Vitamin A Rich Bananas

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Target Micronutrient		Vitamin A	
Target Countries		Sub-Saharan Africa (Uganda, DRC, Burundi, Rwanda, Tanzania)	
Content in Local Varieties (fresh weight – FW)		1080.98µg/100gfw to1819.38µg/100gfw	
Content in Introduced Varieties (FW)		1740.16 to 10632.79 µg/100gfw	
Nutrition Factors		Original Assumption	Measured/ Revised
Banana/Plantain Consumption, grams/day (FW)	Women	500 g/d	700–1,100 g/d[2]
	Children	200 g/d	250 g/d (unpublished)
β-carotene Bioaccessibility (%)*	ABB Plantain	8%	16% [3]
	East African Highland Bananas	8%	27% [3]
Releases			
Fast-track Identified	1740.16 to 10632.79 µg/100gfw		DRC, Burundi – officially 5 varieties released in 2014
2nd Wave	At least 4 varieties		Under agronomic evaluation in Uganda , Tanzania and Rwanda

Background

Micronutrient deficiencies, especially vitamin A deficiency (VAD) remain a public health problem in Sub-Saharan Africa. In East and Central Africa the prevalence of VAD significantly exceeds the WHO threshold point of 15%. Although a number of strategies have been employed in the fight against VAD, reports indicate that the use of food-based strategies is more sustainable especially among rural communities dependent on agriculture for both food and income. Large-scale screening of several Musa germplasm by Bioversity International and its partners from 2005-2010, showed that banana varieties contain varying levels of provitamin A carotenoids (pVACs). Although bananas form a major part of the diet, the popular local banana varieties local in East and Central Africa contain lower pVACs. There are banana varieties from other parts of the worlds contain retinol activity equivalent (RAE) levels of more than 333 µg/100 g dry weight. Since, banana breeding is difficult and time-consuming, direct introduction or 'fast-tracking' of existing pVACs-rich cultivars was seen to offer substantial savings in terms of both cost and time.

With funding from the Harvestplus Challenge program, Bioversity International carried out germplasm screening for over 400 accessions from different regions. The objective was to identify proteins and enzymes responsible for the accumulation of pVACs in the fruit and establish the vitamin A levels in these varieties. The germplasm screening led to a selection of 12 promising varieties of different sub-groups (plantain, East African Highland bananas, ABB cooking bananas, AA and AAA dessert bananas, Pacific plantains, and AA cooking bananas), for trial within East and Central Africa.

Findings

At least five varieties were identified as having the potential to perform well within Eastern Africa. The sensory/organoleptic evaluations of the 5 varieties showed that the overall acceptance of the introduced cultivars was not significantly different from that of local cultivars. In partnership with the Katholieke University of Leuven, Belgium, fruit samples of the vitamin A rich banana varieties were re-analysed for verification. Findings showed that, the Retinol Activity Equivalent (RAE) values of the cultivars ranged from 38.68 – 709.76 µg/100 gfw. These RAEs had significantly higher levels of pVACs as the fruits ripened. Six out of 9 cultivars can meet more than 100% of the vitamin A estimated average requirement (EAR) for children (1–5 years), and 4 out of 9 cultivars meet more than 90% of the EAR for women when 100g of fruit (approximately one finger).

If adopted, consumption of the fruit itself or products derived from the cultivars could provide substantial contributions to the vitamin A intake of vulnerable population groups, such as children 6–59 months and women of reproductive age. Other results from studies carried out with partners indicate that fast-tracking can lead to a 9.6 –17.1% reduction in the burden of illness due to VAD in Uganda and it is more cost-effective than other health-nutrition interventions (Davey et al, 2009).

Through collaboration with the local universities, NARs, Ministry of Health, Ministry of Agriculture and the local government, within the last 2 years 400 community persons have been trained as Trainers of Trainers (TOTs) on nutritional value of the vitamin A rich bananas and appropriate ways of incorporating them in existing diets. These TOTs have reached >3000 farmers with key messages. More than 1000 farmers in DRC and Burundi have received planting materials of the preferred vitamin A rich banana varieties and they will be evaluating them further on their farms before proceeding with multiplication and sharing of planting materials with neighbors.

Top: Vitamin A rich dessert banana from Papua New Guinea – ***To'o***

Bottom: Local East African dessert banana— ***Sukali Ndizi***

Findings Ongoing activities

- Continued evaluation of the varieties on trial and within farmer fields (subsequent cycles, and across different agro-ecological zones) in Burundi and Eastern DRC
- Reaching more farmers within the pilot countries (Burundi and Eastern DRC) with information on appropriate use of banana within their diets and with planting material of the preferred varieties
- Agronomic and organoleptic evaluation of the vitamin A rich varieties in Uganda, Tanzania and Rwanda

Research that needs additional funding

- Moving from in-vitro bio-accessibility to in-vivo human trials in Uganda to validate the actual change in serum vitamin A levels among vulnerable groups following regular consumption of vitamin A rich bananas
- Carry out a study to establish the trade-offs (inputs and outputs) surrounding enhancing access to dietary vitamin A through vitamin A rich bananas compared to other vitamin A sources
- Expanding the trial sites especially in Uganda to ensure more Ugandan farmers can be involved in the trial process (agronomic, organoleptic evaluation) thus fast-tracking the eventual possibility of having majority of farmers with these varieties in their farms

Breeding that combines varieties that are high in vitamin A content but low yield such as 'To'o' those with low nutrition content but high yield nutrition content but high yield.

Varieties under agronomic and organoleptic evaluation for introduction into farming and food systems of Eastern Africa

Variety Name	Country of Origin	Highest bunch weight (Kg)#	Genome-Sub group	Fruit Ripen-ing Stage	Carotenoid (RAE ug/100gfw)*	% Vitamin A Daily need of child (3-5yrs)
Apantu	Ghana	25	AAB-Plantain	Unripe	321.68	80.42
				Ripe	686.50	171.63
Bira	Papua New Guinea	22	AAB-Pacific plantain	Unripe	296.30	74.08
				Ripe	709.67	177.42
Sepi	Papua New Guinea	28	AA-nd	Unripe	138.0	34.5
				Ripe	663	165.8
Lahi	Hawaii	30	AAB-Pacific plantain	Unripe	229.01	57.3
				Ripe	713.13	178.3
To'o	Papua New Guinea	13	AA-Dessert	Unripe	38.68	9.67
				Ripe	544.10	136.03

#Highest bunch weight recorded from 8-10 plants per variety, evaluated over 3 cropping cycles in each site: Burundi-2 sites; South Kivu-3 sites; and North Kivu-3 sites ; *Measures of fruit samples obtained from North Kivu, fresh weight (FW); nd= No data because To'o mature fruit was not available during sample collection thus not analyzed at the moment; A=Acuminata, AA= diploid acuminata, AAA=Triploid Acuminata, B=Balbisiana, BB=Diploid Balbisiana

Key References

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