Fruit carotenoids affect the bioaccessibility but not the intestinal cell uptake of β-carotene from Orange Fleshed Sweet Potato

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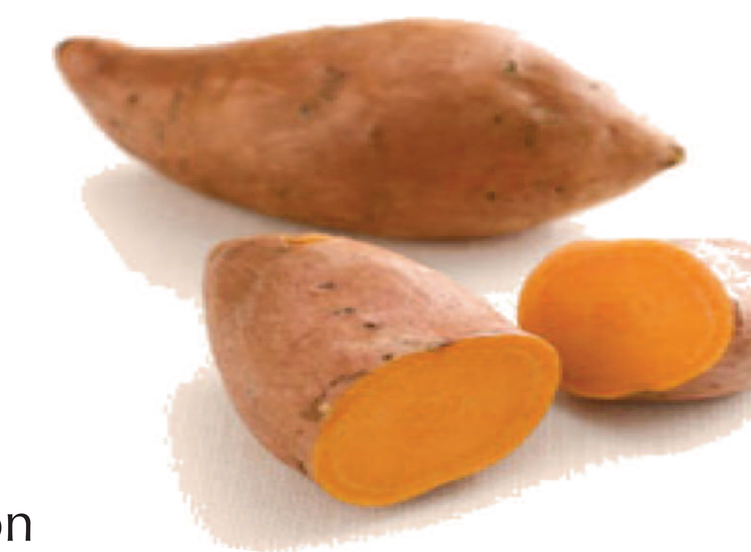
To fight against vitamin A deficiency in developing countries, consumption of orange fleshed sweet potato (OFSP) which contains high concentrations of beta-carotene (BC) (provitamin A carotenoid) (1) is currently promoted. However, biological activity of BC from food is dependent on its bioavailability including bioaccessibility and intestinal absorption whose depends on various factors including other microconstituents in foods. The objective of this study was to assess the effect of carotenoids from fruit juices on the bioaccessibility and cellular uptake of BC from OFSP.



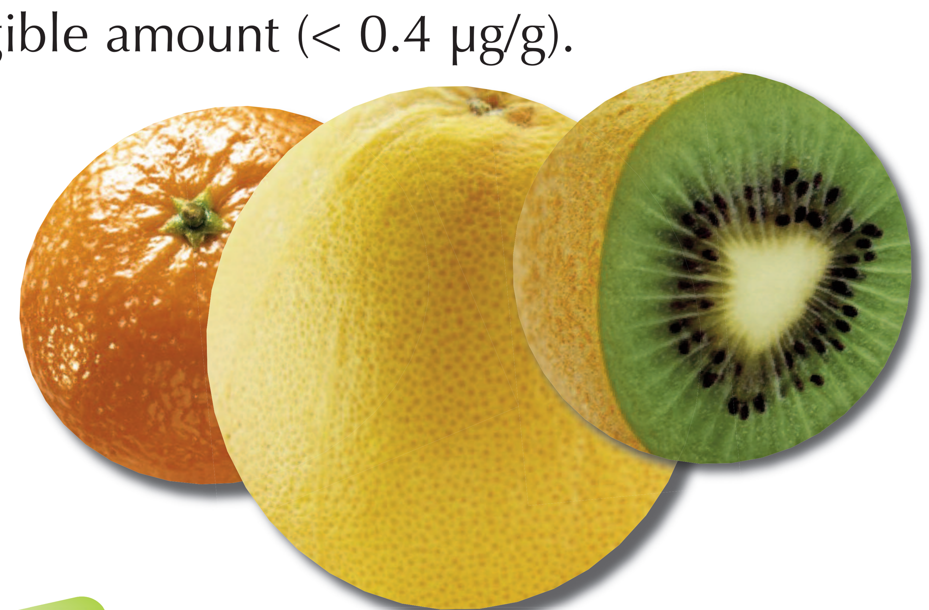
Materials and methods

All fruit juices were selected for their special carotenoid profile where major carotenoid was not BC comparatively with OFSP **(Table 1)**, BC representing negligible amount (< 0.4 µg/g).

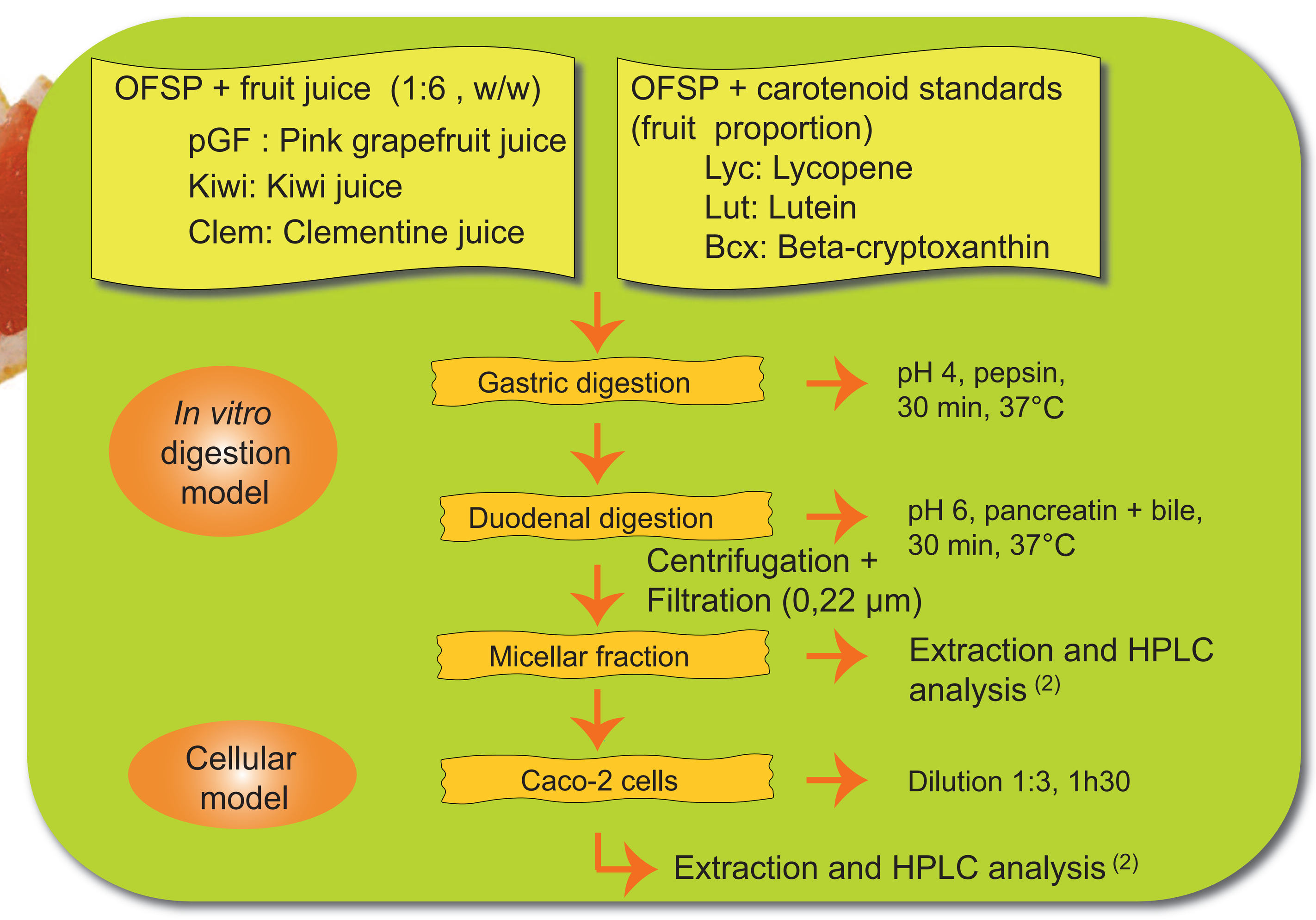
Table 1. Carotenoid content of fruits.

		Carotenoids content (µg/g)
OFSP	all-*trans* BC	75.7 ± 3.0
	13-*cis* BC	8.0 ± 0.4
pGF	Lyc	16.5 ± 0.4
Kiwi	Lut	1.9 ± 0.2
Clem	Bcx	9.7 ± 0.3

Data are means ± SD (n = 3 independent experiments). OFSP: orange fleshed sweet potato.



Coupled in vitro digestion /Caco-2 cell



Micellarization test

Equimolar quantity of carotenoids were mixed and incubated in presence of 5 ml of 100 mg/ml bile during 17 h at 37 °C.

Results and discussion

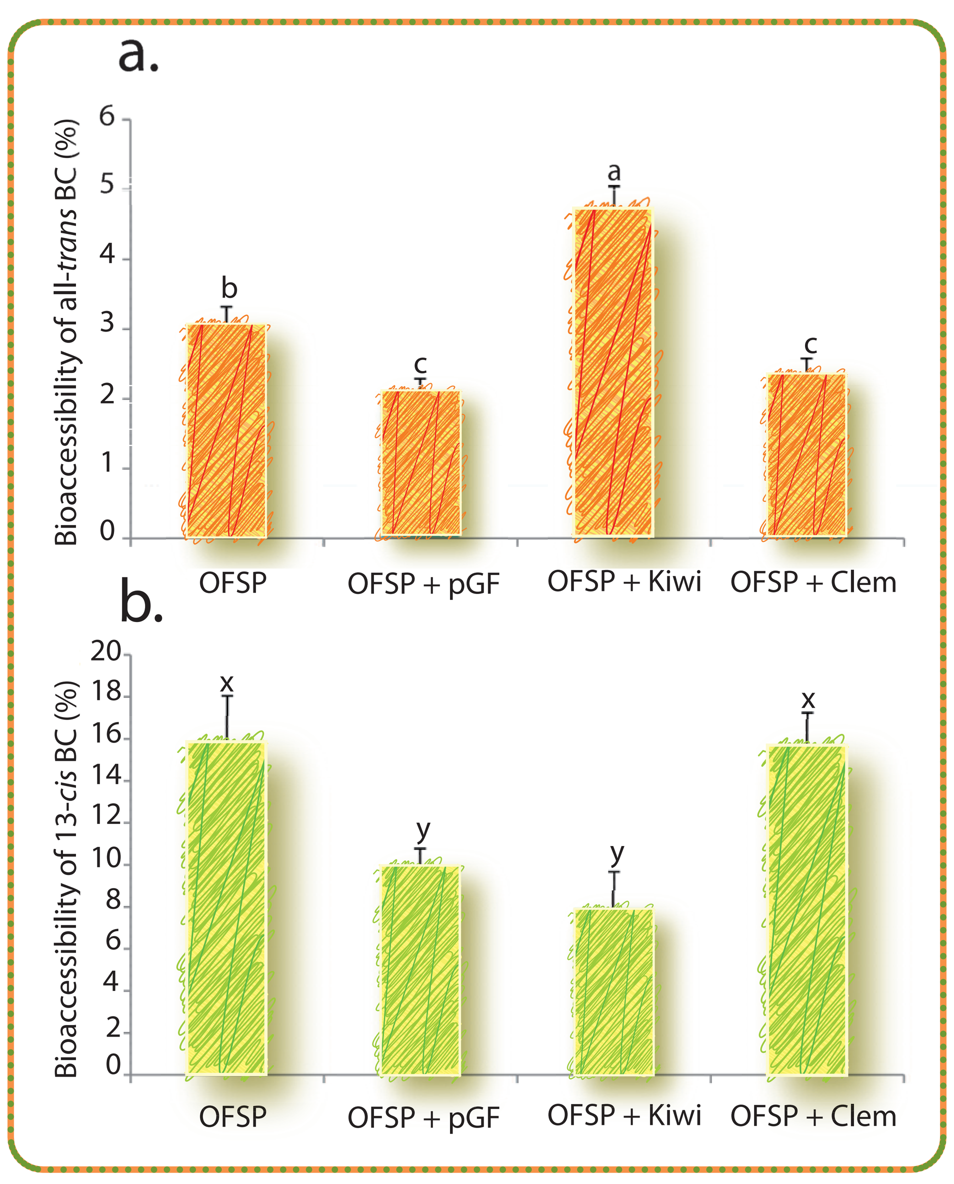


Figure 1. Bioaccessibility of all-trans BC (a) and 13-cis BC (b) from boiled OFSP in presence of fruit juice. Significant differences (P<0.05) are represented by different letter. Data are means ± SD (n=4 independent experiments). OFSP: orange fleshed sweet potato; pGF: pink grapefruit juice; Kiwi: kiwi juice; Clem: clementine juice; BC: beta-carotene.

Addition of pGF and Clem reduced significantly the bioaccessibility of all-*trans* BC whereas Kiwi enhanced it **(Fig 1a)**. Despite a more efficient incorporation of 13-*cis* BC into micelles in all conditions, pGF and Kiwi decreased the bioaccessibility of the *cis*-form whereas no effect was observed in presence of Clem **(Fig 1b)**.

Presence of Lyc standard as a substitute of pGF during *in vitro* digestion confirmed carotenoid interaction decreasing micellarization of both BC isomers from OFSP. When Lut standard was added instead of Kiwi, only the 13-*cis* BC was affected (Data not shown).

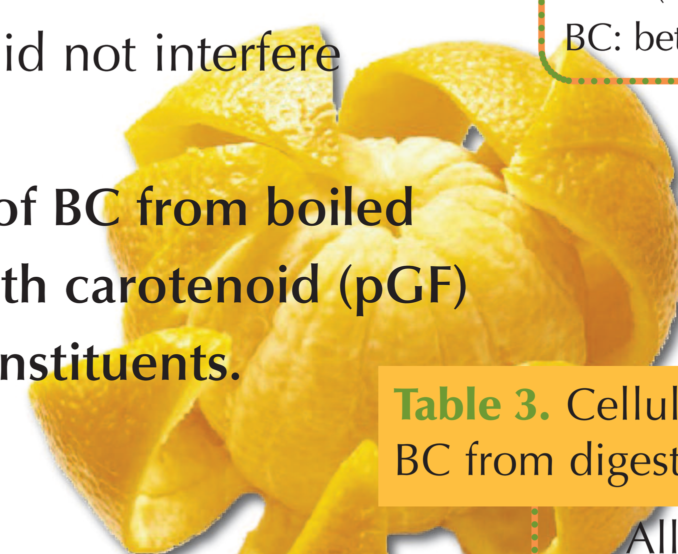
Micellarization test between carotenoid standards **(Table 2)** confirmed BC-Lyc interaction and showed a better micellarization of BC in presence of Bcx suggesting that Clem Bcx did not interfere in decreasing bioaccessibility of BC from OFSP.

Therefore, the modification of the bioaccessibility of BC from boiled OFSP observed in Figure 1 was probably due to both carotenoid (pGF) and fruit matrix (Kiwi and Clem) or others microconstituents.

Table 2. Micellarization test in presence of carotenoids standards.

	BC micellarized (%)
BC	9.6 ± 0.4 b
BC + Lyc	6.5 ± 0.3 c
BC+ Lut	9.1 ± 0.9 b
BC+ Bcx	12.7 ± 0.8 a

Significant differences (P<0.05) are represented by different letter. Data are means ± SD (n = 3 independent experiments). BC: beta-carotene.



No differences were observed in cellular uptake of all-*trans* BC from different digested samples **(Table 3)**. Fruits carotenoids did not interact with BC from OFSP for intestinal absorption. The *cis*-form was less absorbed (9-13 %).

Table 3. Cellular uptake of all-*trans* BC from digested boiled OFSP.

	All-trans BC cellular uptake (%)
OFSP	28.8 ± 3.5
OFSP + pGF	27.8 ± 1.8
OFSP + Kiwi	21.9 ± 1.3
OFSP + Clem	28.3 ± 1.5

Data are means ± SEM (n = 3 independent experiments).

Conclusion

Carotenoids from fruit juices modified the bioaccessibility but not cellular uptake of BC from OFSP. The simulated digestion coupled with the Caco-2 cell appeared to have a global approach of the bioavailability. Therefore, our results suggested that the presence of Kiwi had a positive effect on the bioavailability of BC from OFSP whereas pGF seemed to reduce it. However, further investigations are needed to identify other components responsible for interactions in order to improve the use of OFSP to maintain vitamin A status.

References

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