Table 2. Quality attributes of sweetpotato clones from varietal trial at Komenda, 2011.
[1]Key: Taste scores, 1=non-sweet, 9=very sweet; Virus rating, 1=no symptoms, 9=100% severe symptoms and dead
[2]Officially released variety in Ghana.

Table D7. Characteristics of clones from the varietal trial at Komenda, Central Region, Ghana, 2011.
[1]Key: Taste scores, 1=non-sweet, 9=very sweet; Virus rating, 1=no symptoms, 9=100% severe symptoms
[2]Officially released variety in Ghana.

Near-Infrared Reflectance Spectroscopy: Accelerating sweetpotato breeding at the Sweetpotato Support Platform for West African in Ghana

Eric Owusu Mensah[1,2], Ibok Oduro[1], Ebenezer Obeng-Bio[2], J.N. Asafu-Agyei[3], T. ZumFelde[2], E. E. Carey[2]

[1]Department of Food Science and Technology, Kwame Nkrumah University of Science and Technology, Kumasi, Ghana;[2]International Potato Center, Kumasi, Ghana; [3]CSIR-Crops Research Institute, Kumasi, Ghana.

Background

NIRS

- Near Infrared Reflectance Spectroscopy (NIRS) is a rapid, accurate, and cost-effective technology for screening large numbers of genotypes. It also permits simultaneous estimation of several traits in one measurement.
- While initial cost s high, NIRS can be a very cost-effective method for the routine analysis of multiple quality attributes in breeding populations.

NIRS Capacity at Sweetpotato Support Platform (SSP-WA)

- Capacity for NIRS analysis as well as sample preparation, freeze drying, and milling, was installed at the SSP-WA, Ghana, in 2011.
- Calibrations developed (table 1) at CIP headquarters were adjusted to our instrument and are routinely used to determine:
  protein, starch, sugars (sucrose, glucose, and fructose) and micronutrients (β-carotene, iron and zinc) from freeze dried samples of raw sweetpotato roots.
- The SSP-WA laboratory serves as a resource for the sweetpotato breeding program and university students conducting thesis research
- Over 5,000 samples were processed and analysed.

Fig. Scanning of sweetpotato samples. A. Razak

Breeding approach at the SSP-WA

- Sweetpotato Support Platform for West Africa (SSP-WA) was established at the CSIR-Crops Research Institute, Kumasi, Ghana, in 2010 to strengthen sweetpotato breeding capacity in West Africa.
- Sweetpotato breeding efforts at the SSP-WA focus on development of quality types to expand the range of options for sweetpotato use in staple foods and processed products, including the development of low sugar, high dry matter types.
- Population development is linked to participatory variety development in important sweetpotato production regions in an integrated national and regional breeding effort.

Fig 2. farmers participating in on-field screening

NIRS Calibration and Results

Table 1. Variation of concentrations as measured by reference methods, NIRS-calibration and cross validation statistics for the content of protein, -carotene, iron, zinc, starch and individual sugars concentrations in sweetpotato in the calibration sets

Trait	Reference Values			Calibration		Cross Validation	
	Range[a,b]	Mean[a,b]	SD[a,b]	R^2_c	SEC[a,b]	R^2_{cv}	SECV[a,b]
Protein (N=216)[*]	1.7 – 9.1	4.1	1.7	0.97	0.30	0.95	0.36
-carotene (N=320)[a]	0.0 – 157.2	33.7	37.9	0.98	4.25	0.97	5.69
Iron (N=422)[a]	0.8 – 4.5	2.0	0.7	0.81	0.26	0.80	0.27
Zinc (N=422)[a]	0.5 – 3.1	1.3	0.5	0.91	0.14	0.89	0.15
Starch (N=268)[b]	22.3 – 73.7	58.0	9.3	0.97	1.41	0.96	1.58
Fructose (N=266)[b*]	0.1 – 19.1	2.88	3.0	0.95	0.55	0.94	0.61
Glucose (N=266)[b]	0.0 – 28.3	3.9	4.4	0.95	0.67	0.94	0.72
Sucrose (N=266)[b*]	3.0 – 44.1	13.8	6.7	0.82	2.60	0.80	2.76

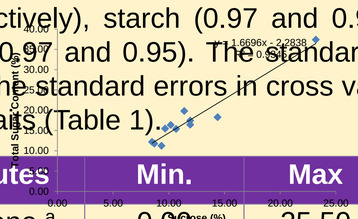
SD = standard deviation, R^2_c = coefficient of determination in calibration, SEC = standard error of calibration, R^2_{cv} = coefficient of determination in cross validation, SECV = standard error of cross validation, * = mg 100 g^{-1} in dry weight, b = % in dry weight.

Source: zum Felde et al, 2009.

Table 1. shows ranges, means, standard deviations of reference data and coefficient of determination in calibration and cross validation of NIRS statistics.

NIRS calibration equations developed on the basis of 216-422 selected samples showed high coefficients of determination for the calibrations (R^2c) (0.81 to 0.98) with slightly lower coefficients of determination for crossvalidations (R^2cv) (0.80 to 0.97). (zum Felde et al., 2009)

The highest R^2c and R^2cv were found for β-carotene (0.98 and 0.97, respectively), starch (0.97 and 0.96, respectively), and for protein (0.97 and 0.95). The standard errors of calibration (SEC) and the standard errors in cross validation (SECV) were low for all traits (Table 1).



Attributes	Min.	Max	Mean
β –carotene [a]	0.00	25.50	6.33
Sucrose [b]	4.23	16.16	6.37
T. Sugars [b*]	6.91	31.01	15.15
Starch [b]	35.00	74.78	52.09
Protein [b]	1.30	3.40	1.69
Iron [a]	0.60	1.70	0.81
Zinc [a]	0.34	0.93	0.50

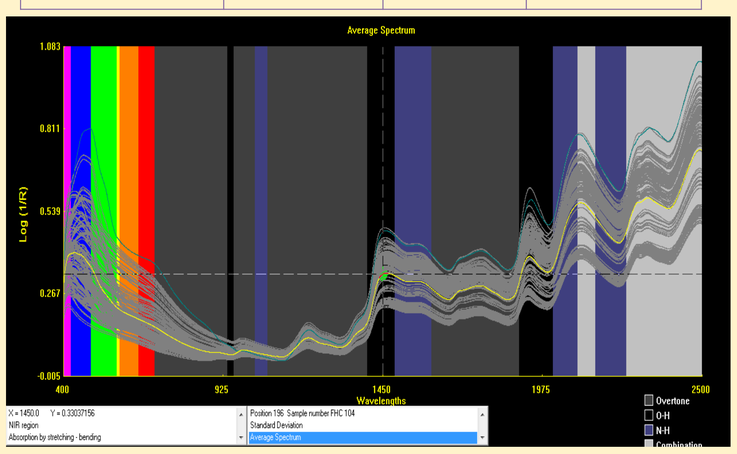


Fig 4: Spectral data of sweetpotato roots scans

NIRS Results and Discussion

Table 2. Ranges of sweetpotato root attributes as measured by NIRS in varietal trials, 2012

Attributes	Min.	Max	Mean
β –carotene [a]	0.00	35.80	4.25
Sucrose [b]	8.50	23.20	11.80
T. Sugars [b*]	11.23	37.38	17.43
Starch [b]	44.11	73.00	65.76
Protein [b]	3.64	5.02	4.07
Iron [a]	1.46	2.52	1.70
Zinc [a]	0.87	1.56	1.01

- Variations in quality attributes analysed by NIRS technology are presented in table 2 and 3. The clones were from 2012 Varietal Trails (VT) and Preliminary Yield Trails (PYT) planted in four production environment.
- The highest β-carotene concentration recorded was 32.80 mg/100g (Apomuden variety) with overall mean of 4.25 mg/100g for VT and 6.33 for PYT.

Based on criteria from zum Felder et al 2009 and Recommended Dairy Intake (RDI) values by FAO/WHO 2002, four of the clones have the potential of providing 100% of RDI of vitamin A for children under five years.

Sucrose content ranges from 8 – 23% DW in VY and 4 – 16 in PYT. Sucrose content (%) had a strong positive correlation ($r= 0.932$, $p< 0.05$) with total sugar content , Fig 3.

Total sugar content

The iron and zinc concentration ranges from 0.87 – 2.52 and from 0.60 – 1.70 mg/100g DW, in the VT and PTY respectively

The mean concentration and distribution of β-carotene, iron, zinc and protein was higher in the varietal than in the preliminary yield Trails

Protein had a strong and slight positive correlation with Iron and Zinc respectively as shown in Fig 4. Thomas recorded similar trends

Acknowledgement

The authors wish to acknowledge the financial contribution and technical supports from the SASHA project and Crop Research Institute. Special thanks to Mr. Eric Kuuna Dery for immerse contribution.

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