

# Matooke

## Key Findings from RTBfoods in Period 2

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*Other Contributing Scientists (listed on last slides of the presentation)*

*RTBfoods 2<sup>nd</sup> Annual Meeting, Kampala, Uganda, 3-7 Feb. 2020*

# Countries of Activity Implementation

## UGANDA

- WP1-Act.3 Surveys
- WP1-Act.4 Processing Diagnosis
- WP1-Act.5 Consumer Testing
- ▲ WP2/WP3 Lab.
- ✕ WP4 Fields
- ✕ WP5 On-Farm /Advanced Trials





# Institutes & Main Scientists Involved

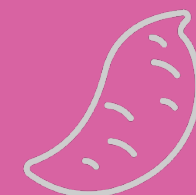
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- **NARL** – Uganda (K. Nowakunda, K. Akankwasa, M. Asasira, E. Khakasa, M. Matovu)
- **Alliance of Bioversity International and CIAT** – Uganda (P. Marimo)
- **IITA** – Uganda (B. Uwimana)
- **NaCRRI** – Uganda (E. Nuwamanya)
- **CIRAD** - Montpellier (Genevive, Christophe, D. Mbéguié-A-Mbéguié)
- **NRI** – United Kingdom (Lora Forsythe, Uli Kleih)

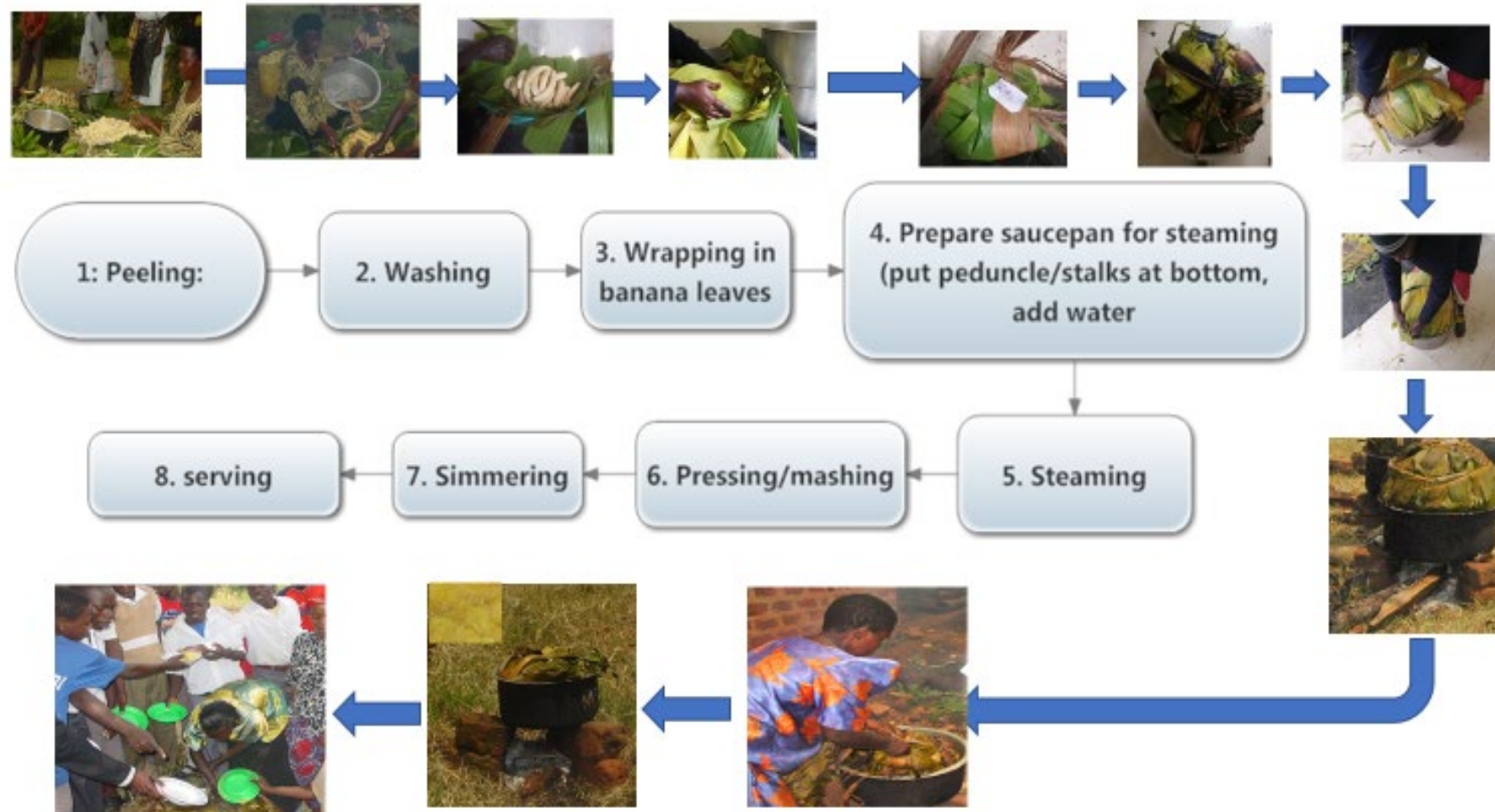


WP1





# Matooke processing description





# List of Quality Characteristics of the Raw Material during Processing **(preferred / less preferred AT EACH STEP)**

## Step 1: peeling

easy to peel, straight  
fingers, soft peel, soft  
pulp,  
yellowish/creamish  
pulp colour, low sap  
content

hard to peel, curved  
fingers

## Step 2: washing

low amount of sap

lot of sap

## Step 3: wrapping in leaves

??

??

## Steps 4-7: preparing pan; steaming, mashing, simmering

No specific  
associated  
characteristic

No specific associated  
characteristic

# Key physical measurements during processing



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- Yield at each processing stage
  - Temperature
  - Duration of each unit operation

# Mean yield (Kg) of the matooke varieties during processing`



Varieties	Weight of fingers (Kgs)	Weight of fingers after peeling (Kgs)	Weight of peels (Kgs)	Peel-PulpRatio	Weight of leaves and fibres used for wrapping (Kgs)	Weight of wrapped bundles (Kgs)	Weight after steaming (Kgs)	Weight of bundle after mashing (Kgs)	Weight of bundle after simmering (Kgs)	Netweight after steaming	Netweight after Mashing	Netweight after simmering
<b>Nakaseke</b>												
Mpologoma	2.064 a	1.235 a	0.925 ab	0.770 ab	0.365 a	1.608 a	1.919 ab	1.820 abc	2.033 a	1.554 ab	1.455 abc	1.668 a
M30	2.023 a	1.314 a	0.866 ab	0.679 b	0.439 a	1.516 ab	2.013 a	1.977 a	1.937 abc	1.575 a	1.538 ab	1.499 ab
Nakitembe	2.004 a	1.072 ab	1.020 a	0.953 a	0.323 a	1.425 ab	1.771 ab	1.869 ab	1.952 ab	1.448 ab	1.546 a	1.629 a
NARITA 2	2.014 a	0.976 b	0.839 b	0.854 ab	0.334 a	1.437 ab	1.777 ab	1.869 ab	1.969 ab	1.443 ab	1.536 ab	1.635 a
<b>Mbarara</b>												
Nakitembe	2.141 a	1.155 ab	0.989 ab	0.868 ab	0.449 a	1.339 b	1.662 b	1.624 bc	1.652 bcd	1.213 b	1.174 c	1.203 b
NARITA 12	2.048 a	1.089 ab	0.969 ab	0.909 a	0.372 a	1.379 b	1.654 b	1.620 bc	1.646 bcd	1.282 ab	1.249 abc	1.274 b
Kibuzi	2.110 a	1.129 ab	0.951 ab	0.846 ab	0.361 a	1.411 ab	1.601 b	1.583 bc	1.569 d	1.240 ab	1.222 c	1.208 b
M30	2.041 a	1.114 ab	0.933 ab	0.843 ab	0.330 a	1.419 ab	1.680 b	1.562 c	1.599 cd	1.350 ab	1.233 bc	1.269 b
Pr > F(Model)	0.474	0.266	0.456	0.230	0.832	0.317	0.171	0.053	0.028	0.283	0.052	0.014
Significant Yes	No	No	No	No	No	No	No	No	Yes	No	No	Yes
Pr > F(Sample code)	0.474	0.266	0.456	0.230	0.832	0.317	0.171	0.053	0.028	0.283	0.052	0.014
Significant Yes	No	No	No	No	No	No	No	No	Yes	No	No	Yes



# Temperature (degrees celsius) at different points during matooke processing

Varieties	Temperature when water starts boiling(0C)	Temperature in the middle of steaming(0C)	Temperature after steaming before pressing(0C)	Temperature after mashing(0C)	Temperature after simmering(0C)	Temperature at serving(0C)
<b>Nakaseke</b>						
NARITA2	95.000 a	95.000 a	91.000 a	87.500 a	90.500 a	82.500 a
Mpologoma	94.000 a	95.000 a	93.000 a	87.000 a	88.000 a	<b>71.000 b</b>
M30	93.500 a	94.000 a	93.500 a	86.000 a	83.500 a	85.500 a
Nakitembe	95.050 a	95.000 a	88.500 a	87.500 a	84.000 a	82.000 a
<b>Mbarara</b>						
Kibuzi	91.000 a	93.250 a	90.250 a	81.000 a	84.250 a	84.750 a
M30	88.525 a	92.500 ab	84.250 a	82.250 a	84.750 a	84.250 a
NARITA12	87.850 a	92.500 ab	90.750 a	83.000 a	84.000 a	79.750 a
Nakitembe	84.000 a	89.250 b	85.500 a	78.500 a	82.750 a	84.250 a
Pr> F(Model)	0.317	0.069	0.506	0.632	0.866	0.085

# Duration (minutes) of the unit operations in matooke processing (2Kg)



Cultivars	Time for peeling/m	Time for washing/m	Time for wrapping/m	Steaming/m	Pressing time/m	Simmering time/m
<b>Mbarara</b>						
NARITA12	5.635 ab	0.885 a	3.613 a	116.700 abc	5.535 ab	76.200 a
M30	4.880 ab	1.567 a	1.963 a	105.600 bc	17.327 a	59.200 a
Kibuzi	3.850 b	1.240 a	3.340 a	77.550 c	4.250 ab	47.450 a
Nakitembe	4.830 ab	1.533 a	3.473 a	93.067 bc	2.367 b	47.800 a
<b>Nakaseke</b>						
Nakitembe	3.805 b	1.073 a	3.410 a	91.500 bc	5.063 ab	70.350 a
Mpologoma	4.155 b	0.375 a	2.235 a	165.300 a	3.410 ab	56.700 a
NARITA2	6.625 a	1.150 a	2.495 a	132.000 ab	2.400 b	57.900 a
M30	4.038 b	1.898 a	2.920 a	71.400 c	2.865 b	44.550 a
Pr > F(Model)	0.157	0.883	0.957	0.021	0.295	0.223
Significant	No	No	No	Yes	No	No
Pr > F(Sample code)	0.157	0.883	0.957	0.021	0.295	0.223
Significant	No	No	No	Yes	No	No



# Quality Characteristics of Raw Material-

(agronomical, post-harvest: morphological & storage ability)



Preferred Characteristics	Rankings				
	W	M	Mb	Nk	ALL
Mature bunch	1	1	1	1	1
Big fingers	2	2	2	3	2
Big bunch	3	3	3	2	3
No sign of diseases	5	4	4	5	4
Long fingers	4	5	5	4	5
Packed/ compact bunch	6	6	6	6	6

Less Preferred Characteristics	Rankings				
	W	M	Mb	Nk	ALL
Small/short fingers	1	1	1	1	1
Immature fruits	3	2	2	3	2
Spotted/ diseased	2	3	5	2	3
Hard/ brittle fingers	4	4	4	4	4
White pulp colour	4	5	3	5	5
Hard to peel	6	7	6	8	6
Small bunch	7	8	7	7	7

- **W** = women, **M** = men, **Mb** = Mbarara district, **Nk** = Nakaseke district
- Indicators of maturity: Roundness, no flower tips, shiny skin...

# Quality Characteristics of Raw Material during Processing (technological & physico-chemical)



PREFERRED characteristics	Rankings				
	W	M	Mb	Nk	ALL
Mature fruits	1	1	1	1	1
Big fingers	3	2	2	4	2
Easy to peel	2	5	4	2	3
Soft pulp	5	2	3	5	5
Soft peel	4	4	5	3	4
Low amount of sap	6	8	6	11	7
Straight fingers	8	7	7	6	6

LESS PREFERRED characteristics	Rankings				
	W	M	Mb	Nk	ALL
Small/short fingers	1	1	1	1	1
Immature fruits	3	2	2	3	2
Spotted/diseased	2	3	5	2	3
Hard/ brittle fingers	4	4	4	4	4
White pulp colour	4	5	3	5	5
Hard to peel	6	7	6	8	6

- Ease of peeling ranked higher by women, minimal differences between sexes and districts



# List of Quality Characteristics of the Ready-to-Eat Final Product



Preferred Characteristics	Rankings				
	M	W	Mb	Nk	ALL
Soft texture	1	1	1	1	1
Good aroma	2	2	2	2	2
Yellow colour	3	4	3	4	3
Good taste	4	3	4	3	4
Smooth mouth feel	5	5	5	5	5
Uniform/homogeneous texture	6	6	6	5	6

Less Preferred Characteristics	Rankings				
	W	M	Mb	Nk	ALL
Hard texture	1	1	1	1	1
Watery	2	2	2	4	2
Pale yellow colour	4	3	3	5	3
Not homogeneous	5	4	4	3	4
Poor/flat taste	3	5	5	2	5

# Main preferred Varieties

	Rankings						
Cultivar	Mbarara			Nakaseke			Total
	F	M	ALL	F	M	ALL	
Nakitembe	1	3	2	1	1	1	1
Kibuzi	2	1	1	7	6	6	2
Mbwazirume	7	3	4	4	3	4	3
Enyeru	3	2	3				4
Nshakala		12	13	2	5	2	5
Mpologoma				3	4	3	6
Kisansa				6	2	5	7

- ❖ All are landrace
- ❖ *Kibuzi*, more preferred in Mbarara; *Mpologoma* only mentioned in Nakaseke; *Enyeru* only in Mbarara
- ❖ Reasons for preferences: medium-big bunch; big fingers; quick maturity; **produces good, soft, tasty food** (*Kibuzi*, *Mbwazirume*, *Enyeru*)
- ❖ Nakitembe, Kibuzi, Mpologoma, 2 hybrids used in Activity 4 and 5



# Less preferred varieties

## Men (Mbarara)

- Bukumu (L)
- Butoobe (L)
- Nshakala (L)
- Entazinduka (L)
- Enkunku (L)
- Enzirabahima (L)

## Men (Nakaseke)

- KABANA (I)
- Mpologoma (L)
- Nakamali (L)
- Katwalo(L)
- Nalugolima (L)
- FHIA (I)

## Women (Mbarara)

- Butoobe (L)
- Enkunku (L)
- Enzirabahima (L)
- Kawanda (I)

## Women (Nakaseke)

- KABANA (I)
- Mpologoma (L)
- Nakamali (L)
- Mukubakonde (L)
- Namwezi (L)
- Siira (L)

Reasons include:

- small bunches and fingers
- none/low-marketability
- processing related - hard peel (*Mpologoma*)
- consumption related – produce hard food when steamed(*Siira*), cools quickly (*Siira*)
- Susceptible to drought-Mpologoma

Contrasting results e.g. *Mpologoma* mentioned as a preferred variety but also less preferred for its other characteristics → trade offs



WP2





# Characterization of Cooking/Processing Ability

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## ❖ Focussed on SOPs development:

1. Matooke Preparation at lab level
2. Matooke texture analysis
3. Matooke Sensory analysis
4. Setting up and training laboratory sensory panel
5. Sensory profiling of the matooke genotypes

# Sensory Profiling of Varieties

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- ❖ [List of Descriptors](#)
- ❖ [Nb of Varieties profiled =29](#)

# Relationship between sensory attributes, instrumental texture and dry matter

Correlation matrix:

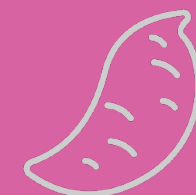
	experimental Hardness	cohesiveness	viscosity	DMC	Yellow	homogeneity of colour	Firmness	Moisture	Smoothness	hardness by touch	Moldability	Stickiness
experimental Hardness	1.00	- 0.25	0.02	0.60	0.00	0.05	0.50	- 0.47	- 0.45	0.50	- 0.38	- 0.54
cohesiveness	0.25	1.00	- 0.84	- 0.16	0.02	- 0.05	- 0.13	0.15	0.20	- 0.14	0.29	0.17
viscosity	0.02	- 0.84	1.00	- 0.04	- 0.14	- 0.05	0.02	- 0.09	- 0.19	0.09	- 0.27	0.03
DMC	0.60	- 0.16	- 0.04	1.00	0.12	0.14	0.54	- 0.58	- 0.43	0.47	- 0.30	- 0.78
Yellow	0.00	0.02	- 0.14	0.12	1.00	0.94	0.01	0.38	0.19	- 0.11	0.24	- 0.32
homogeneity of colour	0.05	- 0.05	- 0.05	0.14	0.94	1.00	0.10	0.32	0.11	- 0.01	0.16	- 0.39
Firmness	0.50	- 0.13	0.02	0.54	0.01	0.10	1.00	- 0.84	- 0.84	0.94	- 0.78	- 0.74
Moisture	- 0.47	0.15	- 0.09	- 0.58	0.38	0.32	- 0.84	1.00	0.79	- 0.85	0.75	0.64
Smoothness	- 0.45	0.20	- 0.19	- 0.43	0.19	0.11	- 0.84	0.79	1.00	- 0.94	0.92	0.53
hardness by touch	0.50	- 0.14	0.09	0.47	- 0.11	- 0.01	0.94	- 0.85	- 0.94	1.00	- 0.91	- 0.65
Moldability	- 0.38	0.29	- 0.27	- 0.30	0.24	0.16	- 0.78	0.75	0.92	- 0.91	1.00	0.46
Stickiness	- 0.54	0.17	0.03	- 0.78	- 0.32	- 0.39	- 0.74	0.64	0.53	- 0.65	0.46	1.00

- ✓ Strong positive correlation between DMC and experimental/instrumental hardness (0.600)
- ✓ Strong negative correlation between DMC and stickiness by touch (-0.784)
- ✓ Moderate positive correlation DMC and firmness in the mouth (0.544)
- ✓ Very strong positive correlation between homogeneity of the colour and yellow colour
- ✓ Very strong negative correlation between Firmness in the mouth and moisture in the mouth, Smoothness, hardness by touch, moldability by touch and stickiness by touch.



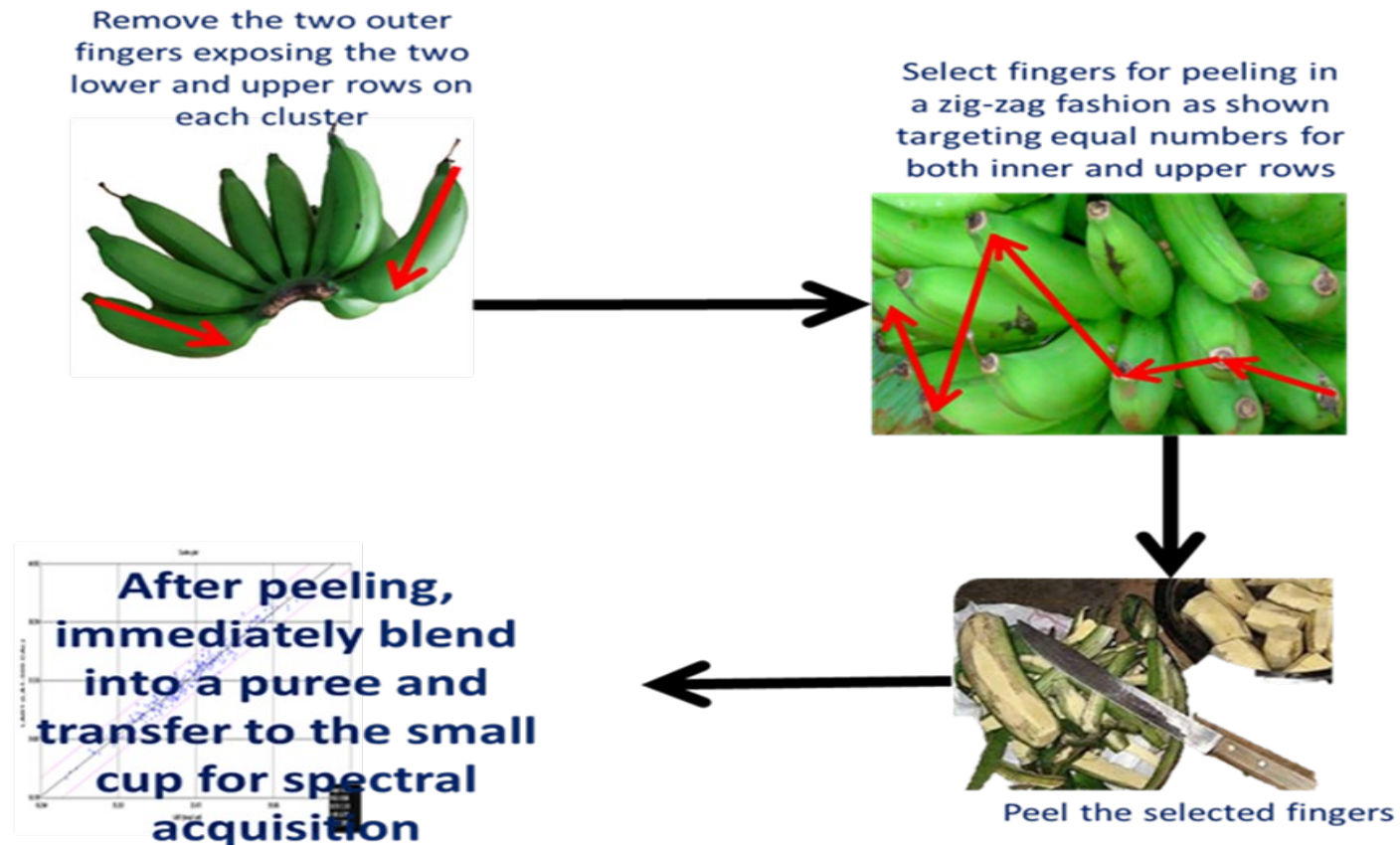


WP3



# Development of Calibrations to Predict Quality Traits

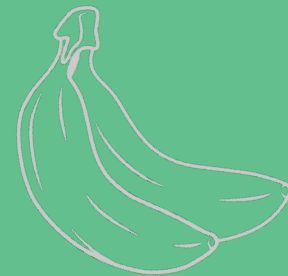
- ❖ Quality Traits for which a Calibration is being developed : Dry matter, Texture,
- ❖ Number of spectra acquired: 184 spectra
- ❖ Process flow:







WP4





# Key Progress in Matooke Breeding for Quality

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- ❖ Promising populations identified
- ❖ Laboratory analysis of the training population comprising
  - matooke-derived hybrids,
  - their direct parents (4x and 2x)
  - their grandparents (3x and 2x).
- ❖ 153 clones so far (out 228 clones) analysed for:
  - Colour
  - Aroma
  - Taste
  - Texture
  - Dry matter
- ❖ G x E studies awaiting field tools





WP5





# On-Farm Trials & Evaluation of Advanced Material



❖ Activities implemented in collaboration with BBB/ABB and NARO/IITA

❖ PYT already established at four sites

1. Western – Mbarara
2. Central - Sendusu
3. Mid-west – Hoima
4. East – Jinja

❖ **Activities:**

- Participatory evaluation using existing procedures
- Select preferred genotypes
- Variety release
- Variety promotion





# Conclusion on Perspectives for all WPs

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- ❖ Traits preferred by end-users of matooke...

  - Draft WP1 report (matooke) and product profile are under review

- ❖ SOPs for product preparation, sensory profiling and texture analysis are completed

  - WP2 will pick key traits for dissection and quantification for use by WP3 and later WP4

- ❖ Interactions: Matooke teams work together in all WPs

- ❖ A publication, based on WP1 finding in advanced stages

*> Title: The East Africa Highland Cooking Bananas ' Matooke' end-user preferences and implications for trait evaluations*

*➤ Akankwasa Kenneth, Marimo Prescilla, Tumuhimbise Roboni, Asasira Moureen, Khakasa Elizabeth, Kisenyi Nelson and Uli Kleih , Lora Forsythe, Geneviève FLIEDEL and Nowakunda Kephass*

*➤ An Msc student writing thesis ' Consumer perceptions and préférences for banana variétal traits in Uganda. Case of urban consumer*

# Conclusion on Perspectives for all WPs

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## ❖ **Focus during Period 3:**

*WP1. Completion and submission of final report/Product profile*

*WP2: Translation of traits into physico-chemical definitions*

*WP3: Generation of calibration models*

*WP4: Continue analysing the training population, maintain the training population to continue supplying bunches to NARL (WP2) and NaCCRI (WP3).*

*WP5: Participatory evaluation of hybrids in field (NARO/IITA)*



RTB foods



# WP1 Collaborating Scientists

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- Kenneth Akankwasa, NARL, Uganda
- Priscilla Marimo, Bioversity International
- Moureen Asasira, NARL, Uganda
- Sarah Kisaakye, NARL, Uganda
- Sara Mayanja, CIP, Uganda
- Edwin Serunkuma, CIP, Uganda
- Lora FORSYTHE, NRI, UK
- Ulrich Kleih, NRI, UK
- Alexandre BOUNIOL, UAC-FSA-CIRAD, Benini
- Genevieve FLIEDEL, CIRAD, France

NOT TO BE PRESENTED

# WP2 Collaborating Scientists

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- Mose Matovu, NARL, Uganda
- Ephraim Nuwamanya, NaCCRI, Uganda
- Uwimana Brigitte, IITA, Uganda
- Gloria Grace Aguti, NARL, Uganda
- Elizabeth Khaksa, NARL, Uganda
- Steven, K. Tumwesigye, NARL, Uganda
- Edwin Serunkuma, CIP, Uganda
- Loyal DAHDOUH, CIRAD, France
- Didier MBEGUIE A MBEGUIE
- Julien RICCI, CIRAD, France
- Dominique Dufour, CIRAD, France
- Christophe BUGAUD

# WP3 Collaborating Scientists

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- Mose Matovu, NARL, Uganda
- Ephraim Nuwamanya, NaCCRI, Uganda
- Uwimana Biggitte, IITA, Uganda
- Sarah Kisaakye, NARL, Uganda
- Nicholas Muhumuza, NaCCRI, Uganda
- Fabrice DAVRIEUX, CIRAD, France

# WP4 Collaborating Scientists

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- Uwimana Briggite, IITA, Uganda
- Jennifer Acayo, IITA, Uganda
- Elizabeth Khaksa, NARL, Uganda



# WP5 Collaborating Scientists

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- Kenneth Akankwasa, NARL, Uganda
- Priscilla Marimo, Bioversity International
- Uwimana Brigitte, IITA, Uganda
- Jennifer Acayo, IITA, Uganda
- Moureen Asasira, NARL, Uganda
- Sarah Kisaakye, NARL, Uganda