Provitamin A activity in traditional foods from Black Sea Area countries

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Introduction

Vitamin A is found in the form of retinol, retinal, retinoic acid or esters in animal sources, while in plant sources (e.g. fruits and vegetables), it is in the form of provitamin A. The conjugated double bonds of carotenoids absorb light and are responsible for the brilliant colours of fruits and vegetables ranging from yellow, orange to red. Moreover, they protect cells from oxidation and cellular damages, contributing to the prevention of major chronic diseases (cancer, cardiovascular and eye diseases). Only the carotenoids that have β-ring end group structure are vitamin A precursors (Fig. 1). In developing countries, the greatest interest on carotenoids is related with pro-vitamin A activity to treat and prevent xerophthalmia, while in developed countries, it is the antioxidant activity to prevent cardiovascular diseases and cancer.

The aim of the present work was to determine the provitamin A activity in traditional foods from Black Sea Area Countries (BSAC) [1].

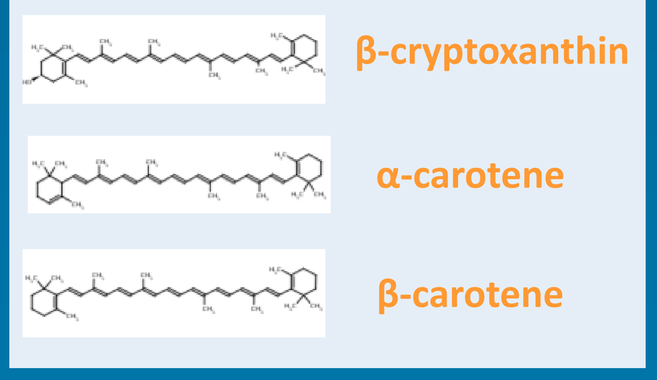

Fig. 1 Chemical structure of carotenoids that contribute for provitamin A activity.

Material and Methods

Extraction of carotenoids

Homogeneized sample
+
$MgCO_3$
+
Hexane/ Methanol 4:3 (v/v)
⇓
5 min in an Ultra Turrax®
⇓
Centrifugation
(5 min at 1500 rpm)
⇓
Re-extraction
⇓
Pool organic phases and evaporate to dryness at 40 °C in a rotary evaporator

Saponification

Extract was redissolved with hexane
+
10 % (w/v) methanolic KOH
⇓
Saponification
(4h at room temperature, protected from light)
⇓
Organic layer washed with distilled H_2O
⇓
Organic extract evaporated
in a rotary evaporator
⇓
Residue dissolved in the organic mobile phase
⇓
Samples were filtered and analysed in the Ultra High Performance Liquid Chromatograph (UHPLC)

Chromatographic conditions

Equipment	ACQUITY™, Ultra Performance Liquid Chromatograph, (Waters) with an auto-sampler binary solvent manager and a PDA detector
Pre-Column	ACQUITY BEH, C18 VanGuard Pre-column (Waters)
Column	ACQUITY UPLC® BEH C18 reverse phase column (Waters)
Column temperature	20 °C
Injection volume	10 µL
Mobile phase	(A) ultrapure water; (B) acetonitrile/ methanol (with 0.05 M ammonium acetate)/ dichloromethane (75:20:5)
Runtime	22 min
λ	450 nm

Results and Discussion

To calculate retinol equivalents (RE) it is assumed that 30% of provitamin A carotenoids are absorbed, 50% are converted into β-carotene and 25% are converted into β-cryptoxanthin and α-carotene. Therefore, 1 RE is equivalent to 1 µg retinol or 6 µg β-carotene or 12 µg of other provitamin A carotenes. Nowadays, vitamin A content is expressed as retinol activity equivalents (RAE) where 1 RAE is equivalent to 1 µg retinol, 2 µg β-carotene dissolved in oil, 12 µg β-carotene or 24 µg of other provitamin A carotenoids.

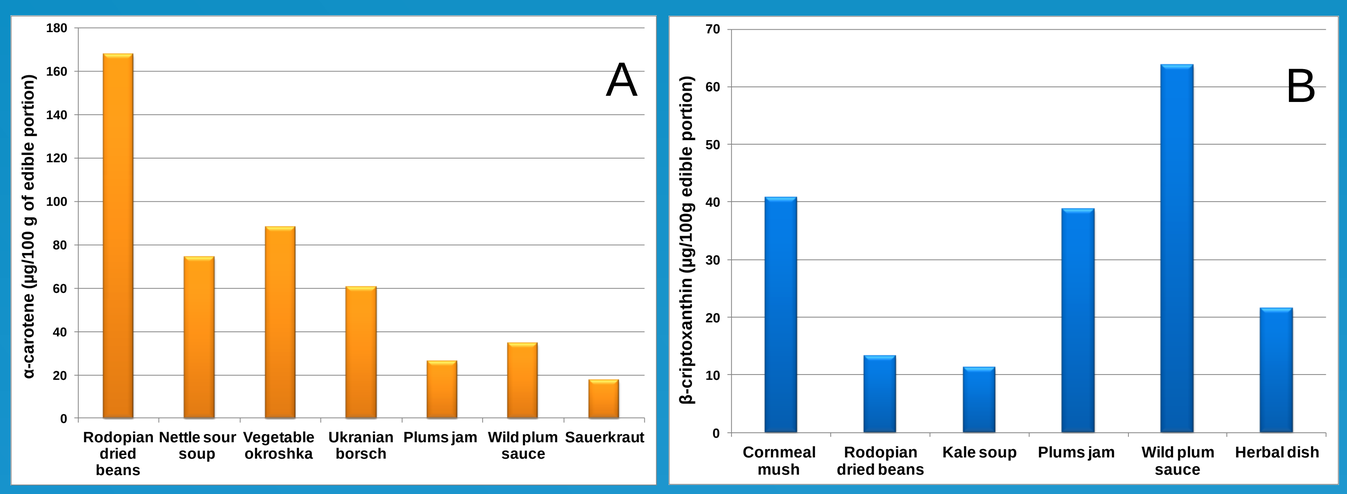

Fig. 2 Carotenoids content (µg/100g edible portion) of the analysed traditional foods in the frame of BaSeFood project that contribute for provitamin A activity: A) α-carotene; B) β-cryptoxanthin; C) β-carotene.

- From the 28 analysed traditional foods for carotenoids content, α-carotene was identified in 11 but only quantified in 7 (Fig. 2A).
- With respect to β-cryptoxanthin (Fig. 2B), this carotenoid was found in 8 samples from the 28 traditional foods from BSAC that were analysed for carotenoids content, but in two samples the content was lower than the limit of quantification.
- β-carotene was quantified in 15 (53.4%) of the analysed traditional foods from BSAC. The sample with highest β-carotene content was plums jam (Fig. 2C).

Table 1. Retinol equivalents (RE), retinol activity equivalents (RAE) per 100 g of edible portion of the selected traditional foods from BSAC.

Traditional foods	Sap.	RE (µg)	RAE (µg)	Traditional foods	Sap.	RE (µg)	RAE (µg)
Baked layers of pastry stuffed with pumpkin	Yes	64.7	32.3	Plums jam	Yes	82.6	41.3
	No	-	-		No	104	52.4
Cornmeal mush	Yes	3.02	1.51	Watermelon juice	Yes	8.11	4.05
	No	3.39	1.7		No	8.12	4.06
Bulgur pilaf	Yes	8.29	4.15	Fruit of the evergreen cherry laurel	Yes	5.75	2.88
	No	-	-		No	4.21	2.10
Rodopian dried beans	Yes	68.8	34.4	Uzvar	Yes	9.99	4.99
	No	32.1	16.0		No	10.3	5.17
Nettle sour soup	Yes	80.9	40.4	Wild plum sauce	Yes	13.8	6.90
	No	35.5	17.8		No	3.22	1.61
Vegetable okroshka	Yes	33.9	16.9	Herbal dish	Yes	50.1	25.1
	No	37.6	18.8		No	15.6	7.82
Kale soup	Yes	90.6	45.3	Sautéed pickled green beans	Yes	17.1	8.55
	No	69.2	34.6		No	5.59	2.79
Ukrainian borsch	Yes	44.5	22.3	Sauerkraut	Yes	6.67	3.34
	No	23.3	11.6		No	10.3	5.16

Sap. - saponification

- From the 28 analysed traditional foods, 12 did not present any RE or RAE. In most of the cases, there was variability on RE or RAE depending on saponification or not of samples (Table 1).
- All the foods of the oilseeds or oilseed products did not present provitamin A activity. The traditional food with highest provitamin A activity was plums jam (Romania), followed by kale soup (Turkey) and nettle sour soup (Romania).

Conclusion

Although a great variability was found in the carotenoids content, some of the analysed traditional foods can be considered excellent sources of provitamin A. Due to the putative health benefits of these compounds, the consumption of those with higher provitamin A activity should be promoted.

Acknowledgements

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References

[1] D'Antuono L.F., Sanches-Silva A., Soares Costa H. (2010). BaSeFood: Sustainable exploitation of bioactive components from the Black Sea Area traditional foods. Nutrition Bulletin, 35, 272-278.