



Going bananas for vital vitamins

Each year, an estimated half a million people go blind from a lack of vitamin A in the diet, and many more deaths are linked to insufficiency of these and other micronutrients. Whilst vitamin supplements can play a vital role in saving lives, HarvestPlus, a collaborative programme involving international agricultural research centres, has been set up to assess the micronutrient content of a range of staple crops. For Vitamin A, golden rice and sweet potato have been the main focus of initial research efforts. But a second phase has introduced additional crops, including banana and plantain.

While a child may have enough to eat, it may still be malnourished. According to the World Health Organisation (WHO), 50 per cent of deaths each year are linked to malnutrition, particularly from lack of sufficient iron, zinc and vitamin A in the diet. The most common symptom of vitamin A deficiency is blindness, but its wider effects are even more deadly, weakening the immune system and increasing mortality rates. In Cameroon, 40 per cent of under-fives suffer from the condition and unless provided with vitamin supplements, up to 10,000 children are at risk of dying each year.

Early archaeological evidence from humid central Africa has revealed that banana and plantain (*Musa spp.*) have been cultivated for over 2000 years. In searching for orange-fleshed varieties, the genebank of the African Research Centre on Banana and Plantain (CARBAP) at Njombe, in south west Cameroon, was an obvious place to start. The collection, one of the biggest in the world, contains over 400 banana varieties and around 140 plantain cultivars.

High speed screening



Using a colour chart to compare a carotenoid plantain variety with normal variety
credit: WRENmedia

It is well known that bananas and plantain are a rich source of nutrients, including vitamins C, B and A. However, orange-fleshed varieties contain a higher content of provitamin A carotenoids, the plant-derived compounds that are converted to vitamin A in the human body. However, of the 600 known carotenoids, only about 50 provide any nutritional benefit and identifying the right kind of carotenoids, for instance beta-carotenes, has required specialised and time-consuming analysis using a technique known as High Performance Liquid Chromatography (HPLC).

Initial work at the Katholieke Universiteit Leuven in Belgium focussed on establishing a standardised protocol for screening a large number of samples using HPLC. In Cameroon, initial selection of bananas and plantains was made using colour keys, with high carotenoid levels generally indicated by orange

flesh. Five varieties were selected for testing, with two proving to have high levels of the required carotenoids.

'Batard', a popular plantain variety in Cameroon, has been found to contain ten times the beta-carotene content of a Cavendish dessert banana. A 200g portion of the plantain, uncooked, could contain up to a third of an adult's daily vitamin A requirement, assuming that none of the nutrients are lost during processing.

However, carotenoid content is heavily dependent on the state of the fruit when it is consumed. And whilst riper fruit with a stronger colour may appear to have a higher carotenoid level, this is not necessarily the case. Tests at CARBAP suggest that up to 75 per cent of the carotenoid content in 'Batard' plantains are lost during the latter stages of ripening. A key focus of the collaborative research has been to identify the stage in fruit development when carotenoid levels reach their peak.

Cooking conundrum



Orange-fleshed varieties contain a higher content of provitamin A carotenoids, the plant-derived compounds that are converted to vitamin A in the human body
credit: © Horry J.P., Cirad, FRA, Fe'i bananas

But finding the best stage of ripeness is not the only requirement for maintaining optimum carotenoid levels as storage, processing and cooking can also all have an effect on vitamin levels. Unlike dessert bananas, plantains must be cooked before being eaten. Initial findings from CARBAP and the Food Research Institute in Ghana suggest that heating plantain initially increases the availability of carotenoids, making them more digestible. But longer cooking - over 20 minutes - particularly for plantains which have been sliced before boiling, may destroy or convert the carotenoids into a form that is of no nutritional benefit.

The work of selecting plantain cultivars and establishing the optimum times for picking and cooking is continuing. The results may lead to recommendations for how people harvest and prepare the fruit, which will involve encouraging behaviour change. A further possibility could be the introduction of orange-fleshed cultivars from the Pacific which may have significantly higher levels of pro-vitamin A carotenoid than any of the African types so far tested, and six times the level found in 'Batard'.



Plantain farmer carrying out a trial of different plantain varieties on his farmland
credit: WRENmedia

