Effect of Baking on the β-carotene Content of Orange Flesh Sweetpotato (Ipomoea batatas) Puree Bread and OFSP Flour Bread

Food and Nutritional Evaluation Laboratory, CIP SUSTAIN Kenya
Euro-Ingredients Limited, Nairobi, Kenya
Tuskys Mattresses Limited, Nairobi, Kenya
Christian Impact Mission, Machakos, Kenya

Presentation by: Tawanda Muzhingi (Post Doc Food Scientist at CIP-SSA)
Background

• **Orange Flesh Sweetpotato (OFSP)** is a biofortified crop rich in provitamin A carotenoids, and is being used a sustainable food based strategy to address vitamin A deficiency (VAD) in sub Saharan Africa (SSA).

• **VAD is a public health problem in SSA.**

• **About 125g of OFSP can provide 100% RDA** for vitamin A for children.
Background

- *In SSA sweetpotato is now emerging as a healthy alternative food crops*
- *There are opportunities to incorporate sweetpotato in the urban markets as an ingredient in industrial food processing.*
- The *possibility of utilizing wheat-sweet potato composite flours in breads and baked goods have been investigated.*
- Most of the *work on OFSP processing in SSA has been focused on OFSP flour for making bread, buns, muffins and doughnut* liked fried products (Mandazi).
OFSP Puree vs OFSP flour

Making bread with OFSP flour commercial is not viable

- It takes roughly 5-10kg of fresh sweetpotato roots in order to make one kilogram of OFSP flour.
- OFSP Puree: conversion rate of 1.3kg of fresh roots to 1kg of OFSP puree
- It is hard to substitute more than 30% of wheat flour with OFSP flour to make bread
- With OFSP puree more than 50% wheat flour substitution can be achieved
OFSP Puree vs OFSP flour

- OFSP flour is easy to make and store than OFSP puree
- OFSP Puree requires a complicated cold storage system since puree is highly perishable
- OFSP Puree requires a complicated manufacturing process with proper GMPs and GAP in place
- CIP is investing in shelf-storable OFSP puree
Study Justification

The degradation of β-carotene in OFSP flour has been studied extensively, however, there is limited research showing the effect of baking on the β-carotene retention and vitamin A value of the baked products made with OFSP puree.
Study objectives

This study was designed to evaluate the β-carotene retention and Retinol Equivalence Activity (RAE) of OFSP bread made with 45% wheat flour substitution with OFSP puree compared to OFSP bread made with 10% wheat flour substitution with OFSP flour.
Methodology

- **OFSP fresh roots** (Kabode) for puree collected in Homa Bay and analyzed for β-C content.
- OFSP fresh roots (Tynung) for flour collected from Machakos for β-C content.
- **OFSP puree** collected and analyze for β-C content.
- **OFSP flour** collected and analyze for β-C content by High Performance Liquid Chromatography (HPLC), C30 column.
Sample collection

OFSP flour Bread
• Baking of the bread was observed and samples of the dough and final bread collected for β-C analysis at FANEL at BecA

OFSP Puree bread
• Baking of the bread was observed and samples of the dough and final bread collected for B-C analysis at FANEL at BecA.
Baking Process

OFSP Flour Bread
• Wheat flour to OFSP ratio was 90:10 w/w, thereby substituting wheat flour by 10% OFSP flour.
• The oven pre-heated to 200°C.
• After mixing, the dough was cut and put in molds and baked for at 200°C for 20 mins.

OFSP Puree Bread
• The ratio of wheat flour to OFSP puree was 55:45 w/w.
• The oven was pre-heated to 200°C.
• Dough in metal molds and baked at 200°C for 20 mins.
• Bread allowed to cool
• Three loaves sampled
Carotenoid Extraction and Analysis

• Samples prepared and analyzed under yellow/golden lights
• Carotenoid extraction conducted with methanol/THF direction
• Carotenoid extraction conducted with mild saponification (KOH) and hexane
• Echinenone used at Internal Standard
• C30 Carotenoid S column for separation
## OFSP Puree Bread Carotenoid Analysis

<table>
<thead>
<tr>
<th></th>
<th>all trans β-C</th>
<th>13 cis-β-C</th>
<th>9 cis β-C</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>OFSP Kabode Puree</strong></td>
<td>4.31 (0.07)</td>
<td>1.19 (0.01)</td>
<td>0.04 (0.00)</td>
</tr>
<tr>
<td><strong>OFSP Puree Dough</strong></td>
<td>1.34 (0.10)</td>
<td>0.23 (0.06)</td>
<td>0.02 (0.00)</td>
</tr>
<tr>
<td><strong>OFSP Bread Crumb</strong></td>
<td>1.78 (0.50)</td>
<td>0.36 (0.01)</td>
<td>0.03 (0.01)</td>
</tr>
<tr>
<td><strong>OFSP Bread Crust</strong></td>
<td>1.18 (0.20)</td>
<td>0.53 (0.04)</td>
<td>0.24 (0.03)</td>
</tr>
</tbody>
</table>
# OFSP Flour Bread Carotenoid Analysis

<table>
<thead>
<tr>
<th></th>
<th>trans β-C</th>
<th>13 cis-β-C</th>
<th>9 cis β-C</th>
</tr>
</thead>
<tbody>
<tr>
<td>OFSP Fresh roots</td>
<td>9.64 (0.21)</td>
<td>1.25 (0.24)</td>
<td>0.27 (0.07)</td>
</tr>
<tr>
<td>OFSP Flour</td>
<td>15.29 (0.27)</td>
<td>3.36 (0.10)</td>
<td>0.46 (0.11)</td>
</tr>
<tr>
<td>OFSP flour dough</td>
<td>0.04 (0.01)</td>
<td>0.01 (0.00)</td>
<td>0.003 (0.00)</td>
</tr>
<tr>
<td>OFSP flour Bread Crumb</td>
<td>0.04 (0.00)</td>
<td>0.02 (0.00)</td>
<td>0.003 (0.00)</td>
</tr>
<tr>
<td>OFSP flour Bread Crust</td>
<td>0.05 (0.00)</td>
<td>0.02 (0.00)</td>
<td>0.007 (0.00)</td>
</tr>
</tbody>
</table>
# Moisture Content of the Breads

<table>
<thead>
<tr>
<th>OFSP Puree Bread</th>
<th>OFSP Four Bread</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>OFSP Puree Dough</strong></td>
<td><strong>OFSP flour dough</strong></td>
</tr>
<tr>
<td>46.40</td>
<td>43.06</td>
</tr>
<tr>
<td><strong>OFSP Bread Crumb</strong></td>
<td><strong>OFSP flour Bread Crumb</strong></td>
</tr>
<tr>
<td>43.79</td>
<td>38.48</td>
</tr>
<tr>
<td><strong>OFSP Bread Crust</strong></td>
<td><strong>OFSP flour Bread Crust</strong></td>
</tr>
<tr>
<td>24.96</td>
<td>19.97</td>
</tr>
</tbody>
</table>
Highlights

- OFSP puree bread had on average of 1.5mg/100g. (1500ug/100g)
- OFSP flour bread had on average 0.04mg/100g (400ug/100g)
- OFSP puree bread will have (125 RAE/100g), one slice 30g (37.5 RAE)
- OFSP flour bread will have 33 RAE/100g, i.e. 10 RAE per 30g slice.
Take Home Message

• OFSP puree is very nutritious, high beta-carotene content, 15ug/g.
• Beta-carotene is an antioxidant
• Two slices of OFSP puree bread will provide 20% of the RDA for preschool children
• ½ loaf of OFSP puree bread provides 35% RDA vitamin A for adult women
So What?

• 125g of OFSP provides 100% RDA for children
• 125g of OFSP puree bread provides 40% of RDA for children
• Our partners can advertise OFSP puree bread as a good source of vitamin A according to the FDA definition
• Our partners can advertise OFSP puree bread as good source of antioxidant (BC)
THE END