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Are there significant differences in the quality of “organic” and “conventional” vegetable?

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Abstract

The work assesses the quality of "organic" and "conventionally" grown vegetable based on content of nutrition elements and contaminants (Na, K, Mg, Ca, P, S, B, Al, Mn, Zn, Fe, Cu, Cr, Ni, Pb, Cd, As, Hg, nitrates) for 218 samples of "conventional" and "organic" carrots. Chemical results obtained were analysed using multivariate statistical methods (PCA) and no significant differences were found. The opinion that “organic” products are in terms of nutritional content and contaminants better than “conventional” products was not confirmed.

Introduction

In recent years, a demand for ecologically grown products has steadily increased together with concern about food quality, especially regarding how, when and where the foods are produced. The term “organic” is sometimes wrongly interpreted such as “ecological”, “green”, “natural” or “sustainable”. One of the aspects of organic production which separates it from others alternative agricultural ways, is that it has a history of regulation. Conventional vegetable farming involves repeated tillage, frequent exposure of soil rainfall and excessive use of fertilisers, pesticides and irrigation water. These practises can result in severe damage to soil structure, soil erosion, reduced soil fertility and the loss of fertilisers and other chemicals from increased runoff and leaching [1]. Carrot is one of the most frequently consumed vegetable rich in nutrients and vitamins. Many authors dealt with analysis of organically and conventionally grown carrots from various points of view: sensory properties [2], vitamin and mineral contents [3], nitrate [4], influence of soil types [5]. This work evaluates “organic”, “conventional” and “self-grown” carrots and attempts to give a view if it makes sense to buy or not buy “organic” vegetable from the consumer´s point of view. Evaluated parameters were: dry mass, nitrates, micro- and macro- nutrients content and contaminants content (Na, K, Mg, Ca, P, S, B, Al, Mn, Zn, Fe, Cu, Cr, Ni, Pb, Cd, As, Hg). There were not considered aspects, such as soil type, in which carrots grows, irrigation, storage and so on, because these facts also are not known to consumers.

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Materials & Methods

Carrot samples were collected during one year and were purchased in stores in (71 “conventional”, 71 “organic”) and obtained from private growers (76 “self-grown”) from different areas in Czech Republic. Samples were washed out and grated with a ceramic grater and a dry matter was determined (105 °C, 48 hours). The determination of nitrates was carried out using the Flow inject analyser (MLE, Germany) in aqueous extracts (10 g of grated sample leached with 10 ml demineralized water). Hg was analysed using the Mercury analyser AMA 254 (Altech, Czech Republic). For elemental analysis, grated samples (0,2 g) were decomposed (in 3 replicates) using microwave digestion unit (Speedwave MWS-2, Berghof, Germany) with 6 ml of 65% (w/v) HNO_3 and 1 ml of 35% (w/v) H_2O_2); the final volume 50 ml. The ICP-OES spectrometer (Integra XL 2, GBC, Australia) was employed for analysis of S, P, Ca, K, Mg, Na, B, Zn, Mn, Fe, Cr, Ni, Al and Cu, the oTOF-ICP-MS spectrometer (Optimass 8000, GBC, Australia) for Ni, Cr, Pb, Cd, As. For quality assurance of the analytical procedures, standard additions were employed in the same experimental conditions and following the same protocol. All measurements were run in triplicate and the average taken. The recoveries for standard addition procedures were from 94 to 103 %.

Results

In all samples was Na from not detected (ND) to 2000, K 1500-110000, Mg 49-310, Ca 220-970, P 160-1200, S 23-410, B ND-7,3, Al ND-200, Mn ND-9,4, Zn ND-22, Fe 0,14-71, Cu ND-5,3, Cr ND-40, Ni ND-46, Pb ND-16, Cd ND-0,39, As ND-1,7, Hg ND-0,0031, nitrates ND-6030, all in $mg.kg^{-1}$, and dry matter 6,6-20,3 %. Recommended daily intakes are given for K 200, Mg 375, Ca 800, P 700, Fe 14, Mn 2, Zn 10, Cu 1 and Cr 0,04, all in $mg.kg^{-1}$. Contaminants in food are restricted by a national regulation: Fe 50, Zn 25, Cu 10, Ni 2,5, Cr 0,2, Pb 0,1, As, 0,5, Cd 0,1, Hg 0,03, nitrates 700, all in $mg.kg^{-1}$. From the nutritional point of view, carrot is a very good source of potassium regardless the origin. On the other hand, there were samples over limits in all origin groups. Nitrates, Fe, As, Cd, and Hg exceeded limits rarely. Ni, Cr and Pb often and it is necessary to admit that samples could be contaminated during decomposition although sample blanks did not indicate it.

Multivariate statistical analysis (PCA) was used to evaluate of the whole data set (Fig. 1a). Even though a wide diverse “self-grown” samples were excluded (Fig. 1b) or if we focused on chosen parameters (statistically significant parameters, contaminants, nutrients, etc.), differences were not found. A very likely reason for not dividing of “conventional” and “organic” samples according to the way of farming can be influence of chemical composition of soil where carrots were grown. This was not taken into the account in the study. A spatial distribution inhomogeneity of elements in carrot roots can mask differences given by growing procedure as well.

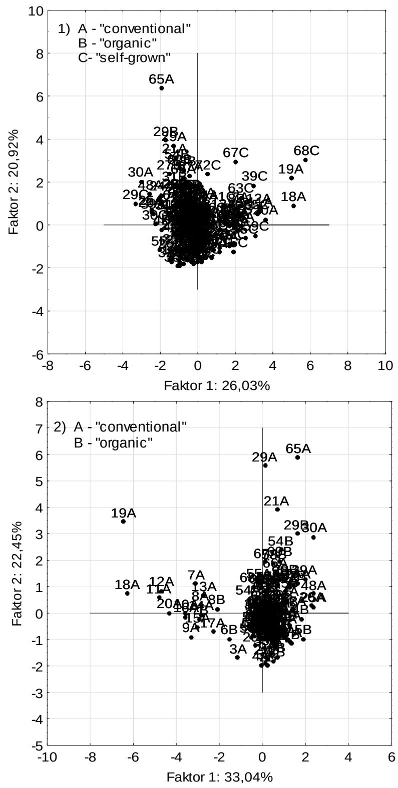

Fig. 1; Results for PCA of the whole data set (a – “conventional”, “organic” and “self-grown”) and the data set without “self-grown” samples (b – only “conventional” and “organic”)

Conclusions

Obtained results were compared with available information about elemental composition of carrots, recommended daily intakes and limits for contaminants in food. From the statistical evaluation of the data set, no significant differences were found between "conventionally" and "organic" carrots, so, the opinion that “organic” products are in terms of nutritional content and contaminants better than “conventional” products was not confirmed. Probably a soil type, an aspect not considered in the study, plays more important role in the elemental composition of carrot than a way of farming. As one of the concepts of sustainable development, it is important to point out that organic farming is ethically and technically friendly to the environment.

References

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