

Orange-fleshed sweet potatoes

Published 2 March 2020, with Dr Jan Low.

Today, a story about product development and food marketing. You may be thinking, oh, he's going to stick it to the food industry again, but you would be wrong. This is about taking a food people don't like and don't even know they need, and slowly, slowly, over about 25 years, building demand and meeting supply -- and improving health into the bargain.

Which was the whole point.

The food in question is orange-fleshed sweet potato. It's a poster child for the idea of biofortification, increasing the nutritional content of the diet by breeding the ingredients to deliver better nutrition in addition to calories and protein.

And if you're thinking, well, what's so special about sweet potatoes that are orange, that might be because you're not in Africa.

At my local greengrocer, all the sweet potatoes are orange. Across most of subSaharan Africa, until very recently, almost all the sweet potatoes had white or pale yellow flesh.

The difference is huge, in all kinds of ways. To learn more, I spoke to Jan Low. She's currently a Principal Scientist with the International Potato Center and based in Nairobi. Back in the mid 1990s, in Kenya, she was a freshly minted PhD in agricultural economics with -- and this is the crucial part -- a minor in nutrition. She was working in a project to find better sweet potato varieties for farmers in East Africa.

Jan: At that point in time, we were doing what we called the best bet strategy. They were breeding around the world and they'd bring in the best different varieties to be tested in East Africa to see what might perform better than the local varieties. And you know, we'd be out in the field with farmers and maybe 40 different varieties, and I recognized that there were some orange ones in the introduced material. And I pointed out to my breeding colleagues, "Look, you have these amazing varieties that have high levels of beta carotene, and please look at the statistics for subSaharan Africa".

The statistics in question -- vitamin A deficiency.

Vitamin A is what's called a micronutrient. You don't need much of it, but it is absolutely vital for a healthy life.

Lack of vitamin A is really serious, especially in young children. Across the continent as a whole almost half the children under 5 were deficient, and in some places the level was as high as 70%. It was a major killer of young children. And orange sweet potatoes, as Jan Low recognised, were orange because they were rich in beta carotene, which the body turns into vitamin A. So what did the breeders say?

Jan: The response was, well, here, the preferences are for white flesh or yellow flesh varieties, and they're going to get thrown out. But what we recognized and noticed was, actually people love the colour. The issue with the varieties was the texture, because for whatever reason, the varieties that have evolved over time in Africa through basically local selection procedures since the 16th century have been very, what we call high dry matter. If you look at the United States, our orange flesh varieties have a dry matter of 18 to 22%. And adult African consumers consider them to be watery.

Now, when we tried those varieties with young children in Africa, they loved them. But the adults hated them, because they thought they were watery. So what became very apparent over time is that what we had to work towards in a breeding programme was to really raise the dry matter content in orange fleshed varieties. And as we were out in the field, actually what sped up the process, which is a very interesting story, is we did find some local farmer landraces which were orange fleshed, and some of those local landraces already had the high dry matter.

Now they weren't very productive in terms of yield. They had degenerated over the years, but we could include them as parents in the breeding process. So, I think it was a recognition of the great need, and it was a recognition that we did ... You know, sweet potato is such a diverse crop. You know, it's a matter of getting the right variety for the right agroecology for the right consumer preferences. So it's a numbers game in the breeding, but the diversity, the natural diversity. In the germplasm is enormous.

Jeremy: Let me take a step back. Vitamin A deficiency was a huge problem in subSaharan Africa. So, but, but, but. That was being treated, as it were, with supplementation. And you can give kids vitamin A supplements and it seems to work. So, what was the impetus to compete with vitamin A supplementation by promoting orange flesh sweet potatoes.

Jan: Well, I always argue that it's not competition: it's complementarity. Vitamin A supplements are high dose vitamin A, pure retinol, that are given out every six months from the time the child turns six months until they're five years of age. They really have a strong protective effect for two months, and then it gradually descends so by the end of four months, it's pretty well gone. Whereas if you're having a food in your food system, you hope that food would be available to eat; ideally year-round, or at least seasonally, and with storage year-round. So I see the two things is complementary.

And then the other point is that we saw, particularly in the work I was doing in Mozambique, poor people are actually very busy. Women tend to take their children during the first year of life on a monthly basis to the health clinic, driven by the fact that during the first year of life, vaccines are given out. And then if you look at the health data in most places after year one, that drops off a lot. And the only time women are really taking to the children to the clinic is when they fall ill, and then they can get their vitamin A capsule if they happen to be in the right cycle.

I also feel that you have to take this multiple approach because everybody should be having more vitamin A in their diet. If you look at the studies that have been done on availability of foods rich in vitamin A in the diet among the different continents, Africa is the lowest. And then I always mentioned that sweet potato – even though we talk a lot about the beta carotene, because it's so rich in beta carotene and just one small root can meet the daily needs of a young child – it has many other micronutrients. It's a good source of vitamin C, E and K and many B vitamins. It has magnesium and potassium. The leaves are a rich source of lutein. No part of this crop. can go to waste. I mean, you can use the leaves, the roots, everything. So just in terms of improving the food system, getting more people eating this food on a regular basis is just good nutrition.

Jeremy: You said that getting the funding for the first study of the effect on vitamin A, you had to ask 21 donors. I'm just wondering what kinds of reasons did they give to say no. And did any of that them said no, did they eventually come around.

Jan: It really was a period where there was not much multi-sectoral work going on. So nutrition tended to be in the health sector. So you'd go to see the health people and they say, well, this is really an agricultural proposal, go to the ag people. You go to the ag people and they say, well, you know, this is really a health intervention, go to the health people. They weren't working across their borders. They weren't working across these lines. And so you can imagine it was a long process. I rewrote the proposal several times trying to address these, to be more appealing to one particular donor. But finally, it was when I went with the head of the nutrition division of Mozambique, at a conference in Durban, South Africa, to visit Venkatesh Mannar of the [Canadian] Micronutrient Initiative, describing how we saw integrated ag nutrition working, with a marketing component as well. And he sat there and he listened carefully and he said, "you know, this is a food based approach that makes sense and I think it could work".

Micronutrient Initiative of Canada got on board. And really that was the breakthrough to get somebody who saw what we were trying to do in terms of doing integrated ag nutrition. Now these days, a lot of people are involved in integrated ag nutrition, but this was back in 2000 2001. It wasn't a mainstream idea to be having agriculture serve nutrition, which seems bizarre, but that's the reality because the nutrition community was very caught up in saying we can address micronutrient malnutrition through capsules and other methods. So really getting that breakthrough ... Then, he provided about two thirds of the funding. And then two of the donors I approached earlier who had liked the idea but didn't have a lot of resources that they could put into it came on board, namely the Rockefeller Foundation and USAID based out of the Washington DC office. So having those three donors together, we were able to proceed and, and conduct the study.

That first study provided some evidence that orange fleshed sweet potatoes could improve nutrition, and that encouraged other donors to fund more, bigger studies. The crucial point, though, is to get

governments on board, and many of the countries in subSaharan Africa were more focussed on their big export crops. Until, that is, Jan and her colleagues developed industrial uses for those orange sweet potatoes.

Jan: But what I've found has really excited the countries themselves, is the potential to diversify the use of sweet potato, in the sense that our work with the sweet potato purée, the boiled and mashed sweet potato, as a partial wheat flour substitution really does appeal to a lot of policymakers. One because they see this as something that private sector can engage in more fully. And two, they see it as saving foreign exchange because a lot of wheat flour in African countries is imported, since in many places it's difficult to grow wheat.

Jeremy: And the question of evidence, that eating orange fleshed sweet potato will indeed improve vitamin A, will indeed get rid of this micronutrient deficiency of vitamin A, that's no longer a question. It's perfectly clear now, is it, that orange fleshed sweet potato provides the vitamin A that people need and all the other micronutrients you mentioned?

Jan: Yes. We were considered being the crop that has one of the strongest evidence bases to draw on because, run by the South African Medical Research Institute, they did a very controlled study with schoolchildren comparing orange fleshed sweet potato with white fleshed sweet potato, and saw the increase in the storage of vitamin A in the liver. And then there was the study that I led in Mozambique where again, the introduction combined with nutrition education provided the evidence that we could impact a young child's vitamin A status.

And then following that, there was a randomized controlled trial study trying to go to scale to 24,000 households in Mozambique and in Uganda, and again, we were able to show the increase in vitamin A intakes, in this case in young children as well as their mothers. And they did the blood work in Uganda this time, and they showed some impact on vitamin A status among young children. So that's a pretty strong evidence base.

But I would argue that for really maximizing impact on nutrition, you need to have both the introduction of the orange fleshed sweet potato

and the nutrition education component at the community level, because really we don't just talk about orange fleshed sweet potato. We're really trying to improve young child nutrition, and therefore we bring in all the other foods that should be making up a balanced diet and how those foods should be fed.

It was very interesting, when I was working in central Mozambique, we found in the initial days that children weren't fed papaya because mothers thought papaya was making them sick because it turned their faeces orange-ish. So it's just giving people the knowledge that, no, actually that's very good. No problems. And so you're getting a food, a fruit tree, that's one of the easiest fruit trees to grow. It was all over the place, but they weren't using it for young child nutrition. And that's why I say the message is: the nutrition education component goes along with the introduction of orange fleshed sweet potatoes. You can bring in other crops as well, because what we want to do is improve the household's ability to improve their own diets.

Jeremy: And in the rural areas, are most people growing the sweet potatoes for their own families, or is it more of a commercial crop?

Jan: Well, again, it's a vast continent with very different conditions in different locations. I think in East and Central Africa, you often find that the principal use is as a food security crop. But then you have certain pockets ... For example, there's this one area in Western Kenya where the farmers are very commercial, and they treat it as a commercial crop and they're supplying the markets and Nairobi and Mombasa. So it does vary a lot by the area you're in and what the linkages are to markets. What we find over time as we introduce the crop and people can produce a surplus, they want to be able to sell that surplus. So one of the things we really invest in is what we call demand creation campaigns, because you have to have the urban consumers aware of the benefits of this crop to create that market. Some countries, it's easier to break into those markets than others, because obviously you're up against the varieties that they've been used to buying. And the nutrition, we found, and studies have been done to show this, when people have more nutrition information, they're more likely to try and buy and test the new orange flesh sweet potato varieties.

Jeremy: And how important was it to all of these efforts – for the nutrition education, for the farmers to be growing it, for the mothers to be using it – how

important was it that this was a sort of a brightly coloured orange variety (or several varieties)?

Jan: Well, you know, orange turned out to be a wonderful colour to promote nutrition. We tended to use patterns of orange and green, green for the leaves and orange, and as part of our demand creation campaign, we really exploited that. We had the marketing stalls painted in orange. The vehicles are orange. We have a lot of orange clothing. The women wear these pieces of cloth in many places – capulanas –and we put messages about the orange fleshed sweet potato onto those capulanas, t-shirts, radio programs. But the orange is a wonderful colour, so it actually turned out to be quite an advantage.

Now I tell you, the first question we would get in every country we worked in, when people saw the different colour, they would say, “is it a GMO?”. You know, unfortunately in subSaharan Africa, there are a lot of people that are afraid of GMOs. And so then you’d have to go back in and explain, no, this is conventionally bred [from] the diversity that naturally exists in sweet potato, to ease the fears. So definitely people picked up that this colour is different, but in general, the colour is really loved. So it’s really been a marketing tool for us.

Jeremy: But it’s interesting that you raised the question of both the colour and the GMOs. I don’t want to get into golden rice here, that’s way too difficult for me. But a lot of the other biofortification crops, there’s no way of knowing that a bean, or whatever it might be, is in fact high in whatever it’s supposed to be high in. And I just wonder whether orange flesh sweet potato is not, maybe, too easy, and that there are going to be all sorts of problems for farmers and others where you can’t see the difference.

Jan: Well, you know, that’s an interesting question because when the movement started, it said, well, you know, the easiest ones to introduce will be the ones without what we call a visible trait. And those will be easier to introduce because as long as the varieties are more competitive than the local varieties, they’ll just easily go into the food system and we won’t have to do much promotion. You have to be able to outperform the local varieties if you’re going to really have high levels of adoption. But we found that the orange trait has been a very significant marketing tool. And yes, it probably, you still have to have, and you know, these are these lessons learned, you still have to be able to beat the local variety in terms of performance because farmers are farmers, and if it’s

really going to be adopted on a wide scale, you have to at least match the yields of the existing varieties.

So I think it's a very interesting issue. Do you see the biofortified crop as an entry point for educating people for better nutrition? Or do you see the easiest way to go is having a biofortified bean that looks like any other bean and it's just been adopted based on its agronomic characteristics.

Jeremy: Do you have any idea of what it's cost so far to get people in, what, 13 to 15 African countries using sweet potato?

Jan: Well, again, it depends on what level you're doing it at, right? And this is why I'm saying it's a combined approach. In the study of reaching end users, the one I mentioned earlier where we were scaling to 24,000 households, the cost per direct beneficiary was \$86 in Mozambique and in Uganda, it was \$56, because Uganda is a much more densely populated country. But then of course, you have all the spillover effects to neighbours and that's much cheaper of course, but they may not be getting the nutrition education component. They're probably receiving the vines and then hearing messages on the radio.

Now, if you just go out and do mass distributions, like in a post-emergency response, and in those kinds of cases we might do some very limited nutrition awareness raising with community theatre or radio and vine distribution, then your cost per beneficiary household goes way down, maybe \$5 to \$10 per household.

And that's the conundrum, right? That's the challenge because we know we get our greatest nutritional impact when we do the combined agriculture, nutrition education, intervention. And the pressure on us is, how do we make that as cheap as possible per direct beneficiary.

At the end of the day, you know, the question I always raise is, well, do you want to just have households eating orange fleshed sweet potato, or do you really want it to make a difference to young child nutrition? And if we're going to make a difference to young child nutrition, there has to be some investment in behavioural change to improve young child feeding practices. And so that is the million-dollar question.

One of the things I'm really convinced now that we need to be doing for the long term impact is really, why do we have to do this community

level nutrition education? It's because no nutrition is taught in schools. And so now what we're doing is really pushing for the integration of nutrition education into primary schools in Africa. We've done some interesting work in Uganda developing school books with the primary school teachers, and the short growing period of four to five months of sweet potato fits in very nicely with the school term. We've had children carrying the vines back to the home. And really in the long term, what we need to look at and understand is that knowledge about nutrition should be a life skill. When somebody leaves primary school, they should have the basic knowledge. And then this cost of delivering nutritious foods per household will go down because we aren't having to deal, or we aren't having to address, a lot of lack of knowledge about how to appropriately use these foods.

Jeremy: That's a very interesting approach as sort of the ultimate of that proverb about teaching a person to fish. You've been at this now for over 25 years; was there a point at which you thought, yeah, this could work, this is actually going to work?

Jan: Well, very early on when I became committed to this idea, when I was a postdoc in 1995, and I was out in the field and I was able to raise with the Kenyan Agriculture Research Institute – we got money from the International Center for Research on Women – to do the initial work on the orange fleshed sweet potato in Western Kenya, and we just set up 10 women's groups that were getting agriculture only and 10 women's groups that were getting the ag plus nutrition education, and looking at those differences. And for me, when I saw the young children eating the sweet potato, it was a no brainer. These kids love orange fleshed sweet potato. So if you have your main target group liking the product, you've got a winner.

It is a no brainer intervention for subSaharan Africa because here's a crop that basically any class of farmer can grow. It wasn't getting the attention that it was due because it's seen as a poor rural woman's crop. It's not seen as a modern crop. And that was its image in subSaharan Africa. Now. It's coming back on the scene because you've got a crop that's ready in three to five months, depending on the variety. We have very unpredictable seasons now. It has flexible planting and harvest times. So now really, as we are seeing the impact of climate change, sweet potato now is not seen as this poor person's crop, but it is seen really as this sort of climate-smart, nutritious crop

From those first trials of a few tens of families, by last year more than 6 million households had been introduced to orange fleshed sweet potato. There's more to be done, for sure, but if orange fleshed sweet potato is now seen as a crop for the future in Africa, it's down not just to Jan, who saw its potential, but to all the other people who have worked with her over the past 25 years to get it to this point.

There's a terrific review of all the effort that took in a recently published paper, which I will link to in the show notes at [eat this podcast dot com](http://eatthispodcast.com).

And I have to confess that I'm on the side of those African adults. I wish the sweet potatoes we get here were just a little bit less watery.

I am grateful to Jan Low for her time and expertise, and to all the listeners who support the podcast with a donation. If you're not yet one of them, please consider going to eatthispodcast.com/supporters and getting a season ticket.