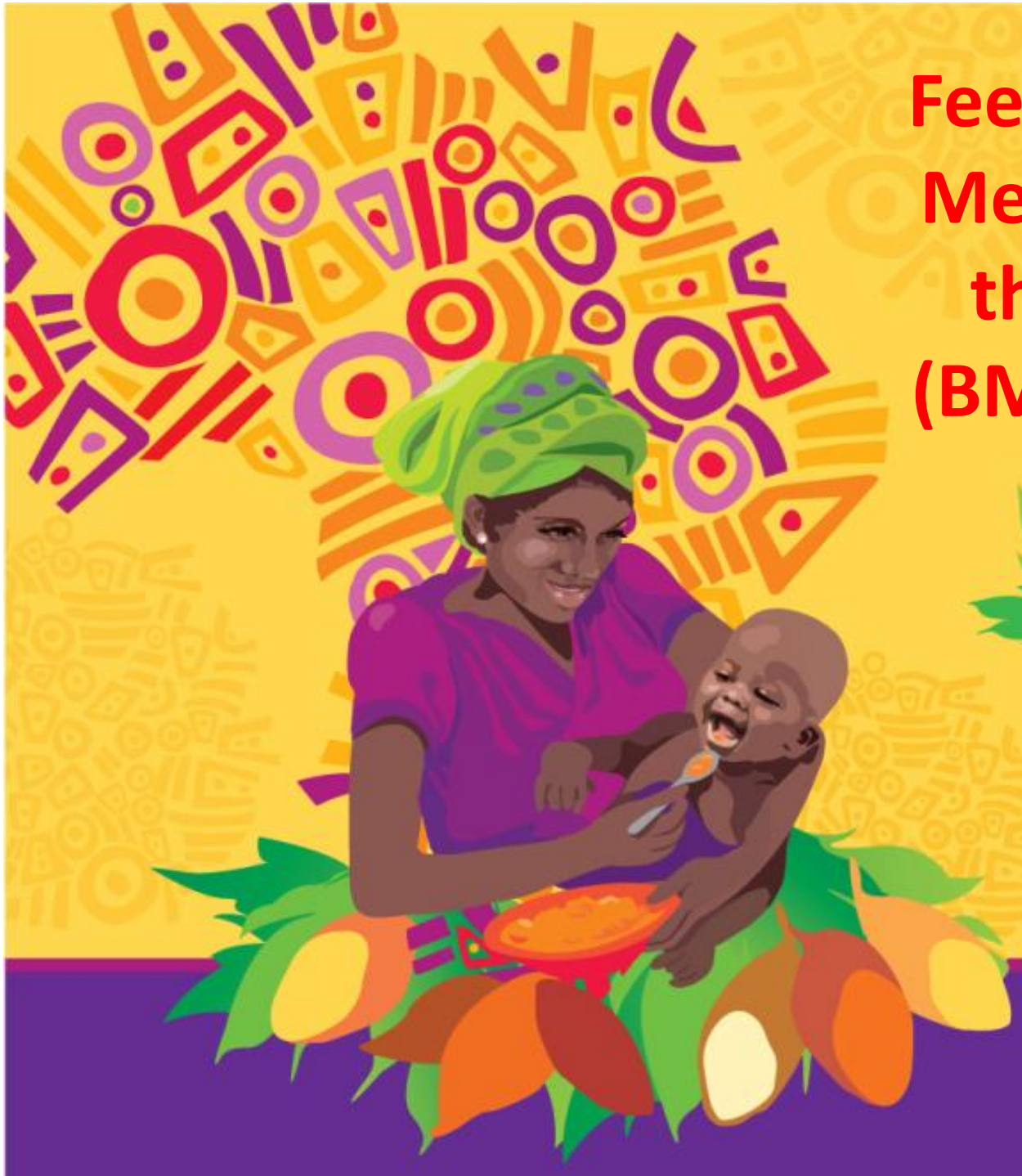
Feedback from MPU_CoP Meeting and Updates on the RTBFoods –CIRAD (BMGF) & FANEL updates



SASHA

Sweetpotato Action for Security and Health in Africa

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SASHA Post-Harvest and Nutrition
RTBFoods CIP Focal Point and WP2 Leader

Delivering Nutritious and Safe Food
To driver adoption of biofortified crops and
Improved varieties of Roots, Tubers and Banana (RTB) crops

CGIAR RESEARCH PROGRAM ON Roots, Tubers and Bananas

CIP INTERNATIONAL POTATO CENTER
A CGIAR RESEARCH CENTER

- Regional Research Support platform for advanced Nutritional Biochemistry, Food Science and Food Safety analysis for CGIAR, NARS, NGO partners and Private sector in SSA linked to CIP projects
- Support R&D for development of safe and nutritious foods and generate the evidence base for value addition of RTB crops
- Support breeding for quality traits and end user preference
- Evaluate nutritional information of recipes for nutrition education
- Capacity building and trainings of nutritionists, food scientists, and post harvests scientists and from NARS.
- Test kitchen for sensory sciences and technology demontrastion

Biochemical Analysis in FANEL

- Proximate Analysis (Crude fat, total carbohydrate, fiber, crude protein, ash and moisture)
- Vitamins determination (vitamin A, C, E)
- Water soluble and fat soluble antioxidants
- Food safety analysis (Food microbiology, water activity, glycoalkaloids and acrylamides)
- Food Science (pH, color, sensory analysis, water activity, texture etc.)
- In vitro studies for bioavailability and bioaccessibility
- Capacity building and training of regional fellows

EQUIPMENT

- HPLC
- UPLC
- LC/MS
- GC/MS
- AAS (minerals analysis) and ICP (machine received from CIP HQ today)
- In house quality control procedure developed
- Method validation (certified reference materials, NIST and FAPAS (UK)
- 1 PhD scientist, 3 (MS levels lab scientists) and visiting fellows
- International collaborations with US, UK, African and Chinese institutions

The meeting was attended by 75 participants from 10 countries (Ethiopia, Kenya, Uganda, Tanzania, Ghana, Nigeria, Malawi, Mozambique, South Africa and United States)

Marketing, Processing and Utilization Community of Practice Meeting, Lotus Hotel, Blantyre, Malawi. April 23-24, 2018

Orange-Fleshed Sweetpotato (OFSP) Value Chains for Sustainable Food Systems in Sub-Saharan Africa. A model for Root and Tuber Crops and Banana

- **The keynote address:** "*Investing in sweetpotato's image and especially in orange-fleshed sweetpotato as a healthy food for all—young and old, rural and urban, and rich and poor consumers are all bound to benefit economically and socially".*
- **Panel discussions:**
  - Nutrition and food systems (CIP, Government of Malawi and Development partners)
  - Between private sector players, regulators, SMEs and farmers. (**Euro Ingredients, Universal Industries, Kenya Bureau of Standards (KEBS), Tehilah Bakery and Value Addition Centre, and local farmers**) who shared their experiences on the challenges and opportunities of OFSP processing in Africa.
  - Inter-CoPs linkages discussions for feedback and reporting.
- **Presentations (Oral and Posters) from 17 participants covering four thematic areas;**
  - Food Science and Processing Activities,
  - Breeding, Seed Systems and Post-Harvest Management as it relates to value chains,
  - Community Nutrition, Advocacy and Nutrition Sensitive Behavior Change Communication
  - Food Systems, Gender and Youth

Field Trip to Tehilar Value addition Center

USAID Funded: Orange-Fleshed Sweetpotato (OFSP) Industry Forum in Malawi. April 25th, 2018 Sunbird Hotel, Blantyre, Malawi

OFSP Industry Forum

The event had over 50 participants from several African countries and the United States.

Orange-Fleshed Sweetpotato (OFSP) Industry Forum in Malawi (USAID Malawi & D.C)

The objectives of the forum were;

- Share experiences of using OFSP in industrial processing
- Provide a forum for networking and business-to-business discussion.
- **Dalberg Consulting Group** OFSP Study preliminary findings on '*Boosting off-taker demand for the Orange-Flesh Sweet Potato (OFSP) in three countries: Malawi, Kenya and South Africa*"

USAID FROM THE AMERICAN PEOPLE

Dalberg

Breeding RTB products for end user preferences

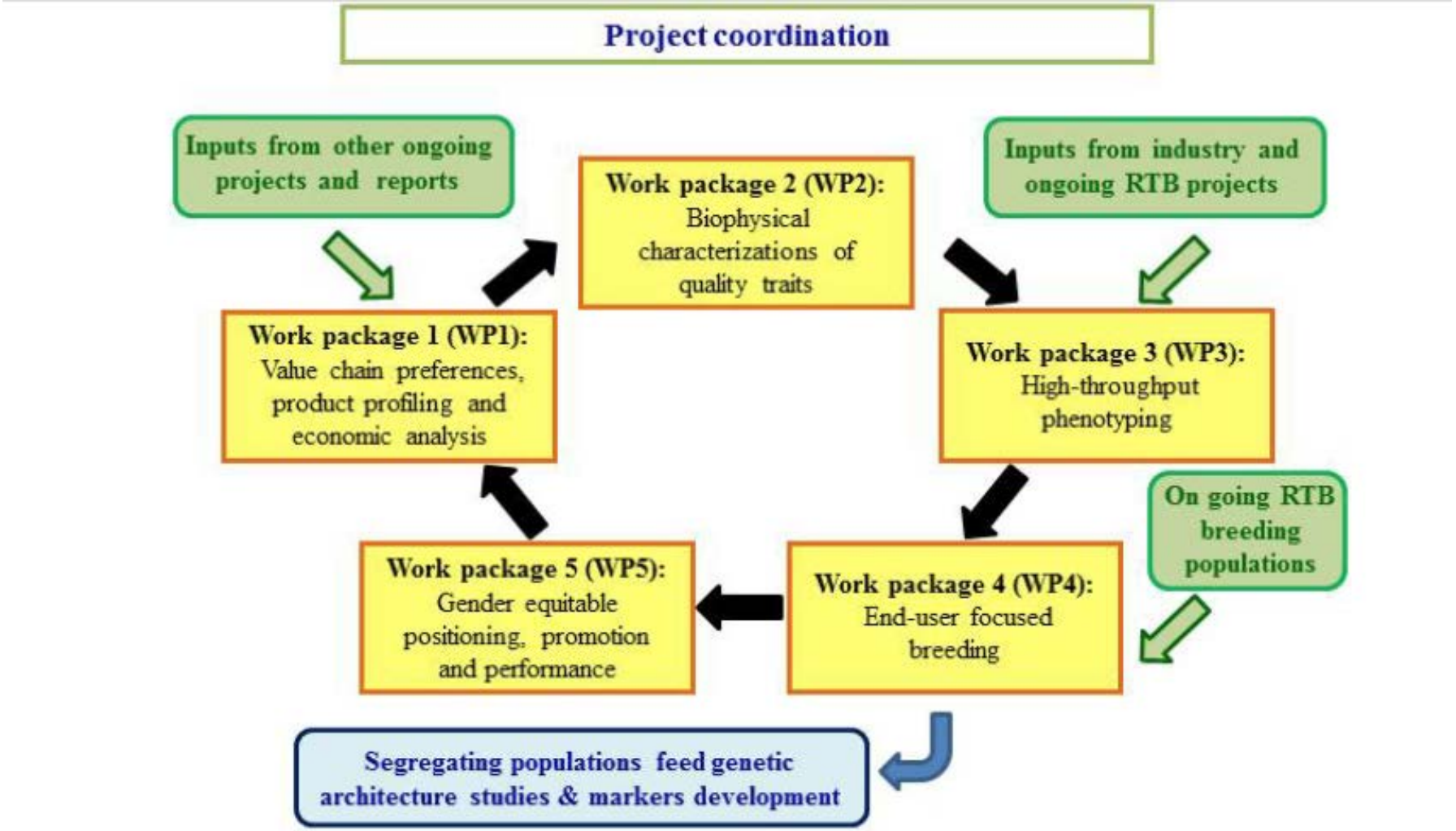
RTBFoods (BMGF) 5 year project

- The emergence of new pests and diseases, climate change, soil erosion and depletion, as well as changes in consumption habits from rural to more urban lifestyles, compel breeders of roots, tubers and bananas (RTB crops) to develop new varieties better adapted
  - *(i) at the farm level to biotic and abiotic stresses and*
  - *(II) at the post-harvest level to agro-industrial value chains.*

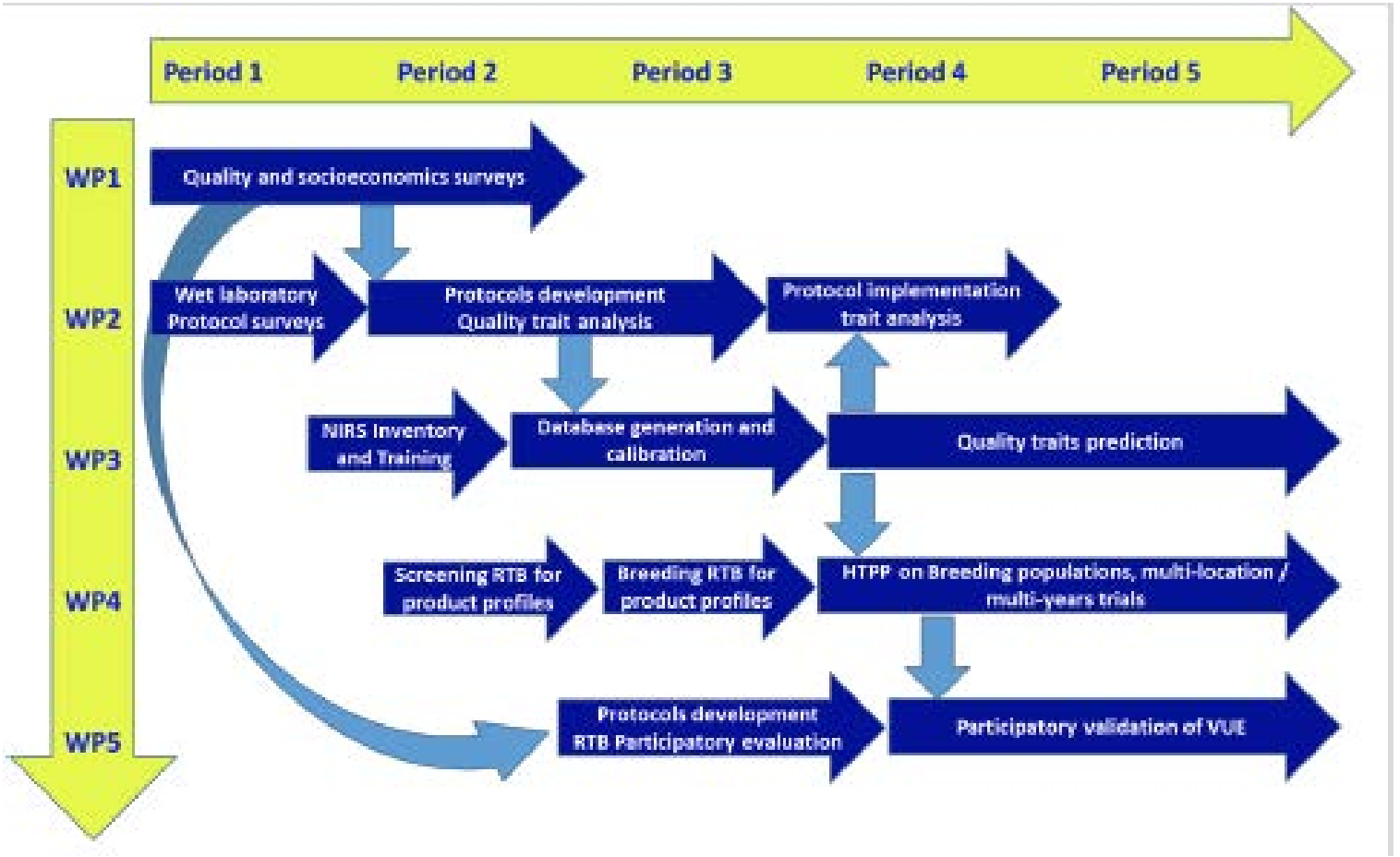
RTBFoods Rationale

- **Knowledge of the socio-cultural structures linking farmers, middlemen, processors and consumers of RTB crops is scarce in Africa**.
- **The understanding of preferences and needs of men and women participating in RTB value chains is incomplete and currently not available for RTB breeders.**
  - Many quality traits that determine user preferences and varietal adoption by stakeholders are to this day only partially studied.
  - Many new varieties developed by breeding programs meet with significant problems of acceptability by the main stakeholders of RTB value chains.
  - The processing ability and quality of end products are a common issue across improved varieties of RTB, hindering their adoption and dissemination.

RTBFoods Project coordination

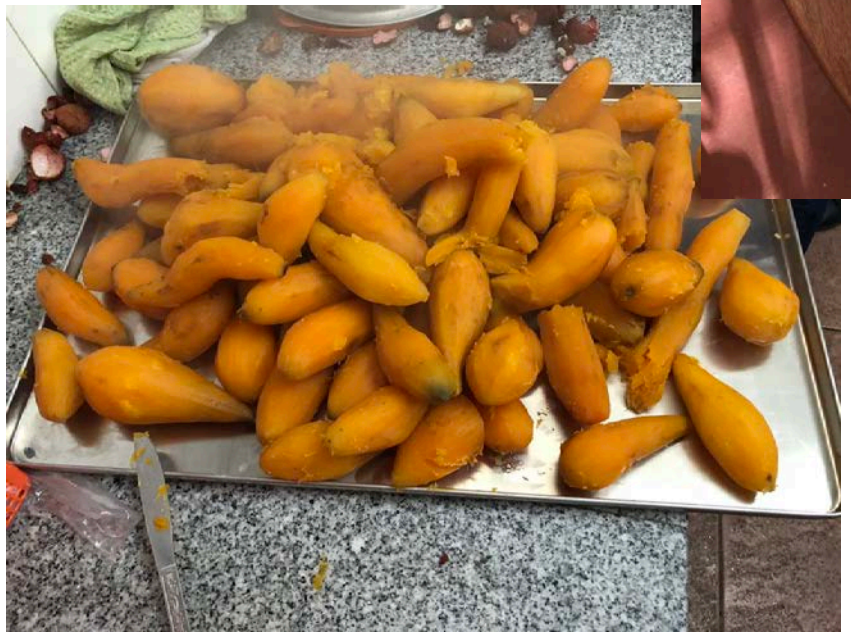


RTBFoods Phasing of activities



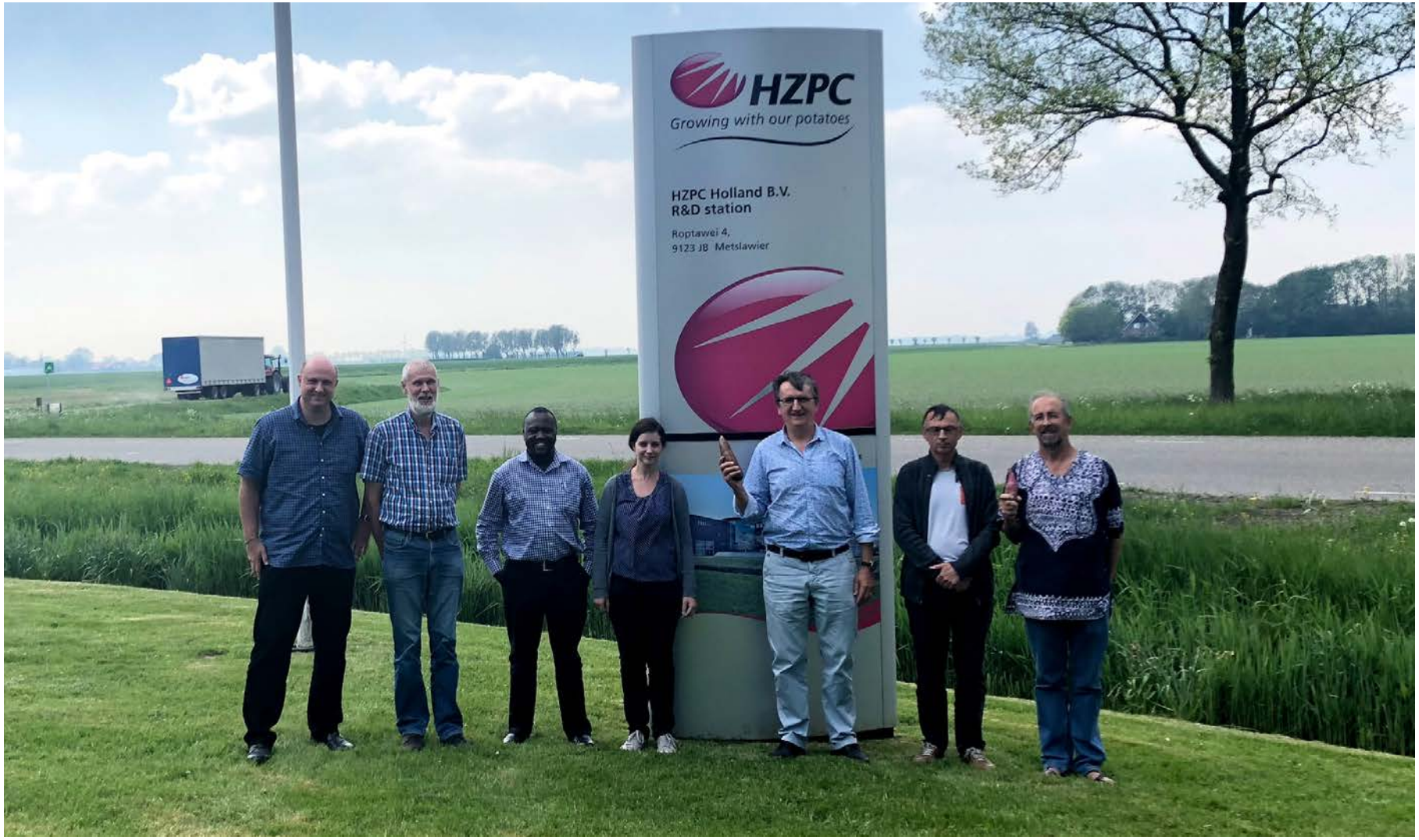
CIP RTBFoods Product Profiles

- Boiled Sweetpotato
- Fried Potato
- Fried Sweetpotato
- Boiled Sweetpotato



JHI –Scotland (potato, sweetpotato)
NARO –Uganda (sweetpotato)
CNRA –Ivory Coast (sweetpotato)

RTBFoods Team visit to HZPC Netherlands



RTBFoods PI
WP2
WP3
WP4
WP5

Why visit HZPC?

- They are an **innovative global market leader in potato** breeding, seed potato trade and product concept development.
- Their breeders develop seed potato varieties that **optimally match local growing conditions.**
- HZPC **respond dynamically to the needs of their market** and market segments such as industry, retail chains and traditional consumer market channels.
- HZPC scientists part of **RTBFoods advisory committee**
- HZPC **willing to collaborate and assist** RTBFoods scientists develop and validate tools

HZPC

HZPC R&D facility

- Genotype team is responsible for breeding
- Quality team is responsible for phenotyping
- Molecular team
- Phytopathology team responsible for diseases
- Post-harvest physiology team.
- Quality, Biometry and Quantitative Genetics departments

HZPC Quality Traits Breeding Program

Quality, Biometry and Quantitative Genetics departments focus on:

- Quality traits for Quick Service Response (Restaurants) (QSR) perspective,
- Development of sensory profiles,
- Application of technology in breeding and selection process
- Communication and sharing of quality data and variety performance for QSR purposes with processors.

The HZPC Quality Traits Team

Focusing on the following quality parameters:

- Texture
- Flavor
- Health and Nutrition
- Processing ability
- Appearance

- The assessment of these parameters used to be very subjective and now they are now assessed objectively and instrumentally.
- The HZPC product profiles consists of 20 traits which are scored on a scale of 0-100 based on an algorithm

Tools for Quality Traits at HZPC Profiling

1. Trained panels (for sensorial profiling)
2. GC/MS for aroma and flavor profiling
3. Texture analysis
4. Cameras for imaging of traits
5. Spectrophotometers (sugars and asparagine)
6. Statistical packages for data handling and interpretation

HZPC Aroma & Flavor Profiling

- Texture is highly correlated with aroma and flavor.
- Understanding the basis of sensorial traits (Sensory Panels)
- For sensorial variance between the traits, it’s important to have full spread of phenotypes and always aim for optimal diversity.
- GC/MS for predicting aroma, flavor and texture of steam potato
- Building a model for sensorial profile of potato from steamed potato volatile compounds.

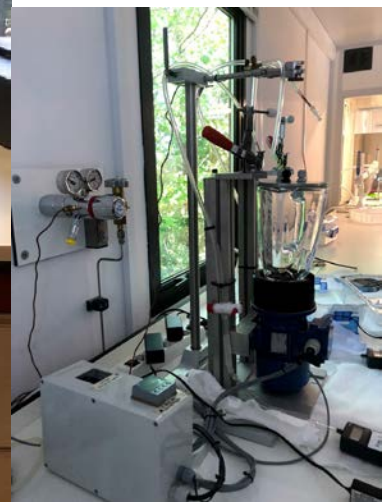
Interactions between flavor and texture

Volatile compounds can be used to predict texture

- Texture affects flavor, the structure of food matrix affects the diffusion and mass transfer co-efficient of volatile compounds.
- Flavor affects texture through rheological properties of food
- Flavor may also affect the digestion of the food product in the mouth
- **Cooked potato flavor** is a related to methional and sulphur amino acid profiles
- **Earthy, green grassy flavor** related to short and medium chain free fatty acids profiles and saturated fatty acid profiles in potatoes.
- **Cooking and processing** change the volatile compounds (Millard reactions)
- **Viscosity** related to sugars and sugars are in turn related to flavor.

GC/MS for Aroma and Flavor Profiling

GC/MS for predicting aroma, flavor and texture of steam potato, coupled with sensory panels data for understanding the basis of sensorial traits



Sensorial profile of steamed potatoes

- The samples are evaluated by trained sensory panel
- The panel assess different sensorial traits
  - Aroma (8 attributes)
  - Flavor (11 attributes)
  - Aftertaste (8 attributes)
  - Texture (13 attributes)
- Assessors rated the intensity of each attribute on 100 point unstructured line scales

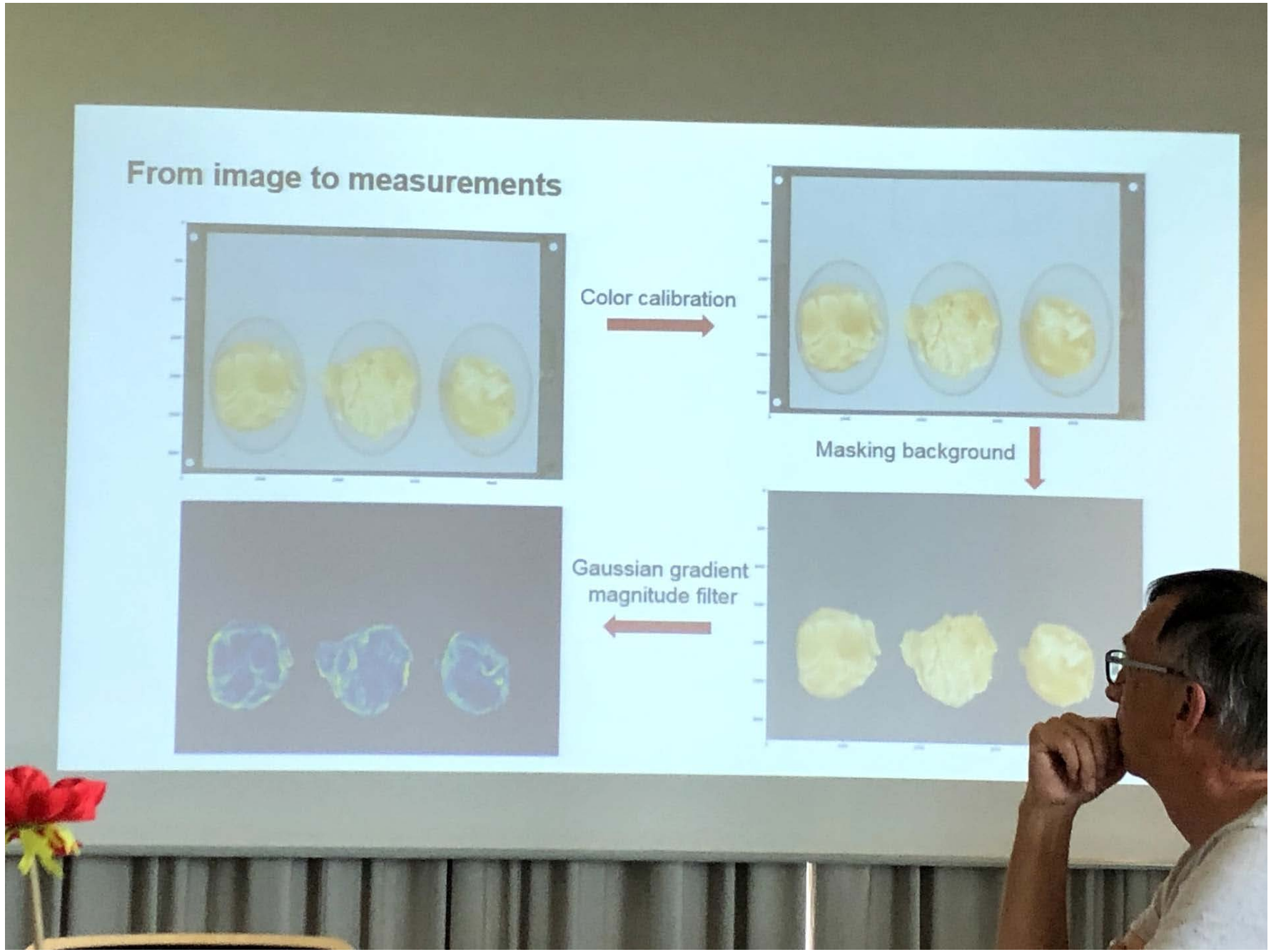
HZPC
Growing with our potatoes

Image Analysis converts image into data or scores

Algorithmic quantification of traits:

- Color,
- Cooking type (is also defined as the degree of organization or disorganization of tissues upon cooking)
- After Cooking Darkening(ACD) for breeding selection

DigiEye camera, Hyperspectral camera and software used at HZPC and for studying dry matter distribution


From image to measurements
Color calibration
Masking background
Gaussian gradient magnitude filter

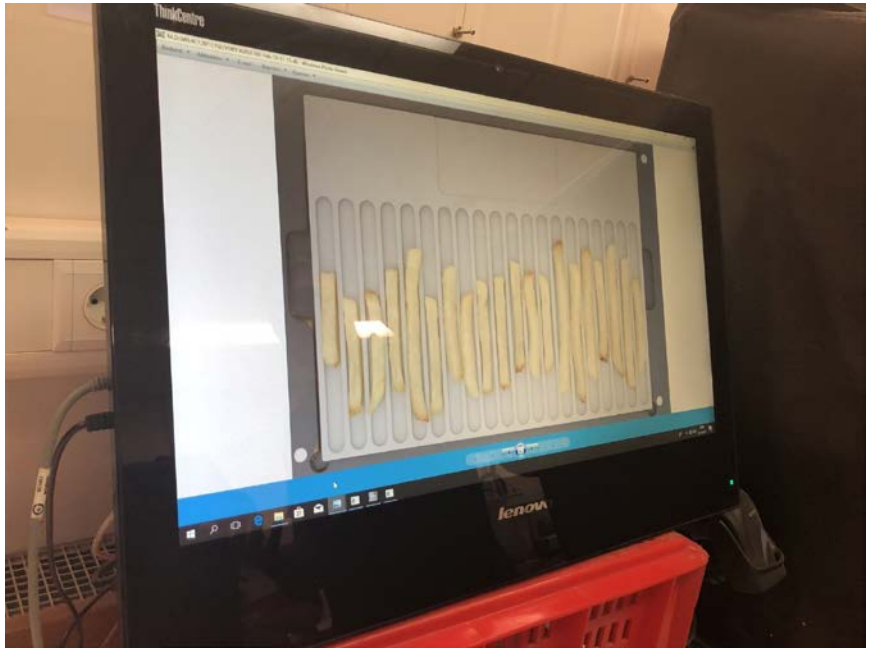
DIGIEYE scoring

What to measure?

- Flesh color (white, yellow, orange, purple, red and multi-colored)
- Cooking type
- After Cooking Darkening
- French fries (Frying color on the ends related to acrylamide)

Visual observations versus objective scoring

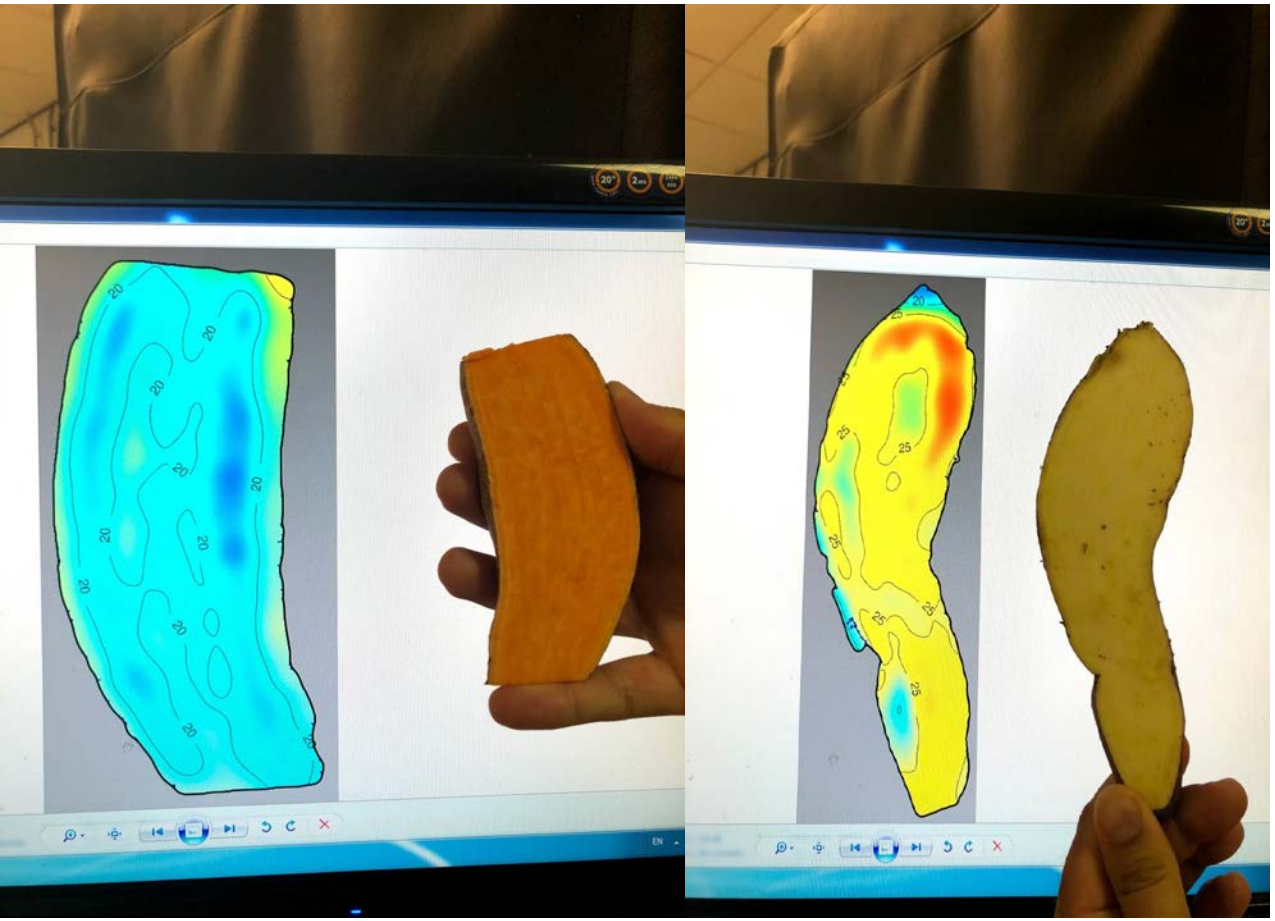
- Visual scoring is very subjective (people see colors differently)
- Dependent on illumination
- Subjected to optical illusions



DigiEye

- **Diffused lighting-** suppressing texture and shadows technique (good for measurement of color).
- **Angled light amplifies** texture and shadows, good for texture and related traits.
- **Examples for DigiEye** applications (cooking type related to dry matter), crumbility good trait for French fries.

Hyperspectral Image Analysis



Dry matter content

- Correlation between dry matter and French fries texture/ crispness.

Dry matter distribution

- Asymmetric distribution related to stress and other problems.
- French fries' industry prefers homogenous distribution of DM and is a breeding goal at HZPC

Hyperspectral Image analysis Led to high heritability of DM and DM distribution

Texture Analysis at HZPC

- Texture traits Profiling defined against targets for McCain Foods
- Texture is highly correlated with aroma and flavor
- Trained Sensory Panels for validation of flavor and aroma profiles and instrumental texture analysis.
- The focus on quality traits from a QSR perspective i.e. the Texture/mouthfeel traits on the MacDonald's' score form

Texture traits Profiling defined against targets for McCain Foods

Texture/mouthfeel traits

- A routine protocol on a 10-channel texture analyzer
- Analysis is calibrated for static and dynamic use
  - Fmax correlated with crunchiness
  - Extension correlated with limpy fries (bending)
- Validated against trained sensory panel data from HZPC consulting firms
- In potato **85% correlation between crunchiness and cell wall composition** and 70-75% correlation between **DM and crunchiness**

Texture Analysis at HZPC

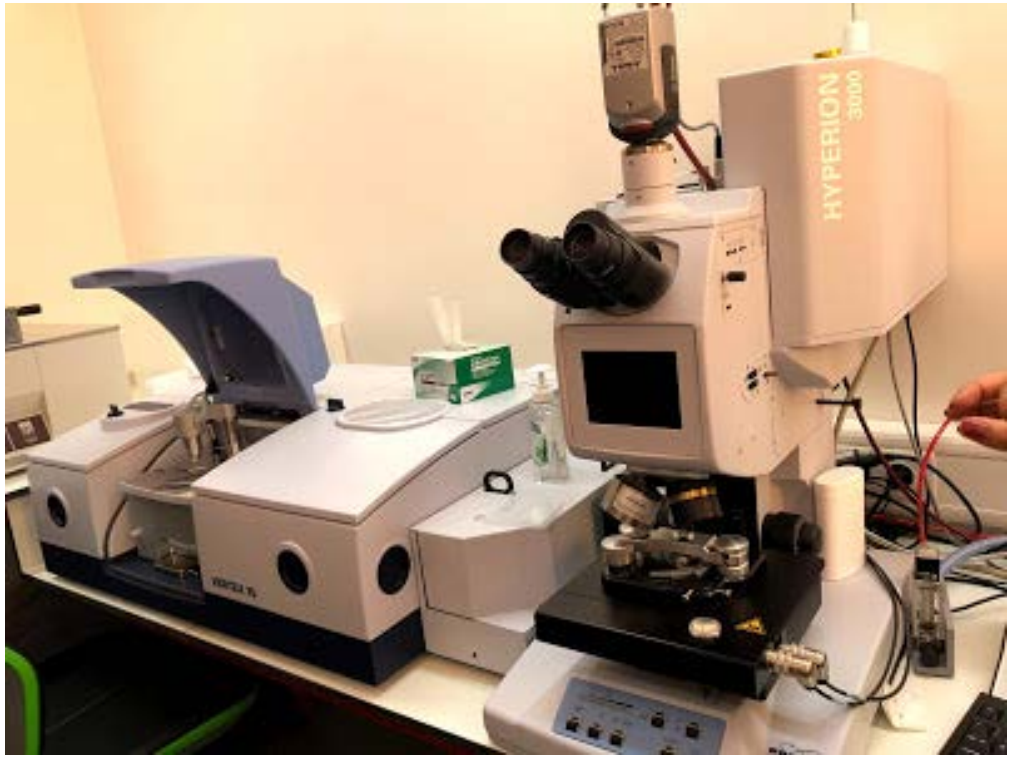
Potato texture influenced by

- Dry Matter (DM),
- Cell wall composition (methylation, side chains and pectin)

Potato frying traits are:

- High dry matter
- Low sugar
- Dry matter distribution

The application of FT-IR using HTS-tensor and vertex for cell wall composition characterization



Chemical composition of cell walls

- FT-IR spectra give information about cell walls and lots of starches
- Cooking degrades pectin and cell wall composition
- FT-IR gives information on the effects of processing on cell wall constituents
- Sensory panels used as reference for the biochemical analysis and FT-IR spectra giving 80% correlations.
- Water interferes with Mid-IR therefore not applicable for fresh samples.

Bruising test and scoring

Bruising and scoring

- Used to screen or test for harvesting and post-harvest handling of potatoes and their shelf-life after rough handling during harvest and transportation.
- After the bruising test, potatoes develop tiny dark spots after a week of observation and the dark spots are counted by visual observations.
- There seems to be a high correlation between high dry matter and skin bruising.

Appearance traits scoring

- The grader (industrial) used for sorting the potatoes at harvest based on their physical shape, appearance and weight.
- This is objective measurement is hereditability of appearance and shape.

HZPC (Total sugars and individual sugars)

Robotic analysis of sugars

- 200 samples per hour
- In potato sugar measurement, 15 genes to explain the sugar variation in potato have been identified.
- Viscosity related to sugars
- Low sugar desired for French fries
- Maturity related sweetening
- Sugars related to dormancy (non-sprouting)

What's practical for RTBFoods Project, CIP (Potato and Sweetpotato)

- Setting up sensory panels (objective scoring)
- Linking sensory panel data to texture analysis of cooked product profiles
- Dry matter (DM)
- DM Distribution
- Cell Wall Structures
- Texture analysis
- Appearance

Thank You