



# VITAMIN A CASSAVA

Improving food and the food system  
with a naturally nutritious harvest











# HarvestPlus: Leading a global movement to deliver more-nutritious crops

Thanks to an innovative and non-GM approach to natural crop breeding, cassava has now been enriched to contain vitamin A—transforming this global staple food into a vital source of this micronutrient that is essential for maintaining good health.

HarvestPlus leads a global effort to develop and promote food crops that are biofortified to be rich in vitamins and minerals, as part of the CGIAR global agricultural research network for a food secure future. In partnership with CGIAR Research Centers including the International Institute of Tropical Agriculture (IITA), national agricultural research systems (NARS), and other world-leading cassava experts, HarvestPlus develops, disseminates, and commercializes vitamin A cassava stems, roots, and foods.

Experts in nutrition, crop development, and agriculture work with HarvestPlus and our partners to unlock genetic variation in cassava to develop vitamin A-enriched (yellow) varieties that can provide malnourished populations with up to 50% of their daily vitamin A needs; conventional (white) varieties of cassava do not contain vitamin A.

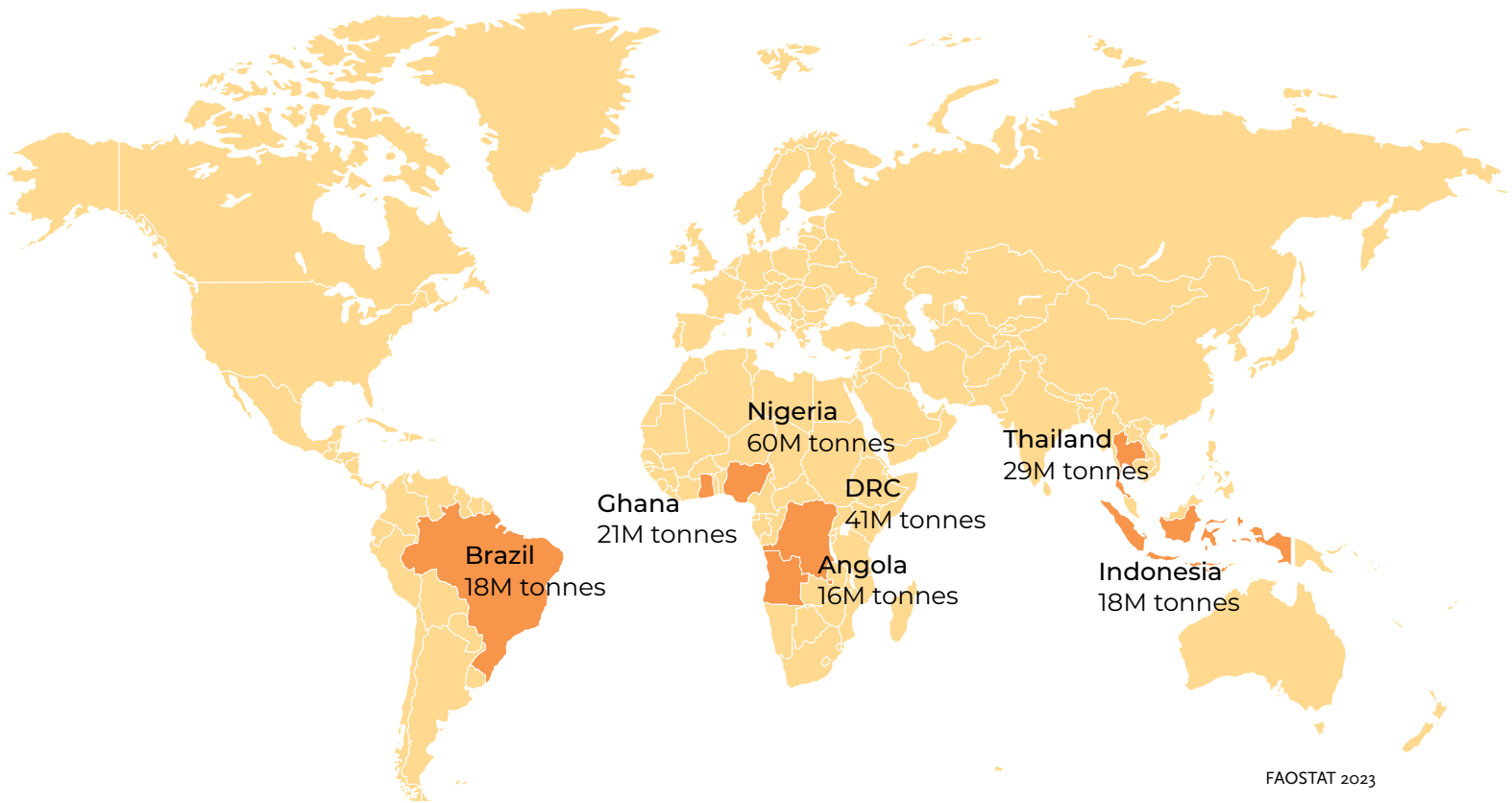
Naturally enriching staple food crops with nutrients through biofortification is proven to reduce micronutrient deficiencies and improve health. Carrots used to be white or purple—now they are mostly orange and a major source of vitamin A.

Our vision is a future where all cassava is yellow, to provide much-needed added nutrients and improve health worldwide.

## **CONSUMERS WANT NATURAL AND ETHICAL NUTRITION**

- Consumers want naturally nutritious foods.
- Vitamin A is an attractive nutrient for consumers because of its role in vision, healthy pregnancies, and strengthening immune systems.
- Research shows that consumers like vitamin A cassava, and prefer it over traditional cassava when they learn about its nutritional benefits.
- Consumers are also increasingly motivated to buy products from ethical businesses and are more likely to buy food from a vendor that cares about nutrition.

## LEADING CASSAVA PRODUCING COUNTRIES



## What is cassava?

- Cassava is a common staple food crop grown widely across countries in tropical and subtropical regions of the world.
- Cassava is an edible root of the species *Manihot esculenta* Crantz. It provides an essential source of carbohydrates for millions of people, especially in lower income communities in Africa and Latin America. As a staple food, it makes up a significant portion of daily energy intake for urban and rural dwellers.
- It is considered a climate-smart crop because it is adaptable to grow on poor soil conditions and can withstand common crop diseases and drought.
- Cassava is versatile. Its derivatives form major ingredients in the industrial production of not only foods, but also textiles, papers, alcohol, medical drugs, and other products.

# Why do we need vitamin A? Authorized nutrient function claims

Vitamin A is needed for hundreds of body processes. Below are the generally accepted benefits that can be stated on food packaging when the food meets the local requirements of “source of” or “high in.”



The normal functioning of the immune system.



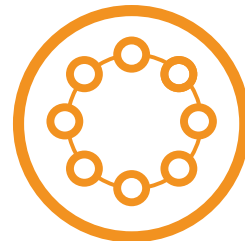
The maintenance of normal skin.



The maintenance of normal mucous membranes and important structures of the body.



The maintenance of normal vision, especially in dim light.



The process of cell specialization, which is most important during pregnancy.

## The importance of vitamin A and the prevalence of vitamin A deficiency

- Vitamin A is a micronutrient that is essential for good health and wellness during all stages of life. Vitamin A deficiency (VAD) is the leading cause of preventable blindness in children, it impairs growth and immunity, and increases the risk of severe morbidity from common childhood infections like diarrhoea and measles.
- Globally, VAD is one of the most prevalent forms of malnutrition especially among young children and women of reproductive age.
- VAD affects approximately 190 million pre-school aged children and more than 19 million pregnant women around the world and is a leading cause of night blindness among these populations, affecting nearly 15 million.

# How much vitamin A do we need?

The optimum amount of vitamin A our bodies need to stay healthy varies depending on several factors, including age, gender, existing vitamin A status, and current health status.

As a guide, 800 micrograms of animal-based vitamin A or its plant-based equivalent is the recommended daily intake for food labelling purposes and as a generic reference for the general population.

The type of vitamin A that is predominant in vitamin A cassava is beta carotene, a plant-based precursor to vitamin A (a provitamin A carotenoid, pVAC) that the body converts to an active form of vitamin A (retinol) once consumed. The body tightly regulates the absorption and conversion of plant-based vitamin A, which minimizes the risk of toxicity from plant-based foods rich in vitamin A.

There are no food safety or toxicity concerns with vitamin A cassava.

## Why don't we get enough vitamin A from our food?

Animal-based foods are rich sources of vitamin A, as are fortified foods and supplements. Several fruits and vegetables contain provitamin A carotenoids.

In many low-income, rural food systems, provitamin A-rich fruits and vegetables are seasonal and

not available year-round, nor are they generally affordable. Additionally, animal source or fortified foods may not be widely available/accessible or consumed in rural and resource constrained households.

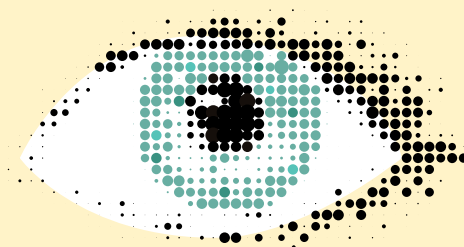
Consumers can recognize the presence of vitamin A by a food's appearance: most plant-based foods that are rich in vitamin A are red, yellow, or orange.

## Ways to improve foods, food systems, and diets

Many countries have implemented supplementation programs with large doses of vitamin A and post-harvest food fortification to address acute and chronic vitamin A deficiency, especially for young children. These programs are proven, effective interventions. Yet, consumers increasingly prefer foods that contain natural sources of vitamins and minerals, not additional synthetic ingredients on the label (such as synthetic vitamin A). Consumers are seeking "cleaner" food labels and foods with fewer added ingredients.

Delivering nutrition directly from plants to food products using biofortification is a cost-effective and sustainable way to meet nutrition needs while addressing consumers' preferences.

Did your parents ever tell you to "eat your carrots so you can see in the dark"? The vitamin A in carrots and other foods like vitamin A cassava can help prevent night blindness.



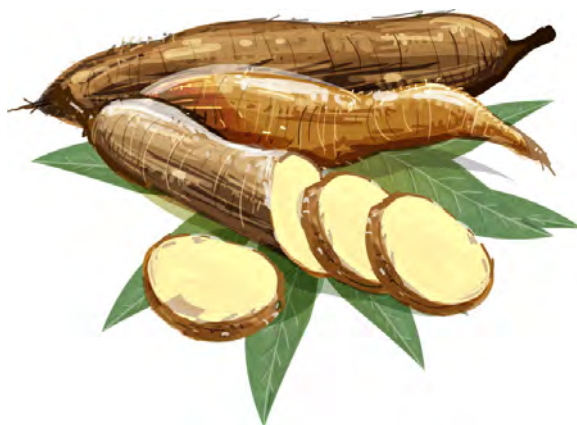
# Vitamin A cassava nutrition

## Communicating nutrition and health claims to consumers

HarvestPlus has developed labelling guidelines for many countries to demonstrate how to communicate nutrition and health claims for vitamin A cassava to consumers. Nutrition claims can be made in compliance with local legislation. For example, depending on the food category and country, a product could carry the following claims:

- Natural source of vitamin A
- Vitamin A is essential for healthy eyesight

Commonly grown cassava does not contain vitamin A. Biofortified vitamin A cassava varieties contain as much as 120 micrograms (ug) of provitamin A carotenoids per 100 grams (g) of cassava; the additional carotenoids are accumulated in the edible parts of the plant as part of the normal growing process.



**Gluten free**  
Suitable for gluten-free diets. Does not contain gliadin or glutenin.

**Part of a healthy diet**  
Contributes to your daily servings of vegetables.

**Naturally colorful**  
The vibrant yellow color is attractive to consumers. Health education campaigns urge consumers to eat a varied, colorful diet.

**Contains antioxidants**  
Rich in beta-carotene, an antioxidant that supports eye health.

**Table 1. Nutrient composition of fresh yellow cassava and conventional cassava\*.**

Nutrient	Vitamin A Cassava	Commonly grown cassava
Carbohydrate	32g/100g	32/100g
Protein	1.9g/100g	1.9/100g
Fat	0.8g/100g	0.8/100g
Moisture	64g/100g	64/100g
Vitamin A µg	120 µ /100g (15% of the RDA)	0

\*Values are based on fresh cassava. Moisture levels, carbohydrate content, and vitamin A retention in processed foods can vary; the [Publicly Available Specification for vitamin A](#) products provides examples of the variation in processing techniques.



# Technical information on beta carotene, vitamin A, and labelling

**Table 2. Classification based on PVAC content in PVAC enriched cassava root**

Class	PVAC content mg/kg	Standard method of analysis (or equivalent)
Class I	≥ 12	AOAC 2017.04 [N2]
Class II	7 –< 12	



- Vitamin A cassava contains provitamin A carotenoids (pVAC) that are converted in the body to retinol. The breeding target for improved nutrition is 1,500µg of pVAC per 100g of fresh vitamin A cassava. Current varieties have 700µg pVAC/100g.
- For food labelling purposes, a retinol activity equivalent (RAE) is used. To determine the RAE, the pVAC value is divided by a conversion factor of 6 (meaning 700µg/100g of pVAC in fresh vitamin A cassava is expressed as 117µg RAE/100g), although in some countries the conversion factor is 12. Therefore, 100 grams of fresh vitamin A cassava provides at least 117µg RAE, equivalent to approximately 15% of the recommended daily allowance of vitamin A (assuming it contains approximately 64% water).

## Standards for levels of vitamin A in cassava

[The Publicly Available Specification \(PAS\) 235](#): 2022 “Provitamin A carotenoids (PVAC) enriched maize grain, cassava and sweet potato roots” sets out targets for vitamin enrichment and provides global standards for vitamin A cassava root procurement.

Buyers can now demand vitamin A cassava at the commodity level for public procurement or as a raw material for food processing. Table 1 from the PAS 235 shows the levels of vitamin A required in order for a crop to be designated vitamin A cassava.

## How does PAS 235 relate to local country regulations?

PAS 235 applies to all countries in the world that grow vitamin A cassava, and all businesses (no matter their size) that produce or procure vitamin A cassava roots for human consumption. It is intended to be used in support of, or alongside, local rules and regulations.



# Vitamin A cassava benefits for actors across the value chain

Vitamin A cassava varieties promoted by HarvestPlus are a pioneering breakthrough that will be part of the solution to one of the world's biggest problems of micronutrient malnutrition, and will respond to increasing consumer demand for naturally nutritious foods.



## For Cassava Farmers

- I want to grow a variety that we can eat as a family and is good for us.
- I want to grow varieties that are in demand.
- I need varieties that are high yielding, cost efficient, and easy to grow.



## For Food Manufacturers and Retailers

- Vitamin A cassava brings innovation to one of the world's most widely eaten staple foods.
- To develop products, I need varieties with good starch content in addition to vitamin A.
- I want to invest in foods that are not only good for profits and consumers but are good for the world. Social responsibility is good for business.



## For Consumers

- I want a naturally more-nutritious version of the food I commonly consume.
- I want to buy healthy foods with fewer added ingredients.
- I want more foods in the market that contain nutritious cassava.
- I want to buy foods that are good for the world, and good for the planet.
- I care about where my food comes from.





# Product innovation and renovation with vitamin A cassava







## How can you get vitamin A cassava into your product portfolio?

### Build supply chains with HarvestPlus

With our partners, HarvestPlus has developed and released 28 varieties of vitamin A cassava that are adapted to different growing regions and climates of the world. We can work with you to find a variety that suits your particular needs.

### Work with smallholder farmers

Vitamin A cassava is a rich source of nutrition for smallholder farming families who also depend on cassava as a source of income. HarvestPlus as a part of the CGIAR has vast experience working with vitamin A cassava and can help you find the right variety to grow in your area.

HarvestPlus can also build larger scale supply chains for your and your business. Depending on your location and the type and volume of vitamin A cassava you are interested in, we can enable sustainable, secure supply chains with traceability processes. Using these opportunities, you will be building market access for the world's most vulnerable smallholders.

### Switch to more nutritious cassava

We understand it is not always possible to work with smallholder farmers; you may already be working with leading growers and have a strong and dependable supply chain of producers. We can work with you and your producers to learn how to switch your current cassava varieties over to the vitamin A varieties.

The expert plant breeders, agronomists, and food technologists at HarvestPlus will help at every step of the way. This work provides a revenue stream for our non-profit organization and, crucially, brings in investment and awareness about malnutrition and food-based solutions. We have several services available to assist with a transition to working with naturally nutritious vitamin A cassava.



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