NATIONAL NUTRITION CONFERENCE
ETHIOPIA 2021
GENERATION AND MOBILIZATION OF NUTRITION EVIDENCE TO TACKLE MALNUTRITION: FROM DATA TO ACTION

Effect of Treatment on the Beta Carotene Retention of Orange Fleshed Sweet Potato Varieties

Yemesrach Tiruneh, Kelbessa Urga, Abebe Bakeries &
Geremew Tassew Weledesemayat

Ethiopian Public Health Institute

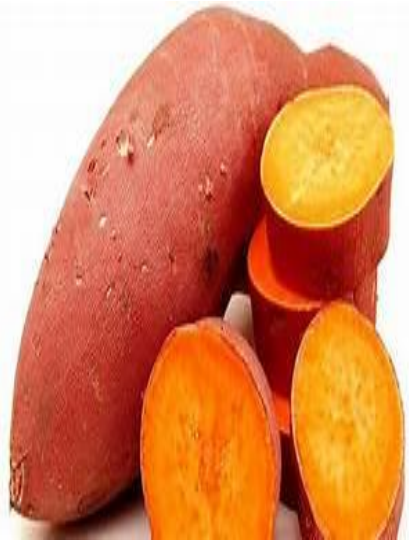
Addis Ababa, Dec 8-10, 2021

Background

- Vitamin A Deficiency (VAD) is a serious public health problem in Ethiopia
- VAD affects vision, growth, tissue differentiation and immune system.
- Around 100 million Africans to a higher risk of visual impairment and blindness (African Union, 2005).
- Foods from plant origin are an important source of pro-vitamin A (**β-*carotene*)** in developing countries.

Background

- **Orange-fleshed Sweet potato (OFSP)** varieties are potential for food security promoted root crop; better source of **vitamin A nutrition** in sub-Saharan Africa.



- OFSP is naturally a bio-fortified crop, a promising solution to VAD and better absorbed than other leaves and vegetables
- It is a known staple food in southern Ethiopia.
- OFSP can make a major contribution in alleviating vitamin A malnutrition in Sub-Saharan Africa.

Objective

General Objective

- To study the effect of treatment method on the beta carotene retention of Orange Fleshed Sweet Potato Varieties (Kulfo and Tulla)

Specific objective

- To determine β-carotene retention of OFSP varieties(Kulfo and Tulla)
- To investigate the effect of boiling, steaming, microwave cooking, sun drying, oven drying, and post steam-drying time on its β-carotene content of OFSP varieties

Materials and Methods

Study area

- Commercially released Orange Fleshed Sweet **Potato varieties (*Kulfo and Tulla*) were collected from Hawassa Agricultural Research Center.**
- Two varieties, grown **for 22 to 24 weeks**
- For each variety, 8 kg roots were harvested, transported with suitable cardboard box and roots were stored at temperature of -25 °C in refrigerator
- β-carotene analyses were carried out in laboratory

Materials and Methods

Chemicals and standards

- All chemicals and reagents used for laboratory analysis of other parameters were analytical grade

- **HPLC Grade solvents**: *acetone, PE, acetonitrile, methanol, ethyl acetate, triethylamine and n-hexane*.

- **Beta-carotene standard**: used to calibrate and quantify beta-carotene

Methods

- **Six treatment methods**
  - ✓boiling, steaming, microwave cooking, oven drying, sun drying and post steam-drying were simulated in the study to check their effects on the True Retention of β-carotene.

Methods of β-carotene analysis

A. Sample preparation of raw roots

Roots from different varieties

1. two medium-sized sweet potato roots (300-350 g) from each variety were quartered longitudinally from the **stem end** to the root end, washed with tap water and a brush, and blotted with tissue paper
2. The two opposite quarters from each root were selected and the peel removed, cut into cubes of ca 2 × 2 × 2 mm and mashed with a porcelain pestle

Method of β-carotene analysis

B. Preparation of cooked roots

- **Boiling and steaming, microwave oven cooking, steam-dried chips, oven and sun drying**
- Method of cooking (boiling, steaming, microwave oven cooking) two medium-sized roots of two OFSP were washed with tap water and brush, blotted with tissue paper, peeled, and then cut into 1 × 1 × 1 cm cubes and mixed well.
- Six portions of samples of **25** g were weighed and used for boiling as well as steaming
- One portion (untreated) and the other five portions of samples were steamed and boiled (10, 20, 30, 40 and 50 minutes, respectively)

Method of β-carotene analysis

- **Steam-dried chips**

✓two medium-sized roots sample : washed, blotted, peeled and cut into 1×1×5 cm strips 10 g per strip. The strips were divided into three portions and weighed

- **Oven drying**

✓ samples (450g)were spread out on aluminum foil lined trays, which were placed in an HT 4 forced- air cabinet oven dryer and dried at 57 °C for 10h to a brittle texture

- **Open-air sun drying**

✓Sliced sweet potato were dried under direct sunlight and occasionally turned to improve the drying process. Drying temperatures varied between 18 and 25°C

Method of β-carotene analysis

Microwave oven cooking

- four portions of samples of 25 g were weighed
- One portion of sample was untreated, and the other three portions of sample were put in plastic microwave bowls, without covers, and cooked for 10, 15 and 20 min, respectively

Method of β-carotene analysis

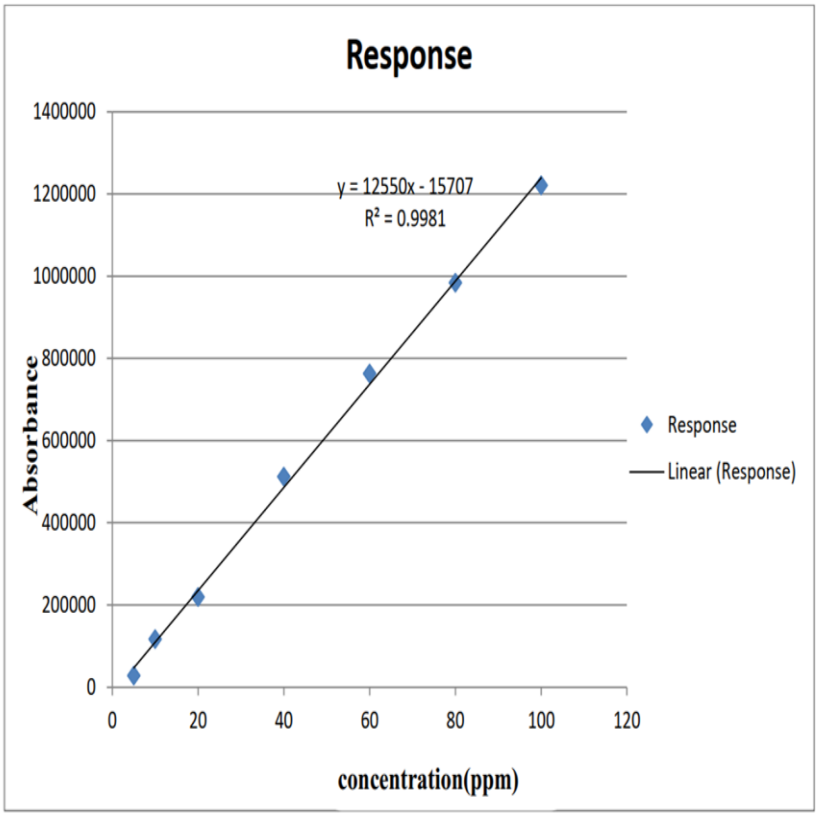
Oven and sun drying

- Two medium-sized 450g OFSP (quartered longitudinally) from the stem end to the root end, washed with tap water and brush, and blotted with tissue paper.
- The two opposite quarters from each root were selected and the peel removed, then sliced to 1–2 mm thickness using a food processor.
- 50 g of portion taken and placed in an amber polystyrene bottle and stored in a freezer (–20 ° C) prior to subsequent carotenoid analysis.

Standard preparation and calibration

- Stock solution was prepared 10 mg in 100 ml n-hexane.
- Calibration points standard solution through a serial dilution to be 0.25-5.0 µg/ml in n-hexane.
- 7 point calibration curve was plotted from 0.25 to 5.0 µg/ml
- calibration curve was linear (r2=0.998)

Appendix 1: Calibration curve for beta carotene analysis



HPLC Condition

- Monomeric C18 column: Waters Spherisorb ODS2 (3µm, 4.6 x 150 mm)
- mobile phases (mixture of acetonitrile, methanol, ethyl acetate and 0.05% triethylamine)
- The isocratic elution program was set as follows 80:10:10, flow rate of 0.7mL/min.
- column temperature was 30 degree celicious and wave length of UV/Visible was 450nm
- The injection volume was 10µl

HPLC Analysis of Beta Carotene

- A 50mL extract was concentrated in a rotary evaporator T ≤ 35 degree celicious,
- dried under nitrogen gas then it was redissolved by using 4mL of HPLC grade acetone
- Filtered through 0.22µg PTFE syringe filter directly into sample vial and inject to HPLC (Shimazu)

Result and Discussion

Table 1: β-carotene content of fresh OFSP Kulfo and Tulla varieties

OFSP Potato varieties	β- carotene content (µg/g fresh peeled weight)
Kulfo	400 ± 0.42
Tulla	335.25 ± 0.07

Duplicate determinations, the β-carotene content in the raw, peeled samples Kulfo and Tulla was found 400 µg/g and 335 µg/g, respectively

Table 2: Effect of boiling time on the β-carotene content of the OFSP (Kulfo and Tulla) varieties

Orange Fleshed Sweet Potato varieties	β-carotene content (µg/g fresh peeled weight)	Boiling time (min)	B-carotene content (µg/g) boiled, peeled	True retention of β-carotene (%)
Kulfo	381.85 ±1.90	10	371.05 ± 0.63	97.1
		20	368.15 ± 1.06	96.4
		30	317.45 ± 0.07	83.1
		40	255.2 ± 2.68	66.8
		50	217.9 ± 0.56	57
Tulla	303.65 ±0.63	10	294.5 ± 2.40	96.9
		20	279.9 ± 1.13	92.1
		30	232.65 ± 0.77	76.6
		40	210.3 ± 0.42	69.2
		50	181.45 ± 1.06	59.8

The level of retention was significantly different ($P<0.05$) among treated orange fleshed sweet potato

Table 3: Effect of steaming time on the β-carotene content of the OFSP Kulfo and Tulla varieties

OFSP Varieties	β-carotene content (µg/g fresh peeled weight)	steaming time (min)	β-carotene content (µg/g) steamed, peeled	True retention of β-carotene (%)
Kulfo	345.3 ±1.13	10	325.85 ± 0.49	94.3
		20	277.6 ± 2.12	80.3
		30	260 ± 1.83	75.2
		40	231.6 ± 0.28	67
		50	187.8 ± 2.61	54.3
Tulla	288.05 ±1.06	10	278.9 ± 1.27	96.8
		20	264.75 ± 2.19	91.9
		30	201.65 ± 2.05	70
		40	176.25 ± 0.21	61.1
		50	156.15 ± 2.05	54.3

The level of retention was significantly different ($P<0.05$) among treated orange fleshed sweet potato

Effect of microwave heating time on the β-carotene content of the orange flesh sweet potato

OFSP Varieties	β –carotene content (µg/g fresh peeled weight)	microwave heating time (min)	β-carotene content (µg/g) microwave heated, peeled	True retention of β-carotene (%)
Kulfo	347.95±1.06	10 15 20	292.3±1.69 166.95±0.21 138.6±0.14	84.0 47.9 39.8
Tulla	280±0.28	10 15 20	197.8±0.42 149.5±1.27 132.1±0.28	70.6 53.3 47.

Values within the same column are significantly different (P<0.05)

Effect of oven drying time on the β-carotene content of the orange fleshed sweet potato

OFSP Varieties	β –carotene content (µg/g fresh peeled weight)	Oven drying time (hr)	β-carotene content (µg/g) Oven dried, peeled	True retention of β-carotene (%)
Kulfo	385.5±0.14	Oven dried at 570C for 10hr	373.2±0.98	96.8
Tulla	311.95±0.35	288.85±0.07	92.6	

Values within the same column are significantly different (P<0.05).

Effect of sun drying time on the β-carotene content of the orange fleshed sweet potato

OFSP Varieties	β –carotene content (µg/g fresh peeled weight)	Sun drying time (min)	β-carotene content (µg/g) Sun dried, peeled	True retention of β-carotene (%)
Kulfo	334.05±0.35	Sun dried 18-250C	264.35±0.35	79.1
Tulla	288.75±0.63	224.35±0.07	77.6	

Values within the same column are significantly different (P<0.05)

Effect of drying on the content of β-carotene in orange fleshed sweet potato chips

OFSP Varieties	Content (µg/g)of fresh peeled weight	Steamed for 20 min	Content of β-carotene in chips (µg/g)	True retention of β-carotene (%)
Kulfo	367.7±0.14	Dried at 50 °C for 5 h after steaming Dried at 50 °C for 11 h after steaming	345.7±0.28 289.05±0.21	94.0 78.6
Tulla	330.35±1.20	Dried at 50 °C for 5 h after steaming Dried at 50 °C for 11 h after steaming	288.1±0.14 199.8±0.14	87.2 60.4

Values within the same column are significantly different ($P<0.05$)

Conclusion

- β-carotene contents in OFSP varieties (*Kulfo and Tulla*) were significantly affected by processing method, Environmental condition and stage of maturity
- The effect of treatment time on β-carotene content of OFSP Varieties can lead to a reduction in the β-carotene content.
- Microwave cooking has biggest loss of β- carotene content among the six treatment methods.
- OFSP should be prepared for consumption, using methods that protect the loss of β-carotene content which helps OFSP as a staple food as well as a snack food for supplying vitamin A for both rural and urban populations.

- Addis Ababa University research office and staffs for the all rounded support rendered throughout this research development and completion.

- The staffs of Ethiopian Food and Drug Authority and Ethiopian public health institute and were also among the people to be appreciated for their cooperation in providing the necessary reference materials.

Thank you for your Attention