

- ✓ Need for alternative reliable rapid tests at the fortification site
- ✓ Portable rapid test (iCheck™ FLUORO) developed to measure vitamin A in fortified samples such as premix and flour
- ✓ Study conducted to compare performance of iCheck™ FLUORO device with the HPLC vitamin A reference method

FORTIFICATION OF CEREAL GRAINS

Conclusion - The iCheck™ FLUORO method is well suited for quality control of fortified flour samples because of its simplicity, speed and accuracy

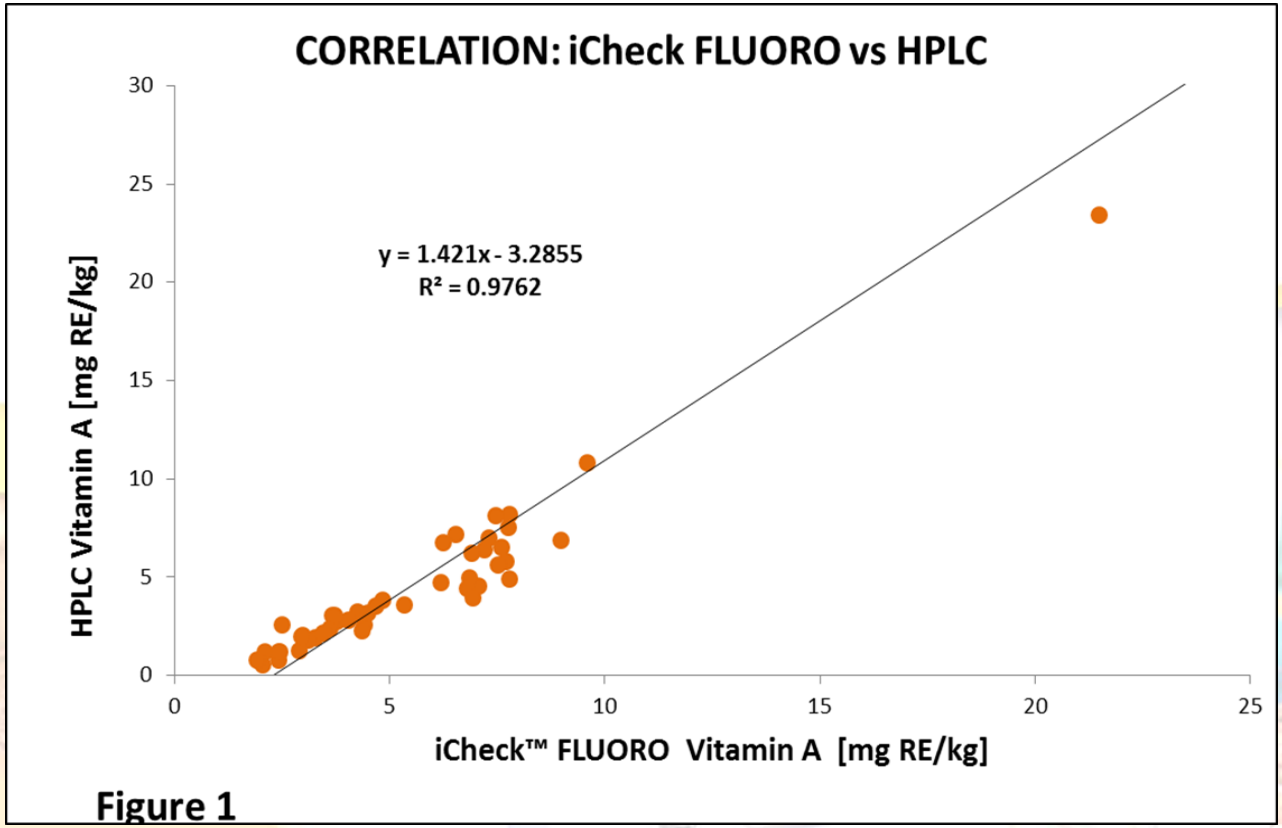


Figure 1

- ✓ NEED FOR RELIABLE INTERNATIONALLY ACCEPTED QUALITY DATA ON CEREAL GRAINS AND OILSEEDS
- ✓ DATA TO BE USED FOR DECISION-MAKING DEPENDING ON SPECIFIC APPLICATION
- ✓ FOCUS OF RESEARCH TO BE DETERMINED BY INDUSTRY NEEDS
- ✓ COLLABORATIVE RESEARCH CRITICAL TO ENSURE PROJECT TEAMS INCLUDING SPECIFIC TECHNICAL EXPERTISE

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