

Impact of local cooking on β -carotene bioaccessibility from orange-fleshed sweet potato derived products made in Uganda

ORANGE-FLESHED sweet potato (OFSP), a rich source of β -carotene, is currently being promoted in Uganda where sweet potato is a staple crop, to tackle vitamin A deficiency. OFSP flour was used to prepare three types of local food: porridge, chapatis and mandazis well accepted by consumers. The present study aims to evaluate the impact of the cooking process (boiling or frying) in these OFSP flour products on β -carotene bioaccessibility.



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Materials and methods

Chapatis, mandazis and porridge were prepared in Uganda according to local recipes, with 30% OFSP flour, water and/or oil. Extraction and HPLC analysis of carotenoids from micelles and from OFSP food products were carried out according to previous work. Carotenoid bioaccessibility from OFSP food products was assessed using an in vitro digestion in order to simulate gastric and small intestinal phases of digestion (1). Samples were incubated at 37°C with pepsin (pH: 4) for 30 minutes and with bile extract and pancreatin (pH: 6) for a further 30 minutes. Micelles were collected in the aqueous fraction after centrifugation and filtration.



Results and discussion

- Chapati and mandazi presented similar all-trans β -carotene contents (31.5 and 32.9 mg/kg respectively) whereas that of porridge was only 8.7 mg/kg. Boiled OFSP had the highest content of all-trans β -carotene (95 mg/kg) (Table 1).

Table 1. β -carotene content in OFSP¹ food products.

OFSP food	Fat matter (%)	All trans- β -carotene ($\mu\text{g}\cdot\text{g}^{-1}$)	13-cis- β -carotene ($\mu\text{g}\cdot\text{g}^{-1}$)
Boiled OFSP	-	95 \pm 2.4	7.4 \pm 0.2
Porridge	-	8.7 \pm 0.3	1.2 \pm 0.1
Chapati	7.4 \pm 1.0	31.5 \pm 1.4	2.5 \pm 0.5
Mandazi	3.3 \pm 0.2	32.9 \pm 1.7	3.7 \pm 0.4

¹ Ejumula variety.

Average \pm standard deviation (over three extractions). Fatter matter and β content are expressed h weight basis.

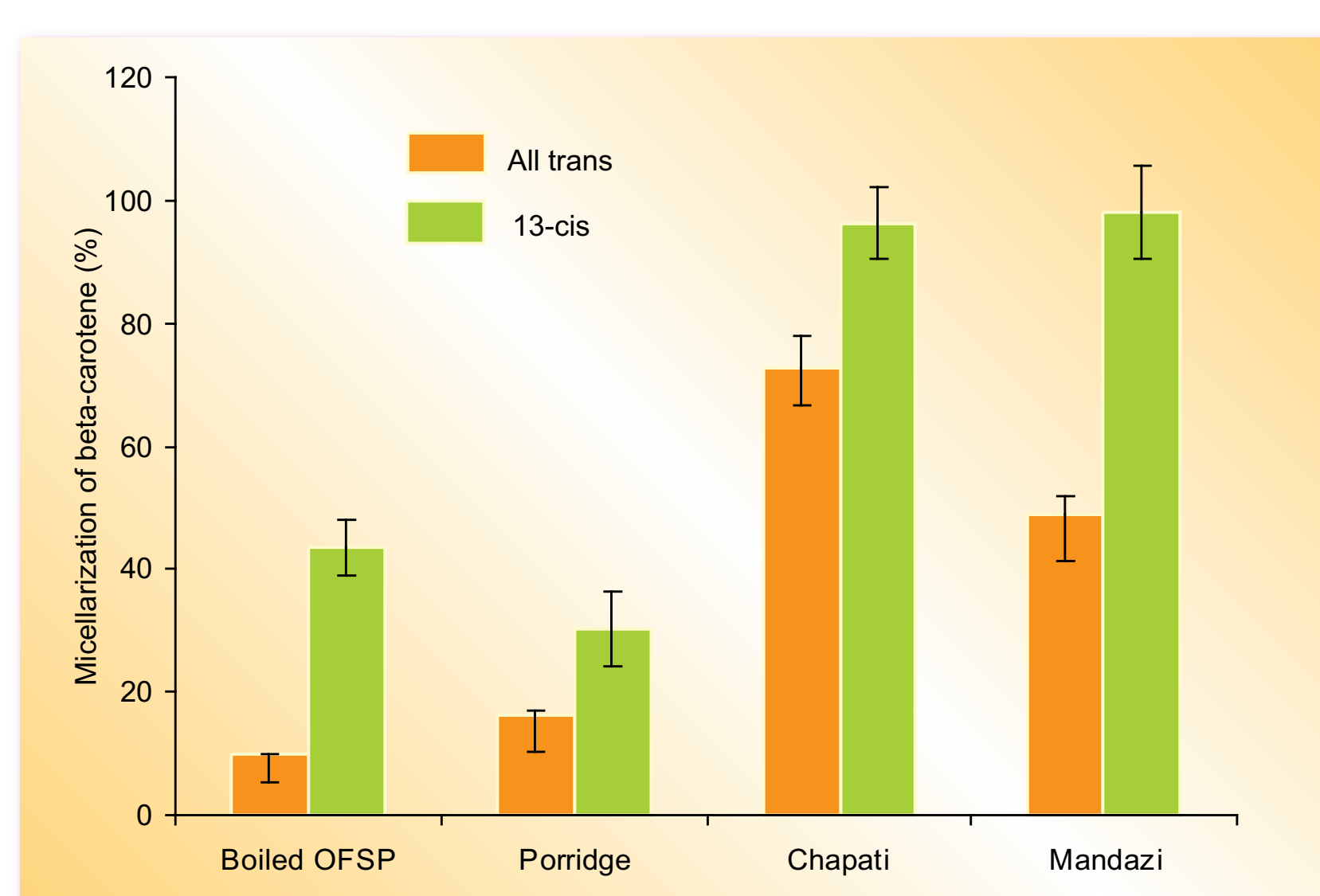


Figure 1. Micellarization of all-trans and 13-cis- β -carotene during simulated digestion of boiled OFSP and derived products.

- After in vitro digestion, the bioaccessibility, i.e., the percentage of micellarization of all-trans- β -carotene was greater in products cooked with oil: chapati (73%), mandazi (49%), as compared with the boiled ones: porridge (16%) and puréed root (10%) (Figure 1). The presence of fat during the preparation of chapati (7.4%) and mandazi (3.3%) clearly improves the bioaccessibility of β -carotene in OFSP. The more efficient incorporation in micelles of the 13-cis- β -carotene as compared with the all-trans form was observed in all the products.

- Taking account bioaccessibility and applying a 50% conversion to retinol would indicate that a 100g portion of the OFSP purée could provide 46%, of the daily vitamin A requirement (RDA) for child under 6 years. In comparison 100g of porridge would only provide 6% of the daily vitamin A requirement (RDA) for child under 6 years. Interestingly, two mandazis and one chapati could bring 75 and 100% of the RDA respectively (Figure 2).

Estimation of vitamin A activity (% RDA for a child <6 years to meet 400RE)

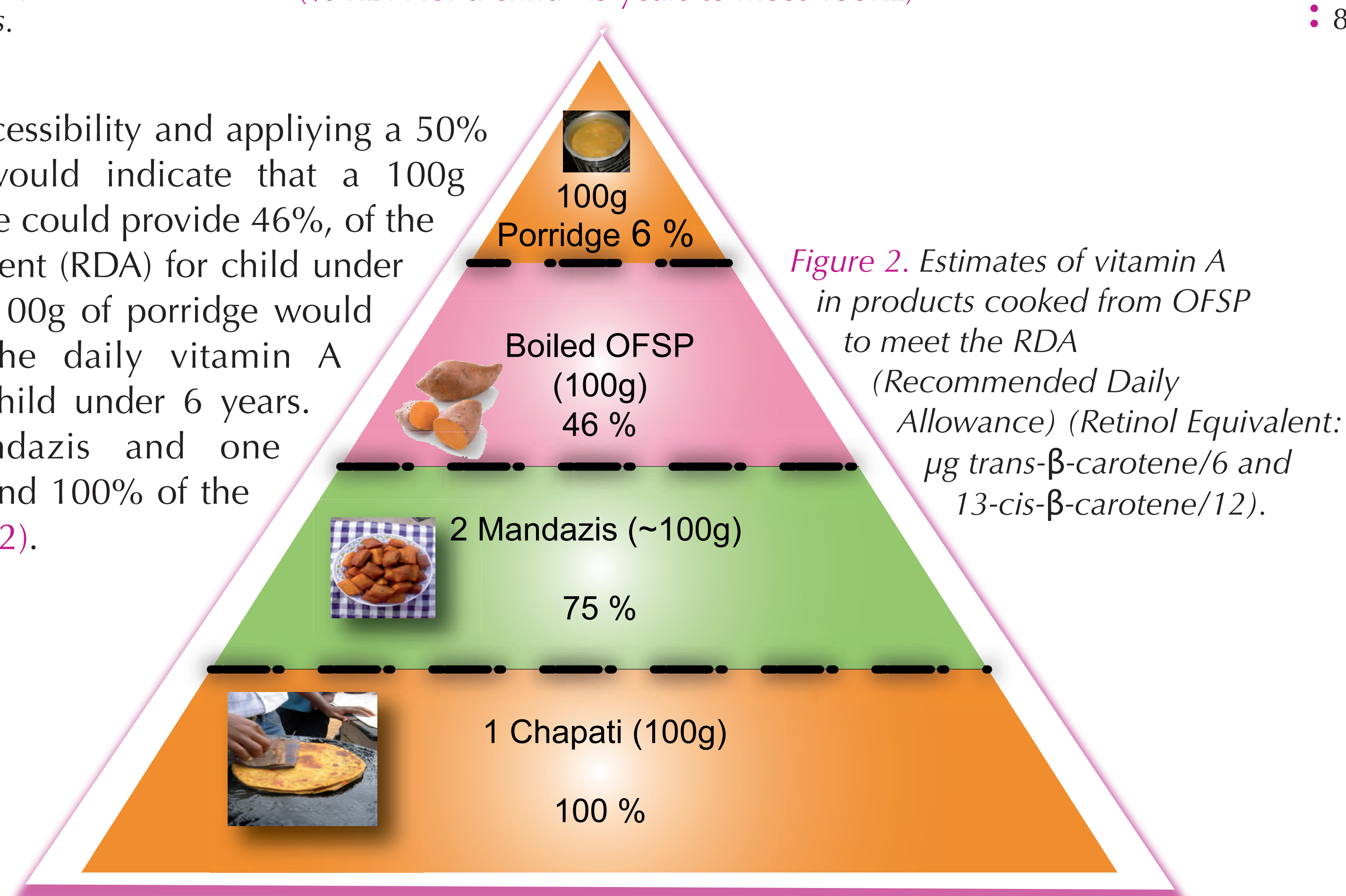


Figure 2. Estimates of vitamin A in products cooked from OFSP to meet the RDA (Recommended Daily Allowance) (Retinol Equivalent: μg trans- β -carotene/6 and 13-cis- β -carotene/12).

Reference

- Dhuique-Mayer C., Borel P., Reboul E., Caporiccio B., Besancon P. & Amiot M. J. (2007). Beta-Cryptoxanthin from Citrus juices: assessment of bioaccessibility using an in vitro digestion/Caco-2 cell culture model. British Journal of Nutrition, 97, 883-890.



- Results reported in Figure 3 showed that classical estimate of RAE were overestimated for boiled OFSP and porridge but were underestimated for chapati.

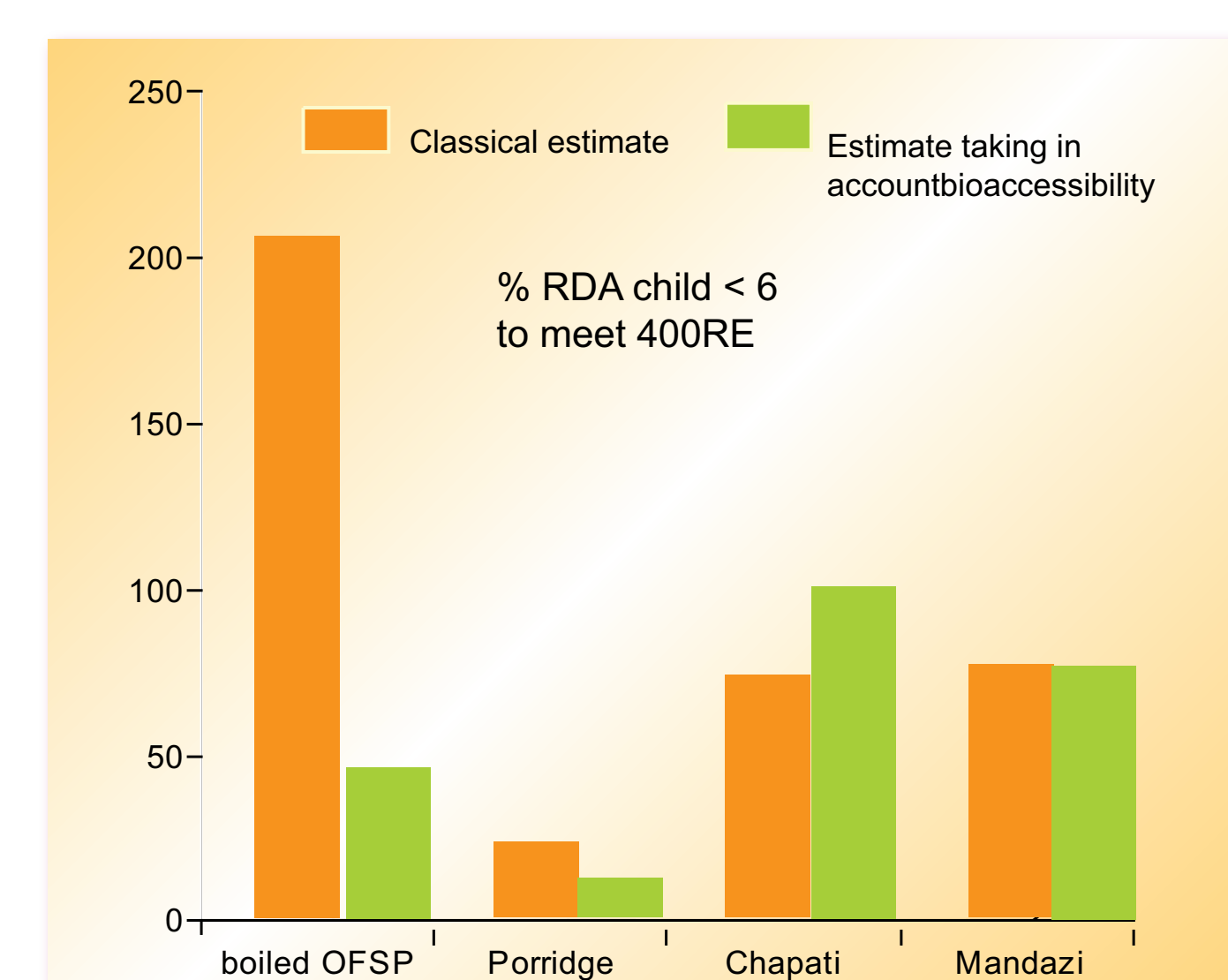


Figure 3. Differences between estimates of vitamin A in products cooked from OFSP using classical estimate (RAE from food (Retinol Activity Equivalent- μg trans- β -carotene/12 and 13-cis- β -carotene/24) and estimate taking into account bioaccessibility (calculated with RE).



Conclusion

THESE last results highlighted that β -carotene bioaccessibility is critical in the process of establishing the vitamin A activity of a particular food product. Indeed, this study suggested that the consumption of products made from a composite flour incorporating OFSP flour in Uganda could favourably contribute to decrease of vitamin A deficiency.

