DETERMINATION OF THRESHOLDS FOR KEY QUALITY TRAITS

Quality & Preferences
- Task Force -

Ibadan, NIGERIA

25th-26th March 2024

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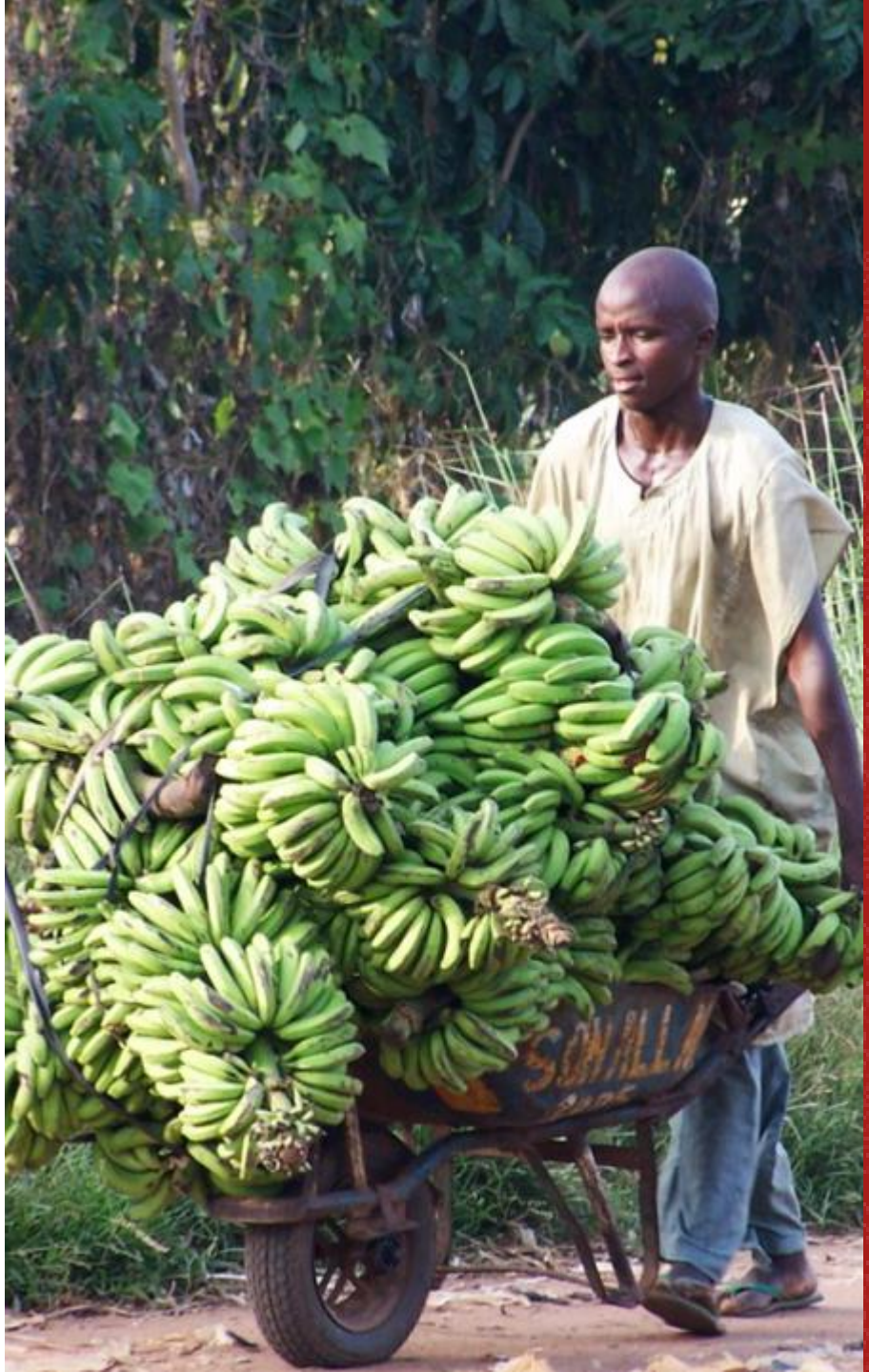
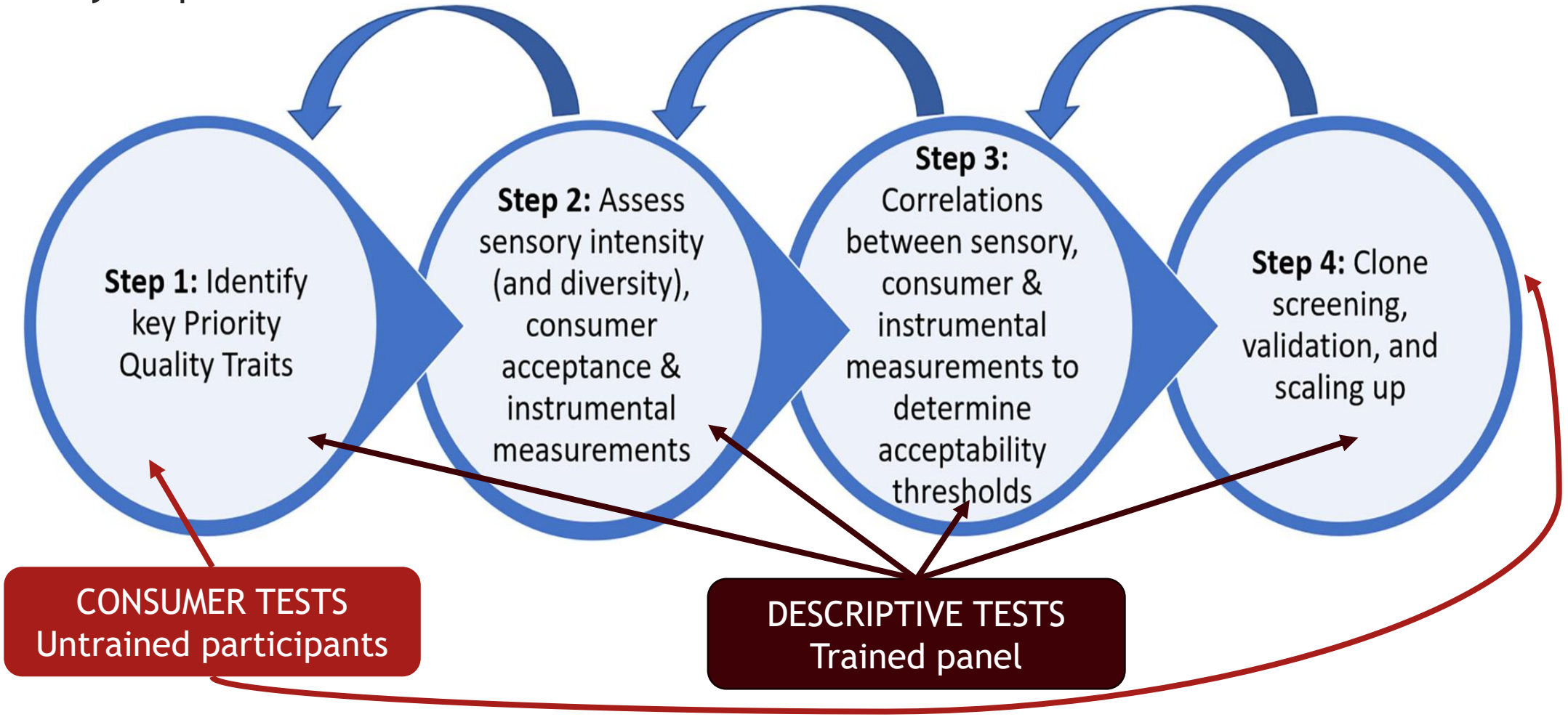
WALKING PLAN

- Sensory analysis for breeding – a background
- Determination of thresholds for KPQs
- Progress by various RTB products
  - Boiled plantain
  - Boiled sweetpotato
  - Boiled yam
- General progress across crops and products
- Evidence for application in breeding – selection index
- Needs for smooth implemetation
- How can we help breeders better? (panel discussion)



SENSORY ANALYSIS FOR BREEDING

REF : https://doi.org/10.1002/jsfa.12723 - Bechoff et al. (2023) ; Add Lora Forsythe publication



DEFINITION OF TERMS – TRAINED PANEL,JAR, QDA, CONSUMER TESTS

BREEDER: Is it good enough to advance / release?

THRESHOLDS = quantitative targets

CONSUMER TESTS
Untrained participants

Pseudonym - JOY
"I like this sweetpotato very much" – Likert scale (acceptability)
"I would like this SP better if it were sweeter" - JAR
"I would like this SP better if it had less water" - JAR

What does sweet mean?
What does Joy mean water in sweetpotato?

DESCRIPTIVE TESTS
Trained panel

Pseudonym - TRUST
"On a scale of 0 – 10, this sweetpotato is 6 for sweet taste" - QDA
Lexicon : Sweet taste is taste of sugar

DETERMINATION OF ACCEPTABILITY THRESHOLDS FOR KEY QUALITY TRAITS

To determine the thresoholds, three types of tests/ analysis are required:

2 different types of Sensory Analysis

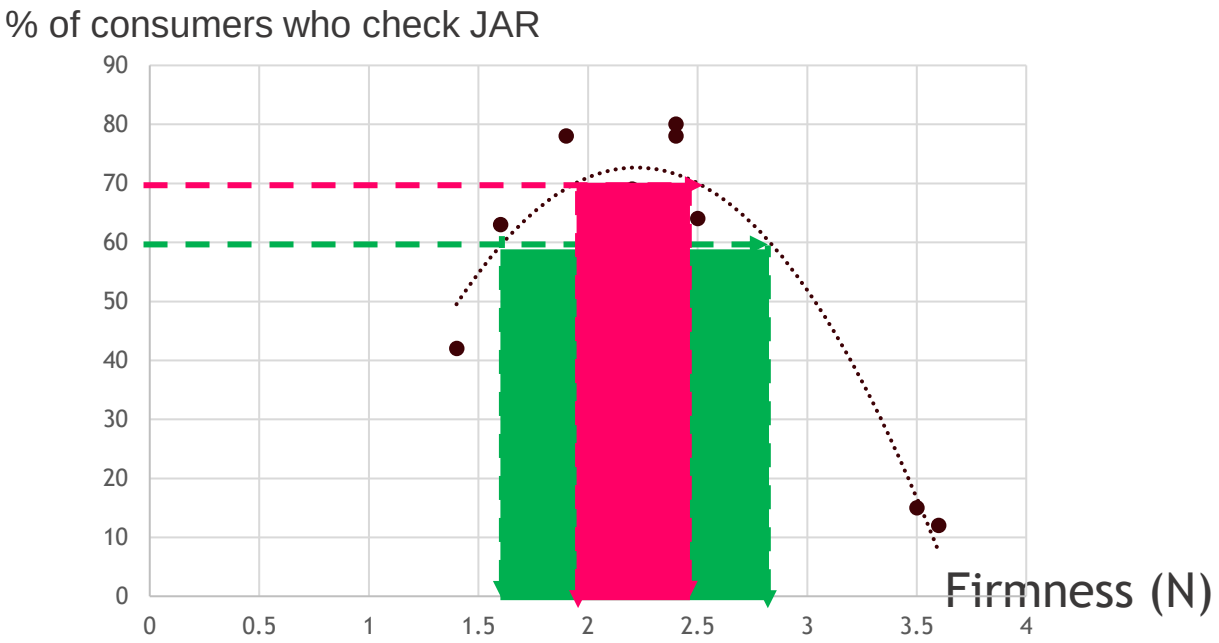
1 : Consumer Test:
Objective : determine the preference and accepatbility of consumers.
Who : ~ 100 untrained consumers.
Type of test : Just About Right (JAR), Overall liking - Likert

2: Quantitative Descriptive Analysis
Objective: obtain sensory measurements of the intensity of characteristics.
Who : A panel of 12 - 15 trained judges
Type of test: Quantitative descriptive Analysis (QDA)

3 : Instrumental analysis
Instrumental measurement techniques corresponding to sensory attributes

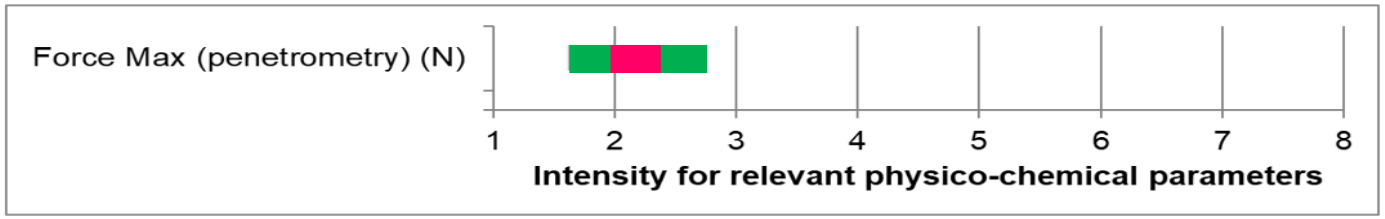
DETERMINATION OF ACCEPTABILITY THRESHOLDS FOR KEY QUALITY TRAITS

Results : Example of a curve representing consumer acceptability as a function of **firmness** instrumental measures



Samples	JAR	Instrumental measures* (N)
1	69 %	2.2
2	52 %	2.7
3	15 %	3.5
4	83%	2.4
…	…	
6	12 %	3.6

Bugaud et al. SH (2016)



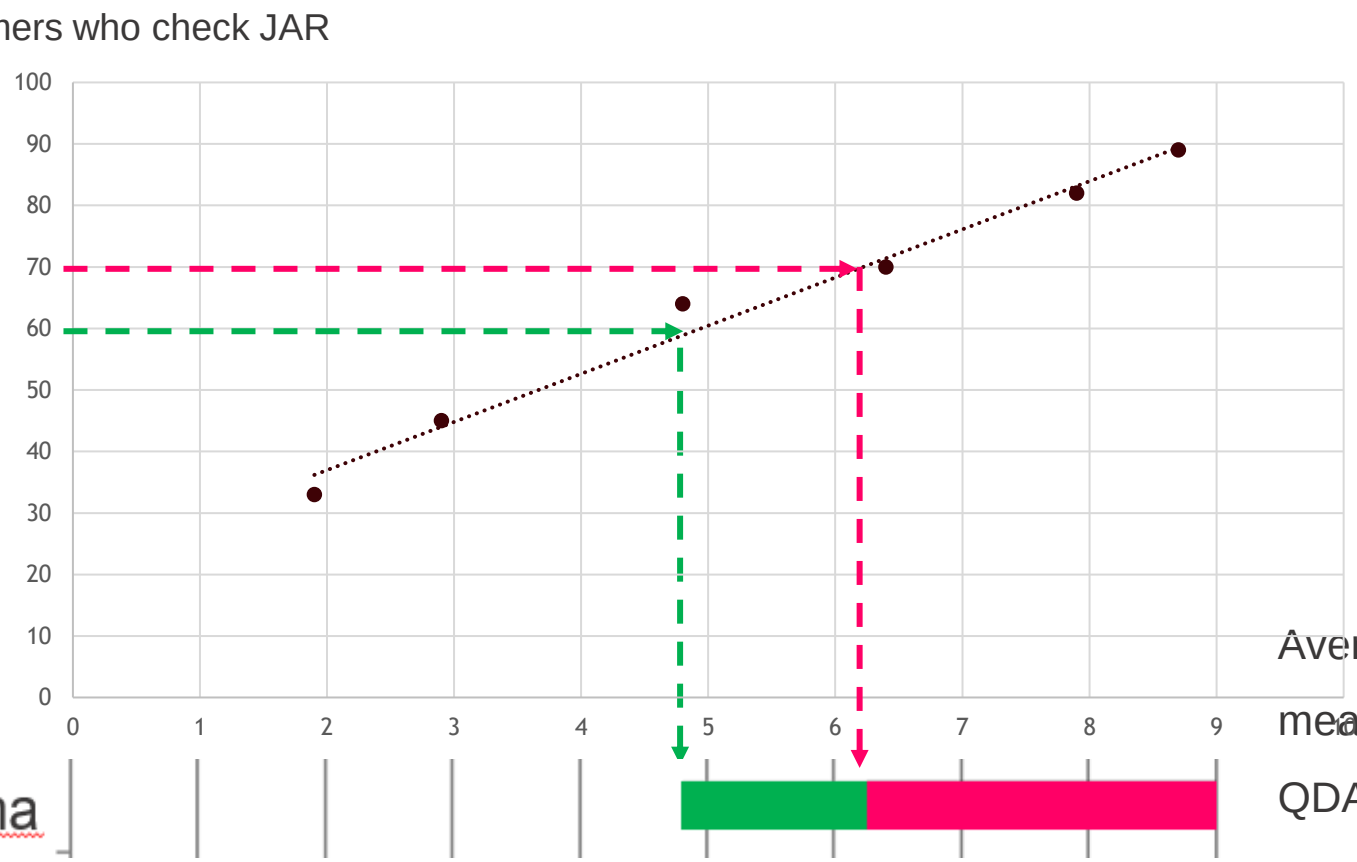
Thresholds

1.9 N < optimal firmness < 2.4 N

1.6 N < acceptable firmness < 2.8 N

DETERMINATION OF ACCEPTABILITY THRESHOLDS FOR KEY QUALITY TRAITS

Results : Fictitious example of a curve representing consumer acceptability as a function of **banana aroma** measured in QDA



Samples	JAR	QDA mean
1	33 %	1.9
2	82 %	7.9
3	64 %	7.8
4	89%	6.4
…	…	…
6	45 %	2.9

Average intensity of banana aroma measured by the whole panel in QDA

EXAMPLE 1: BOILED PLANTAIN

Preliminary studies on Thresholds of **boiled plantain** quality traits using:

- data obtained from consumer testing (JAR) more than 120 untrained
- Quantitative Descriptive Analysis (Firmness, wetness, sweetness & colour), n=15
- Texture and biophysical analyses (dry matter content, Total soluble solids, Total titratable acidity & colour).

- Pearson correlation coefficients obtained at 5% threshold
- Plots drawn to determine R^2 values between JAR data and QDA data

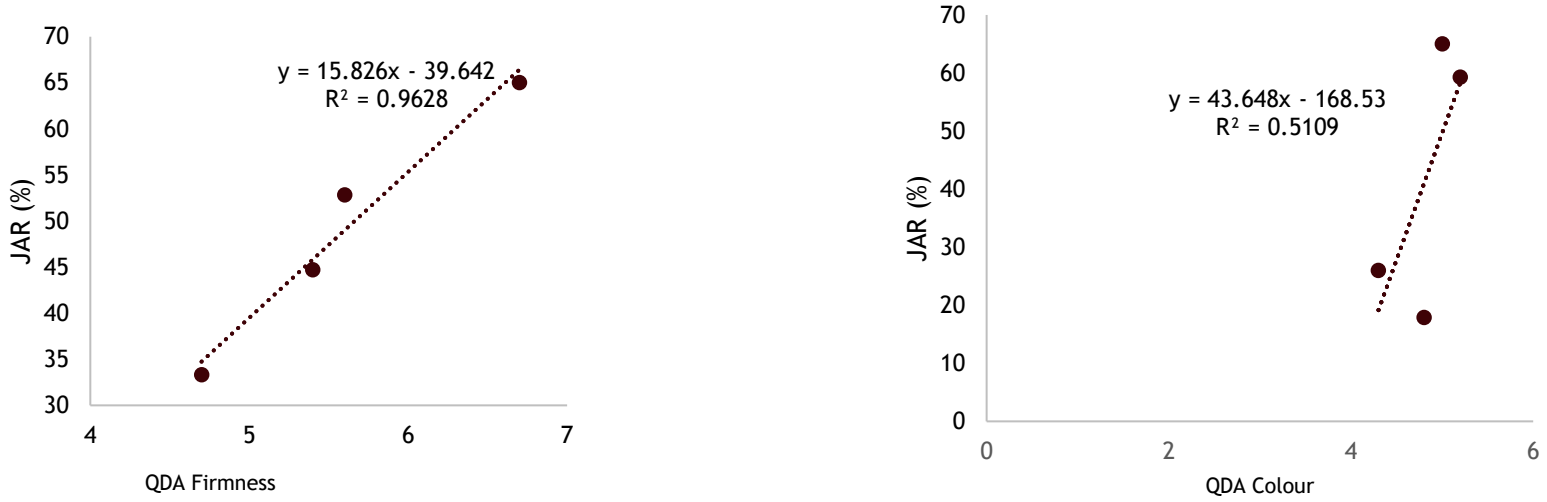


Figure 1. Plots of %JAR vs QDA Firmness and QDA Colour

EXAMPLE 1: BOILED PLANTAIN - APPLICATION

Thresholds using QDA firmness

DMC, TPA hardness and TPA resilience were the traits that presented R^2 values greater than 0.5 with QDA firmness

DMC = **32.03%**

TPA hardness = **8737.31**

TPA resilience = **291.56**

Thresholds using QDA colour

TSS and DMC were the traits whose R^2 were greater than 0.5 with QDA colour

DMC = **32.54%**

TSS = **13.9 °Brix**

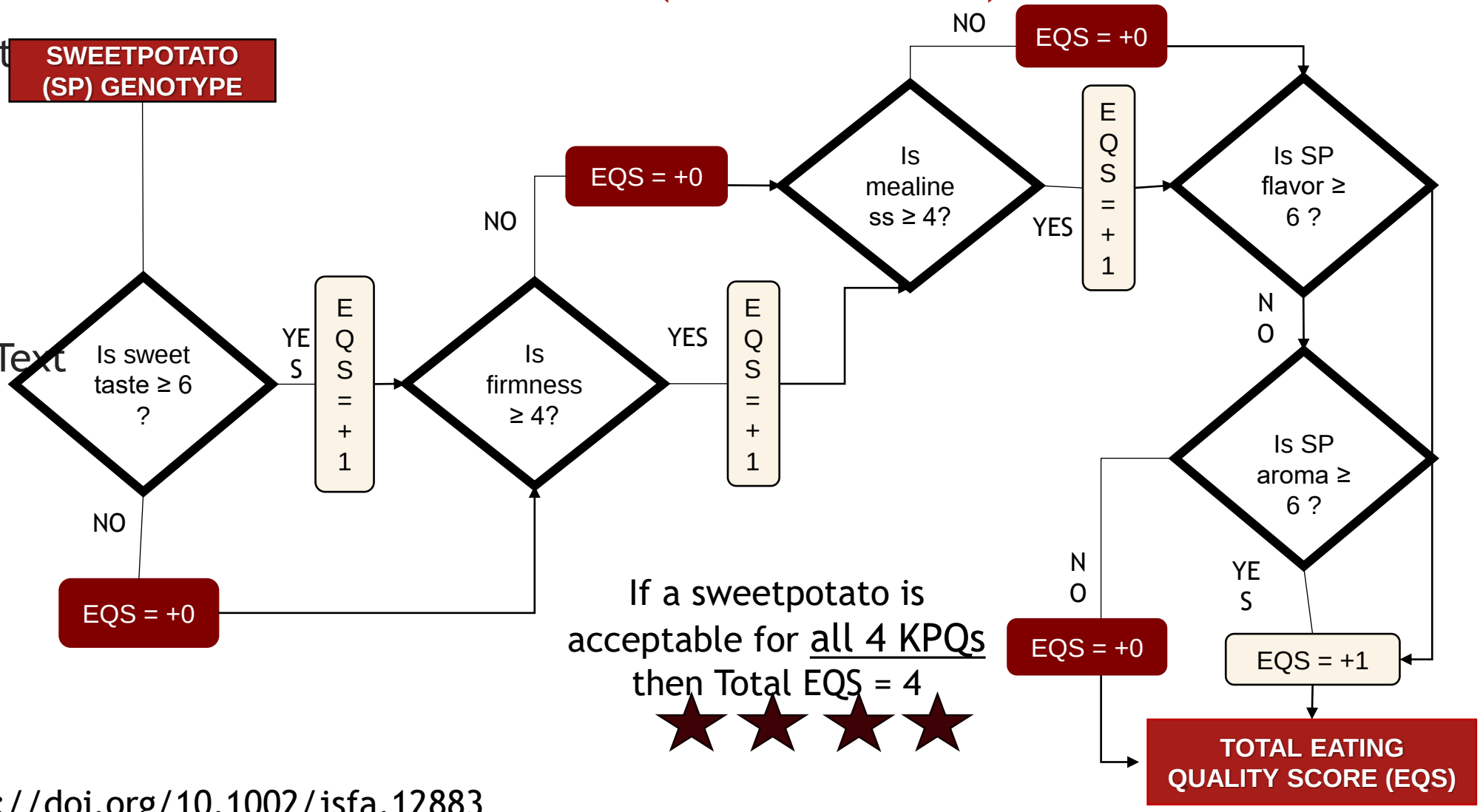
Data collected on 09 plantain clones ⟶ **need to increase sample size**

https://doi.org/10.1002/jsfa.12977 https://doi.org/10.1002/jsfa.13072 https://doi.org/10.1002/jsfa.12723

EXAMPLE 2: SWEETPOTATO QUALITY SELECTION INDEX (UGANDA)

Text

- Text



If a sweetpotato is acceptable for <u>all 4 KPQs</u> then Total EQS = 4

https://doi.org/10.1002/jsfa.12883

EXAMPLE 3: BOILED YAM (BENIN)

9 samples analysed for threshold acceptability

doi.org/10.1002/jsfa.12589

Main sensory attributes	Consumer satisfaction (%)	Sensory score		Penetration force (N)		Sugar intensity_raw (g/100g, dry basis)	Dry matter_raw (g/100g)	
		Min	Max	Min	Max		Min	Max
Easy to break	60	5	8	5	9	-	33	40
	80	5	7	6	8	-	35	38
Crumbly	60	> 6		< 7		-		
	80	> 7		< 6		-		
Sweet taste	60	> 6		-		< 4	> 39	
	80	> 7		-		< 3	> 45	

GENERAL PROGRESS ACROSS CROPS

PRODUCT (include progress from all RTB products)	CONSUMER TESTS (Number of genotypes, number of consumers)	Descriptive sensory analysis (number of panelists, characteristics)	Instrumental Measurements	Preliminary findings
Pounded Yam	Consumers = 120 Characteristics: Genotypes:	Number of panelists=15 Sensory attributes:	Instrumental measurement on colour and textural quality (hardness, cohesiveness ,adhesiveness, extensibility)	Good correlations between instrumental and colour measurements
Matooke	Consumers = 120 Characteristics: color, taste, firmness Genotypes = 10	Panelists – 12 Attributes – sweetness, yellow, homogeneity, firmness	Instrumental texture on raw and boiled	
Boiled sweetpotato (Mozambique) *	Mealiness, browning, fibrousness, sweetness	Mealiness, brown color, fibrousness, sweetness	Instrumental texture DigiEye images	

GENERAL PROGRESS ACROSS CROPS

PRODUCT (include progress from all RTB products)	CONSUMER TESTS (Number of genotypes, number of consumers)	Descriptive sensory analysis (number of panelists, characteristics)	Instrumental Measurements	Preliminary findings
Boiled plantain *	Consumers = 200 Characteristics: firmness, color, sweetness, wetness Genotypes: 10	Number of panelists=15 Sensory attributes: firmness, color, sweetness, wetness	Instrumental texture Dry matter content Total soluble solids Titratable acidity	text
Boiled potato *	Mealiness, potato taste, bitter taste, firmness	Mealiness, potato flavor, firmness	Instrumental texture – firmness	
Boiled sweetpotato (Uganda) *	Consumers = 240 Characteristics: sweetness, firmness, mealiness, Genotypes = 8	Number of panelists= 12 Sensory attributes : mealiness, firmness		

EVIDENCE FOR APPLICATION IN BREEDING

1. BOILED SWEETPOTATO - UGANDA

APPLIED to AYT

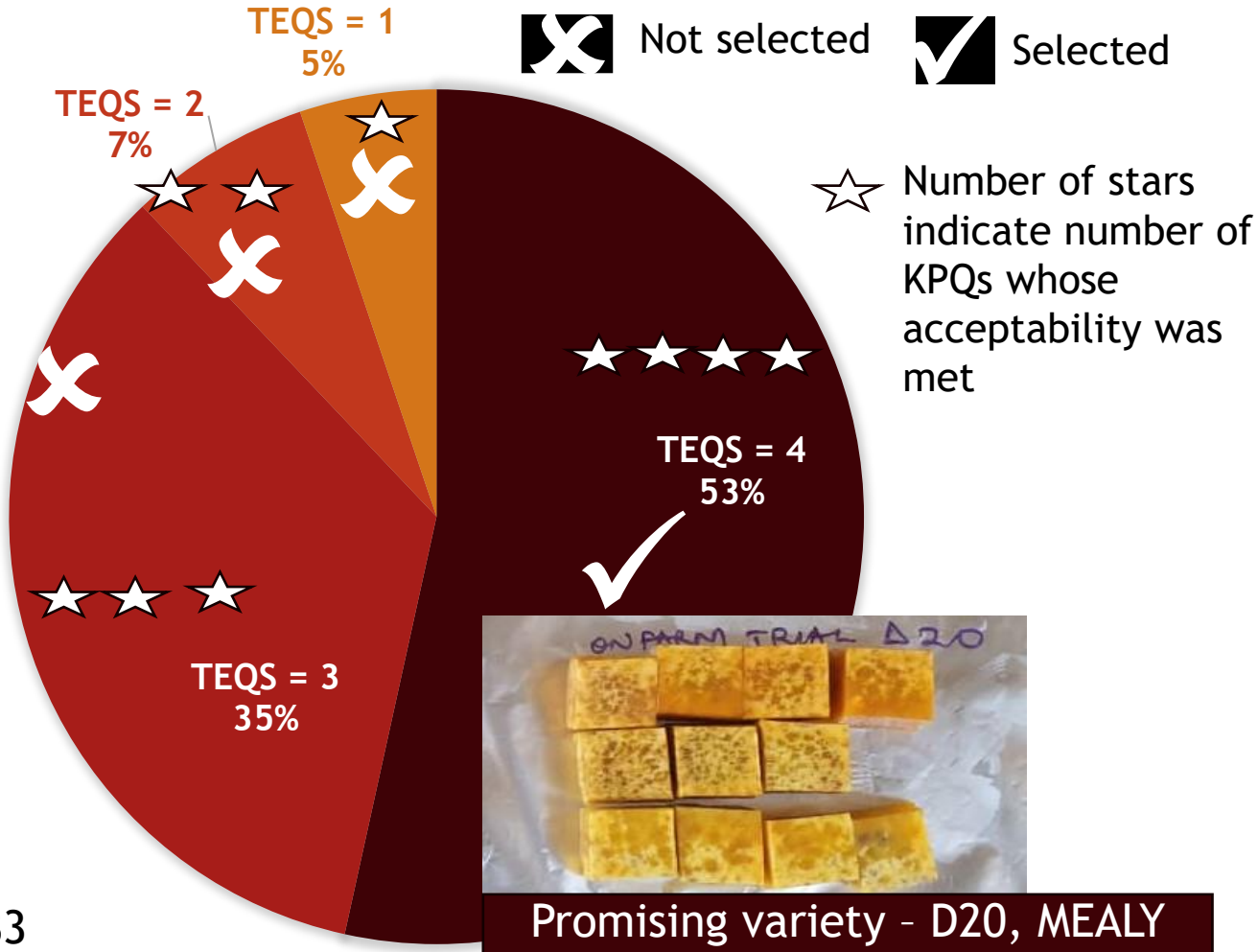
SCREENED 50%

Allows for consideration

Of other traits BUT

Ensuring satisfaction

Of consumer



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EVIDENCE FOR APPLICATION IN BREEDING

2. BOILED YAM – Benin & Nigeria

Overall liking = f (Dry matter_raw yam and penetration force)

Deviation (DI) from the ideal/optimum on the overall liking scale used as selection index

High DI values were corresponded to those with high overall acceptance

Varieties	Location	DI	Rank
TDa 0000194	Abuja	0.40	4
	Ubiaja	-0.35	12
TDa 1508044	Abuja	0.49	1
	Ubiaja	0.15	8
TDa 1510043	Abuja	0.27	5
	Ubiaja	-0.58	13
TDa 1515030	Abuja	0.21	7
	Ubiaja	-0.27	11
TDa 1520008	Abuja	0.45	3
	Ubiaja	-0.10	9
TDa 1520050	Abuja	0.27	5
	Ubiaja	-0.12	10
TDa 1520002	Abuja	0.46	2
	Ubiaja	nd	nd

NEEDS FOR SMOOTH IMPLEMENTATION

SOME FACTS…

Method is expensive….

- Use of a panel is cumbersome
- 7-10 cultivars/clones min. are necessary to conduct this.
- Sensory panel, consumers, lab instruments = all at the same time/same products

but necessary

Once the method is developed, it could be used for screening.

some traits may be difficult to predict using physicochemical characteristics: aroma, mealiness

NEEDS FOR SMOOTH IMPLEMENTATION

- Well trained and motivated sensory panel
- Availability of samples (for example diversity (all), maturity time in bananas and plantains)
- Availability of field and laboratory equipment (logistics)
- Well organized multi-disciplinary and dynamic team

RTB foods

RTB Breeding

THANK YOU

PANEL DISCUSSION

- What do the breeders expect from the quality team (selection index, thresholds)?
- What strategies do we need for better collaboration with breeders?
- What are the challenges for threshold determination?

REACTIONS

- What do the breeders expect from the quality team (selection index, thresholds)?
  - Flexibility in application of research methods e.g. select different traits to prioritize at different breeding stages (1-2 per stage)
  - Get proxy measurements for certain traits
  - to overcome limitation of GXE should include reference products and provide acceptable ranges rather than discrete values, consider screening parents,

- What strategies do we need for better collaboration with breeders?
  - Role of food scientist – service provider or equal scientist (to breeder) or both: Food scientists desire to be equal scientists as members of the same team yet some breeders would prefer that they provide a service to ensure quick delivery of results
  - Involve non-breeding scientists in all routine breeding stages including budgeting, product design, planning activities, product advancement

- What are the challenges for threshold determination?
  - Logistics : increase team in terms of number and expertise (turnaround from outsourced laboratories takes long), in-field data collection methods