Lucrări ştiinţifice **Zootehnie şi Biotehnologii**, vol. **41 (1)** (**2008**), Timişoara

DETERMINATION OF THE CAROTENOIDIC COMPOUNDS FROM POTATO TUBERS (*SOLANUM TUBEROSUM*)

DETERMINAREA COMPUŞILOR CAROTENOIDICI DIN TUBERCULII DE CARTOFI (*SOLANUM TUBEROSUM*)

IANCULOV I.*, DUMBRAVĂ DELIA**, WIDMANN NORGIA*,
GOIAN M.*, MOLDOVAN CAMELIA**
** Faculty of Agriculture, Timişoara, România*
*** Faculty of Agrofood Products Technology, Timişoara, România*

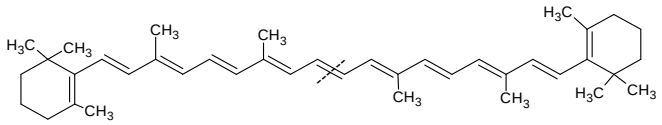
Determinations concerning the carotenoidic compounds content was achieved on four potato varieties (Hansa, Sieglinde, Nicola and Linda) obtained from a German private sources, country were this potato varieties are frequently cultivated and consumed. The potatoes were cultivated both in the classical and biodynamic conditions. For the carotenoids extraction was used an 80% acetone water solution, and for the quantitative determination was used a colorimetric method based on the specific absorption of this compounds at different wavelength. The results interpretation was achieved with the aid of some calculus relations.

Key words: potatoes, carotenoidic compounds, colorimetric method, biodynamic methods

Introduction

The carotenoidic compounds are widely spread in nature, having a very important biochemical and physiological role: take parts to numerous metabolic processes, form oxidation-reducing systems, give the taste, flavor and color of some food products. Carotenoids are the most spread natural pigments from the vegetable kingdom. Due to the molecular conjugated double bonds they confer to the tissues a yellow, orange, red or even blue color.

These pigments take parts from the terpenes class, being formed from more isoprenoidic units. The most important carotenoidic compound is the β-carotene, that have an 11 conjugated double bonds chain and, at the both ends, a β-iononic cycle:



β-carotene

Characteristic for β-carotene structure is the perfectly symmetrical molecule given to a plan tracing exactly on the middle of this: the isoprenic radicals had-end

still are inverted from the middle of molecule. β-Carotene is A vitamin precursor, since through molecule scission in two parts, exactly on their middle, are formed two A vitamin molecules. In nature the β-carotene is predominant. Besides β-carotene, in nature are frequently meet the α- and γ-carotene.

α-Carotene have the β-iononic cycle, respectively the α-iononic cycle at the two ends of the molecule chain. Thus the α-carotene have in their molecule 10 conjugated double bonds and a isolated double bond. Through the α-carotene molecule scindation at their middle results a single A vitamin molecule. Identically take place the thinks in the γ-carotene molecule case. Therefore, 1 mg of β-carotene showed potentially a vitamin activity of two times higher than that 1 mg of α- or γ-carotene.

In the some carotenoidic compounds build are present different functional groups: hydroxyl, aldehyde, cetone, epoxide, carboxylic.

Carotenoids have a lot of utilizations in the pharmaceutical, cosmetics and food industries, in medicine, animal breeding and agriculture. They have a efficiently therapeutic action in the wounds cure, increase the toxins body resistance and have an anticarcinogenic action. The carotenoidic compounds have protective effects against cancer to smokers. The provitaminic carotenoids are essentials for the eyesight mechanism [Ciorănescu et al., 1986; Goodwin, 1980].

Materials and Methods

For the experiments achievement was used following four potato varieties, obtained from a German private sours, country were this potato varieties are frequently cultivated and consumed:

- *Hansa* - ovoid form, shiny yellow peel, yellow pulp resistant to depositing;
- *Sieglinde* - long ovoid tubers, in the kidney form, shiny yellow peel, yellow pulp;
- *Nicola* – lengthened ovoid form, dark- yellow pulp, high water content, fine aroma;
- *Linda* – oval - lengthened tubers form, dark- yellow pulp, and fine aroma.

The potatoes crop was achieved in Schőngeising, Germany, at 25- 30 km from Műnchen, on an experimental ground with a 100 m^2 area, brown soil, with pH of 5.5- 6.7, with a high phosphorus and potassium content and low magnesium content. Potatoes were seeded in 2005 year, April second decade, and the tubers were harvest in the September first decade. The atmospheric conditions were unfavorable for the potatoes production: warm and dry weather almost on the all vegetation period.

In this purpose was used both the classical and biodynamical crop methods.

In the *classical conditions* was used following chemical fertilizers from "*Lebosol*" company, Germany:

- ***Aminosol***, 9% solution of organic bounded nitrogen fertilizers, the nourishing substance being the aminic acids;

- ***Magphos***, that contain 30% P_2O_5, 3% N and 7% MgO, the nourishing substance being phosphorus;
- ***Kalium*** ^{450}, that contain 3% N and 31% K_2O.

These solutions were blended in 1:5:1 proportion, being applied in 0.05 l on classical conditions crop potatoes area.

The *biodynamic preparations* used for potato crop were following [Steiner, 1977; Sattler, 2005]:

- ***the 500 preparation*** obtained by introduction of the cow manure in an cow horn that gave birth to 3 calfs; in 3 September 2005, this cow horn was buried at approximate 50 cm and draw out on 28 February 2006; the horn dung was blended with 12 l of rain water;
- ***the wheat straw compost***, blended with vegetal mass (leaves, weeds, young branches); the fermentation period of this biodynamic preparation was 4 weeks, after which was blended with a small quantity of rain water.

The two biodynamic preparations were then blended and spread over experimental ground immediately after ploughing.

The method used for carotenoids extraction is based on their solubility in organic solvents. The better extraction solvent was proved to be an aqueous acetone 80% solution (v/v), in which was added 2 mg of magnesium carbonate and 1 mg of sodium bisulphate at 1g of vegetal material [Arnon, 1949; Edwards and colab.; McKinney, 1941].

For the quantitative determination, was used a colorimetric method, based on the specific absorption of this compounds at three different wavelengths: 480 nm, 645 nm and 663 nm. The results interpretation is made using the following relation [Hendry and Price, 1993]:

$$Crt = \frac{[(A_{480} + 0.114A_{663} - 0.638A_{645})xvx1000]}{112.5}$$

where: - Crt = total carotenoidic compounds content, in mg / l;
- A_{480} = sample absorbance at 480 nm;
- A_{645} = sample absorbance at 645 nm;
- A_{663} = sample absorbance at 663 nm;
- v = extractive solution volume, in ml.

Results and Discussions

All determination concerning the carotenoidic compounds content of the four studied potatoes varieties (*Hansa*, *Sieglinde*, *Nicola* and *Linda*) were achieved comparatively, both for the classical and biodynamical conditions. All results are reported to dry vegetal material.

The obtained results are presents in the table 1.

Concerning the carotenoidic compounds content, for the potatoes tilled in ***classical conditions***, the obtained values are between 0.53- 0.93 μ mol/g and are frame in the values domain specified by the studied literature, for other potatoes varieties [Lachman et al., 2001; Maga, 1994; Duke, 1992a; Duke, 1992b].

Table 1

Carotenoidic pigments content (μmoli/g) of potato tubers under classical and biodynamical crop conditions

Potato varieties	**Carotenoids content, μmoli/g**	
	Classical	**Biodynamical**
Hansa	0,93	0,98
Sieglinde	0,69	0,79
Nicola	0,53	0,59
Linda	0,78	0,92

Through the obtained values, the Hansa, Sieglinde, Nicola and Linda potato tubers varieties could be used effectively in the food industry.

Concerning the ***potatoes tilled by biodynamic agriculture methods***, it could be observed a significant increase of the carotenoids content, the obtained values being higher with 5-20%. This thing could be explained by the fact that through biodynamical preparations utilization were removed the harmful factors from the modern agriculture and was achieved a live soil, with an energetic and protective surplus, in truly naturals conditions, in which it could develop sound potatoes, with a high vitality, unlike the potatoes tilled in chemical conditions. These potatoes become more resisting to pests and depositing.

Through biodynamical tilled potatoes it achieved more healthy food products, that will contributed to human life unfolding in normal conditions, in accordance with the present and future requirements. This foods transmits to consumers more vitality and the possibility to recognize the unimaginable benefic vibrational- energetics dimension that exists in the properly natural nutrients [Steiner, 1977; Sattler, 2003; Sattler, 2005].

Conclusions

The conclusion that results following the researches is that the chemical fertilizers applied for increasing potatoes production, from ecological point of view, represents a risk, because they penetrate the potatoes tissues, disturb their metabolism and modify the tubers chemical composition, decreasing the active principles content of this.

Many researches considers the modern agriculture "*a traditional agriculture*" that must be substituted, because by using of fertilizers and phyto-pharmaceutical substances in great quantities, the food products quality decrease and increase the human and animal illness percent. Deficiency of more and more greater utilization of the fertilizers and phyto- pharmaceutical substances consists in soil erosion acceleration, increase of the illness and pests number, decrease of the plants and animals physiological resistance, high animals sterility, decrease of foods quality as a result of some harmful substances content growth.

The "*traditional agriculture*" drawbacks, could be removed by utilization of a "*biodynamical agriculture"* for plants crops. Through biodynamical agriculture

the soil structure is recovered, that confer to plants and animals an increased vitality. This agriculture secret consists in the farmer wisdom concerning the administration of all preparative steps for soil, compost, seeds and the natural plants biodynamical preparations. In the biodynamical agriculture, by the way in which are achieved the works, it could be follow and condition that the plant develop healthy and to overtake to obtain of healthiest food products.

The biodynamical agriculture benefits were showed in this work through tillage of some potato varieties in biodynamical conditions, by administration in ground, in homeopathic doses, both biodynamic preparations and compost and manure (from vegetal and animal remainders) for soil re-mineralization and achievement of a live soil, with an energetic and protective surplus. The biodynamical conditions tilled potato tubers showed higher values concerning the active principles and energetic value. These potatoes are capable to resist at different stress conditions, comparative with the classical tilled potatoes.

All of this lead to hope that, in the future, this agricultural practice will take in the world new and important dimensions, that the biodynamical agriculture become truly rescuer for the 21th Century humanity.

Bibliography

1. **Ciorănescu E.** (1986) - *Enciclopedia de Chimie*, vol.3; Ed. Ştiinţifică şi Enciclopedică, Bucureşti, 162-165.
2. **Goodwin T. W.** (1980) - *The Biochemistry of the Carotenoids*, Ed. Chapman and Hall, London, 84-108.
3. **Steiner R**. (1977) - *Bazele spiritual-ştiinţifice pentru prospectarea agriculturii*, Ed. Triada, 71-143.
4. **Sattler R.** (2003)- *Ferma biodinamică*, Ed. Wisinghausen, 18-24.
5. **Sattler R.** (2005) - *Hrană vie din agricultura biodinamică*, Ed. Wisinghausen, 18-30.
6. **Arnon D. I.;** (1949) - *Copper enzymes in isolated chloroplasts*, Plant Physiol, **24**, 1-17.
7. **Edwards E.J., R.E., Saint, A.H., Cobb** (1998) - *Is There a Link Between Greening and Ligth- Enhanced Glycoalkaloid Accumulation in Potato (Solanum tuberosum L) Tubers*, J. Sci. Food Agric, **76**, 327-333.
8. **MacKnney G.** (1941)- *Absorbtion of light by chlorophyll solution*, J. Biol. Chem, **144**, 315-323.
9. **Hendry G.A.F., A.H., Price** (1993) - *Methods of Comparative Study*, Ed. Chapman and Hall, London, 148-152.
10. **Lachman J., K., Hamonz, M., Orsák, V., Pivec** (2001) - *Potato Glycoalkaloids and their significance in plant protection and human nutritione*, Series Rostlinná Výroba, **47** (4), 181-191.
11. **Maga J. A.** (1994) - *Glycoalkaloids in Solanaceae*, Food Rev. Int., **10**, 385-418.
12. **Duke J. A.** (1992a)- *Handbook of biologically active phytochemicals and their activities*, Ed. CRC Press Inc, Boca Raton FL, 471-478.
13. **Duke J. A.** (1992b) - Handbook of phytochemical constituents of grass herbs and other economic plants, Ed. CRC Press Inc, Boca Raton, FL, 163-165.