NUTRITIONAL AND ECONOMIC ENHANCEMENT OF GHANAIAN TRADITIONAL DIETS USING THE ORANGE-FLESHED SWEETPOTATO (OFS) PRODUCTS

Development and quality evaluation of weaning foods based on Orange-Fleshed Sweetpotato (OFS) flour to alleviate infant malnutrition in Ghana

W.A. PLAHAR (PhD)
CSIR-Food Research Institute
Accra, Ghana

Introduction

- The problem of infant malnutrition
- Leading forms of malnutrition in developing countries
  - Protein-energy malnutrition
  - iron deficiency anemia
  - vitamin A deficiency
- Focus on the O-FS root, with its high β-carotene content as a means to enhance the nutritive value of the traditional diets of Ghanaian children
- Developing acceptable weaning food products based on the OFS for children to help alleviate the effects of vit. A deficiency in this vulnerable group of the population

Purpose

- To develop acceptable high-quality weaning foods based on OFS flour formulated with maize and soybeans.
- Process optimization and standardization for effective value addition and enhanced sensory attributes were the main focus in the product development efforts.

Materials and Methods

- Materials
  - Orange-fleshed sweetpotato (OFS) flour prepared from the newly released United States (Beaurgard) sweetpotato variety was obtained from Selasi Farms Ltd., Ghana
  - maize (*Zea mays*), soybeans (*Glycine max*) and peanuts (*Arachis hypogaea*). These were obtained from local grain markets in Accra, Ghana.

Preparation of blend ingredients

- Raw grains were first cleaned separately by removing extraneous materials and then sorted
- Roasted maize flour (with and without peanuts), full-fat soyflour, and dehydrated fermented maize flour were all prepared individually by standard methods developed at the CSIR-Food Research Institute
- Cleaned maize and peanut samples were roasted separately in a gas heated pan roaster equipped with a mechanical stirrer (FATECO, Ghana Ltd.) maintained at 150°C for one hour.
- Samples of full-fat soy flour and dehydrated fermented maize meal were prepared by the method of Plahar *et al*. (1997).

Blend formulation and product development

- Blend formulations were based on orange-fleshed sweetpotato, maize, peanuts and soybeans to simulate the traditional infant weaning foods

- The normal product development phases involving:

  idea generation,
  screening of ideas,
  technical development processes for optimization, and
  prototype refining by sensory techniques,

  were applied in the development of the new weaning foods

Major factors considered in the product development process included:

1. Optimization of the orange-fleshed sweetpotato flour to enhance β-carotene content of the weaning blend,

2. Effects of the relative concentration of the various ingredients on the general quality, especially the nutritional and sensory characteristics, of the final products.

Six different formulations were prepared based on the traditional Tom Brown (4) and the traditional fermented maize meal (2) porridges.

Chemical Quality Evaluation

- Moisture (AOAC 925.10),
- Protein (AOAC 984.13),
- Fat (AOAC 920.39) and
- Ash (AOAC 923.03)

were determined by the AOAC (1990; 2000) standard methods

- Iron, calcium and phosphorous were determined by AACC (1983) bipyridyl colorimetric, permanganate titration, and molybdenum methods respectively

- Carbohydrates were calculated by difference.

- Energy values were obtained using the Atwater factors

Sensory evaluation

- Sensory preference was evaluated using cooked porridges prepared from the samples
- A 15-member trained panel of judges was used in the laboratory sensory tests.
- Nine-point hedonic scale (Larmond 1977) used to determine relative preferences for the various sensory attributes of colour, texture, aroma, taste, mouth feel and overall acceptability.
- Detectable differences between the OFS weaning foods and the traditional counterparts, determined by the triangle test.

RESULTS & DISCUSSION

Blend Formulation	Product Characteristics
Tomvita 25:	
Roasted maize. …. …. …. 60%	Brown flour which, when reconstituted and cooked, becomes a smooth porridge that is light brown in colour.
OFS. …. …. …. …. ….. 25%	
Roasted peanut. …. …. … 0%	
Soy flour. …. …. …. ….. 15%	
Tomvita 25 G-Plus:	
Roasted maize. …. …. …. 55%	Slightly dark brown flour which, when reconstituted and cooked, becomes a smooth deep brown porridge.
OFS. …. …. …. …. …. 25%	
Roasted peanut. …. …. .. 5%	
Soy flour. …. …. …. … 15%	

Blend Formulation		Product Characteristics
Tomvita 50:		
Roasted maize. …. …. ….	40%	Yellowish brown flour which turns into a smooth brown porridge when reconstituted and cooked.
OFS. …. …. …. …. ….	50%	
Roasted peanut. …. …. ..	0%	
Soy flour. …. …. …. …	10%	
Tomvita 50 G-Plus:		
Roasted maize. …. …. ….	35%	Yellowish brown flour which turns into a smooth dark brownish yellow porridge when reconstituted and cooked.
OFS. …. …. …. …. ….	50%	
Roasted peanut. …. …. ..	5%	
Soy flour. …. …. …. …	10%	

.

Blend Formulation		Product Characteristics
Mayvita 25		
Fermented maize meal. ….	60%	Slightly orange coloured flour from which a smooth light orange coloured porridge is obtained when reconstituted and cooked.
OFS. …. …. …. ./… ….	25%	
Soyflour. …. …. …. …. .	15%	
Mayvita 50		
Fermented maize meal. ….	40%	Orange coloured flour from which a smooth bright orange coloured porridge is obtained when reconstituted and cooked.
OFS. …. …. …. ./… ….	50%	
Soyflour. …. …. …. …. .	10%	

Samples of roasted maize flour porridge containing 25% (TOMVITA 25) and 50% (TOMVITA 50) Orange-Fleshed Sweetpotato flour

TOMVITA 25

TOMVITA 50

Samples of roasted maize & peanut flour porridge containing 25% (TOMVITA 25) and 50% (TOMVITA 50) Orange-Fleshed Sweetpotato flour

TOMVITA 25-G

TOMVITA 50-G

Samples of fermented maize meal porridge containing 25% (MAYVITA 25) and 50% (MAYVITA 50) Orange-Fleshed Sweetpotato flour

MAYVITA 25

MAYVITA 50

Table 2a. Triangle difference tests for OFS-based weaning foods and existing traditional weaning foods

Samples compared		Identification of odd sample (p>0.05)	Degree of difference	Relative acceptability	Comments
Traditional "Tom Brown" vs. OFS-Tom Brown Porridge	25% OFS without Peanuts	Positive identification of odd sample	Slight	OFS product more acceptable	Tasty product with nice aroma, colour and consistency.
	25% OFS with Peanuts	Positive identification of odd sample	Much	OFS product more acceptable	Tasty product with good appearance, nice aroma and colour.
	50% OFS without Peanuts	Positive identification of odd sample	Much	Traditional product more acceptable	Very colourful with a sweet taste but has an undesirable after-taste
	50% OFS with Peanuts	Positive identification of odd sample	Very much	Traditional product slightly more acceptable	Appealing yellowish colour but has a funny after- taste and an undesirable aroma.

Table 2b. Triangle difference tests for OFS-based weaning foods and existing traditional weaning foods

Samples compared		Identification of odd sample (p>0.05)	Degree of difference	Relative acceptability	Comments
Traditional fermented maize meal vs. OFS-fermented maize meal porridge	25% OFS without Peanuts	Positive identification of odd sample	Much	Traditional product more acceptable	Desirable appearance, but has an off-flavour and poor taste.
	50% OFS without Peanuts	Positive identification of odd sample	Very much	Traditional product more acceptable	Poor aroma and taste with an unattractive bright yellow colour.

Table 3a. Mean sensory scores for OFS weaning foods and existing traditional weaning foods [1]

Sensory characteristics	OFS-Tom Brown Weaning Foods				OFS-Fermented Maize Meal Weaning Foods	
	25% OFS without Peanuts	25% OFS with Peanuts	50% OFS without Peanuts	50% OFS with Peanuts	25% OFS	50% OFS
Appearance	8.0 ± 0.61[a]	8.1 ± 0.24[a]	7.8 ± 0.75[a]	7.7 ± 0.75[a]	8.1 ± 0.78[a]	8.0 ±0.79[a]
Colour	7.9 ± 0.66[a]	7.7 ± 0.61[a]	7.8 ± 0.83[a]	7.9 ± 0.60[a]	8.1 ± 0.97[a]	8.1 ± 0.90[a]
Aroma	7.7 ± 0.83[a]	8.4 ± 0.49[a]	7.3 ± 0.69[b]	7.4 ± 0.62[b]	7.2 ± 0.81[b]	6.7 ± 0.86[c]
Consistency	7.7 ± 0.69[a]	7.8 ± 0.81[a]	7.7 ± 0.85[a]	7.9 ± 0.60[a]	7.7 ± 0.77[a]	7.4 ± 0.87[b]
Taste	7.9 ± 0.78[a]	8.2 ± 0.56[a]	7.4 ±0.94[b]	7.2 ± 0.81[b]	7.1 ± 0.78[b]	6.2 ± 0.83[c]
Mouth-feel	7.7 ± 0.59[a]	8.0 ± 0.50[a]	7.7 ± 0.86[a]	7.5 ± 0.56[b]	7.5 ± 0.72[b]	6.5 ± 0.87[c]
Overall acceptability	7.8 ± 0.81[a]	8.2 ± 0.64[a]	7.3 ± 0.71[b]	7.5 ± 0.86[b]	6.9 ± 0.75[b]	6.2 ± 0.97[c]

[1]Means within a row not followed by the same superscript letter(s) are significantly different ($p<0.05$)
Interpretation of scores: 1= dislike extremely; 2= dislike v. much; 3= dislike moderately; 4= dislike slightly; 5= indifferent; 6= like slightly; 7= like moderately; 8= like v. much; 9= like extremely

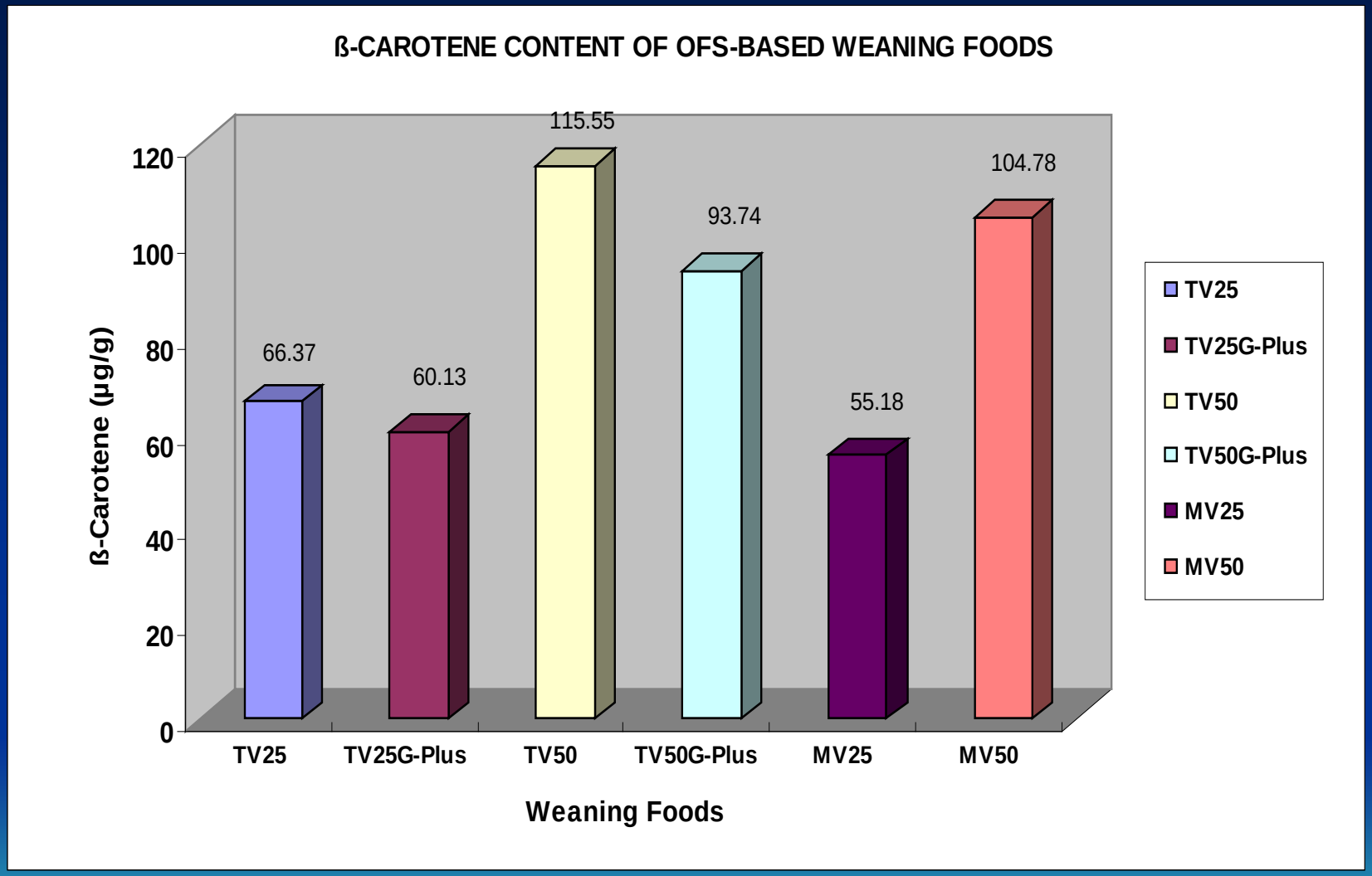
Table 3b. Summary of overall acceptability scores, degree of liking and limiting sensory factors for the OFS-based weaning foods

Product		Acceptability mean score	Degree of liking	Limiting sensory factor(s)
OFS-Tom Brown Weaning Foods	25% OFS without Peanuts	7.8 ± 0.81	very much	none
	25% OFS with Peanuts	8.2 ± 0.64	very much	none
	50% OFS without Peanuts	7.3 ± 0.71	moderate	Taste
	50% OFS with Peanuts	7.5 ± 0.86	moderate	Aroma & taste
OFS-Fermented Maize Meal Weaning Foods	25% OFS	6.9 ± 0.75	moderate	Aroma & taste
	50% OFS	6.2 ± 0.97	slight	Aroma, consistency, taste and mouthfeel

Table 4. Proximate composition and mineral content of OFS weaning foods with or without peanuts[1]

Component	OFS-Tom Brown Weaning Foods				OFS-Fermented Maize Meal Weaning Foods	
	25% OFS without Peanuts	25% OFS with Peanuts	50% OFS without Peanuts	50% OFS with Peanuts	25% OFS without Peanuts	50% OFS without Peanuts
Moisture (g/100g)	5.41 ± 0.21	5.19 ± 0.04	5.26± 0.02	5.11±0.75	6.07 ± 0.16	5.86± 0.12
Ash (g/100g)	2.21±0.00	2.28±0.04	2.54±0.03	2.54±0.04	2.32±0.04	2.54±0.08
Fat (g/100g)	6.35±0.35	10.14±0.08	5.01±0.06	7.52±0.27	5.32±0.19	4.80±0.11
Protein (g/100g)	14.97±0.04	16.54±0.12	12.13±0.01	13.45±0.12	15.02±0.08	13.42±0.09
Carbohydrates (g/100g)	71.13±0.18	65.56±0.31	75.08±0.08	71.40±0.19	71.29±0.10	73.39±0.19
Energy (kCal/100g)	389.56±2.04	404.49±2.38	384.27±0.25	395.18±1.1	381.73±1.36	380.28±0.58
Calcium (mg/100g)	100.73±5.63	256.57±5.51	91.96±11.32	357.89±23.30	290.58±2.42	115.96±11.31
Phosphorus (mg/100g)	0.69±0.15	0.26±0.00	0.71±0.14	0.40±0.19	0.28±0.04	0.86±0.10
Iron (mg/100g)	23.57±4.5	14.31±1.66	17.49±1.02	10.91±1.65	13.95±1.15	17.34±0.81

[1]Values are means of triplicate determinations ± standard deviation.


ß-CAROTENE CONTENT OF OFS-BASED WEANING FOODS
ß-Carotene (µg/g)
120
100
80
60
40
20
0
66.37
60.13
115.55
93.74
55.18
104.78
TV25
TV25G-Plus
TV50
TV50G-Plus
MV25
MV50
Weaning Foods
TV25
TV25G-Plus
TV50
TV50G-Plus
MV25
MV50

Conclusions

- The orange-fleshed sweetpotato flour can be used at 25% replacement levels (at least) with maize, in the formulation of highly acceptable good quality weaning foods based on the soy-fortified traditional Tom Brown to help alleviate malnutrition problems in Ghana.

- The obvious contribution of high levels of β-carotene makes the orange-fleshed sweetpotato a useful ingredient with the potential to improve the vitamin A content of such blends.


THANK YOU