

# Influence of geographical conditions on carotenoid content of Portuguese cabbage

M. Graça Dias <sup>a</sup>, M. Filomena Camões <sup>b</sup>, Luísa Oliveira <sup>a</sup>

<sup>a</sup> Departamento de Alimentação e Nutrição (DAN), Instituto Nacional de Saúde Doutor Ricardo Jorge, I.P.

Av. Padre Cruz, 1649-016 LISBOA – PORTUGAL

<sup>b</sup> CCMM/DQB – Faculdade de Ciências da Universidade de Lisboa, FCUL

Campo Grande, 1749-016 LISBOA - PORTUGAL

e-mail: m.graca.dias@insa.min-saude.pt



## Introduction

Carotenoid content of food plants often varies not only with species and variety but also with natural factors such as light exposition, soil and temperature. The extent of this variation is not established since many non-controllable factors are involved for a long period of time and these factors may affect different plants in different manners.

The positive impact on human health from intake of foods containing carotenoids [1] and the variability of carotenoid content determines the need for their analysis and the inclusion of this information on food composition databases.



## Aims

The objectives of this work were to study the carotenoid content of the variety Portuguese cabbage in three landraces of three country regions and to contribute to the definition of the respective sampling plan.



## Materials and methods

### Samples

Portuguese cabbage (*Brassica oleracea* L. var. *costata* D.C.)



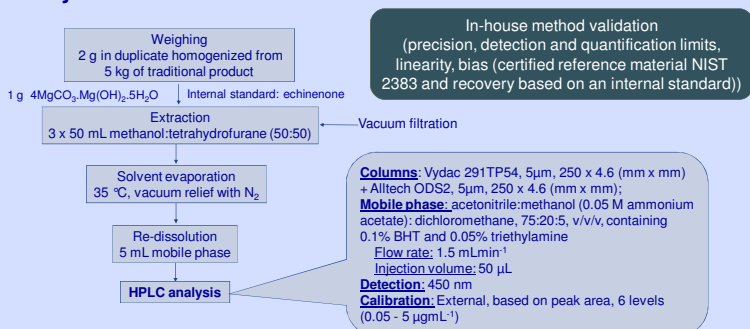
Landraces

*Valhascos* – Ribatejo region (centre)

*Penca* – Minho region (north)

*Glória de Portugal* – Beira Alta region (inland north)

### Analytical method



▪ Analytical measurement uncertainty was estimated based on data from the in-house method validation, using the coverage factor 2 [2].

▪ Between sample variance was compared with the analytical measurement uncertainty through a *F*-test, at a confidence level of 0.05 [3].

▪ Estimation of the sample dimension was based on between sample variance and accuracy [4].

$$n \geq (t_{\alpha, n-1})^2 (\text{between sample variance}) / (\text{estimated mean} \times \text{accuracy})^2$$

where *t* is the *t*-value at a significance level of 0.05



## References

- [1] Cooper, D.A. (2004). *Journal of Nutrition* 134(1), 221S-224S.
- [2] EURACHEM/CITAC Guide CG4 (2000), 2<sup>nd</sup> edition ; www.eurachem.ul.pt.
- [3] Dias, M.G., Camões, M.F., Oliveira, L. (2009). *Food Chemistry* 113, 808-815.
- [4] Miller, J. C., & Miller, J. N. (1993). (3rd ed.). Ellis Harwood L.



## Results and discussion

### In-house method validation

The analytical method is unbiased, based both on reference material analysis and on recovery studies, (*z*-score for the analysis of the standard reference material between -1.5 and +0.1; mean recovery 93.7%, not statistically different from 100%, confidence level 0.05).

### Carotenoid content

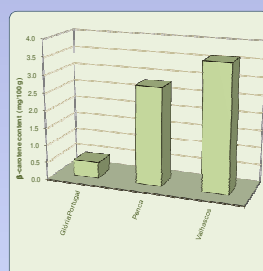


Fig. 1 – β-carotene in three Portuguese cabbage landraces (harvested in December)

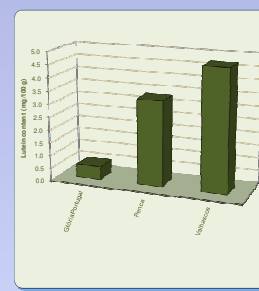


Fig. 2 – Lutein in three Portuguese cabbage landraces (harvested in December)

From the carotenoids analysed (α-carotene, β-carotene, β-cryptoxanthin, lycopene, lutein and zeaxanthin), Portuguese cabbage contains lutein and β-carotene.

### Analytical relative standard measurement uncertainties

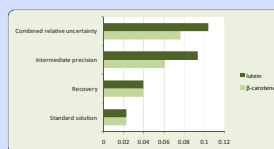


Fig. 3 – Analytical relative standard measurement uncertainty for carotenoids in cabbage

Relative analytical measurement uncertainty was 0.19 and 0.21, respectively, for lutein and β-carotene. At a significance level of 5%, *Valhascos* and *penca* landraces did not present statistically significant differences. However, *glória de Portugal* landrace was statistically different from the last two.

### Sample dimension

*Valhascos* landrace presented a higher carotenoid content than *penca* landrace; however the difference was not statistically significant considering measurement uncertainty. *Glória de Portugal* landrace it was statistically different from the last two.

The sample dimension to obtain a sample mean value with 20% accuracy, for the group *Valhascos* and *penca* is 5 for β-carotene and 11 for lutein; according to resources available the analysis of composite samples may be needed.



## Conclusions

❖ The analysed Portuguese cabbages are very good sources of lutein and β-carotene, therefore its consumption presents health benefits.

❖ The results show that carotenoid content of Portuguese cabbage varies with the geographical region of production easily overshadowing contributions from the analytical process. That factor should be addressed in the production of data for Food Composition Data Bases.

❖ Based on this study, for the group of *Valhascos* and *penca*, and for the predominant carotenoid, lutein, 11 primary samples are necessary to estimate the population's mean value, with a 0.05 confidence level and 20% accuracy; according to resources available the analysis of composite samples may be needed.