THE CONTENTS VARIATIONS OF THE CAROTENOID PIGMENTS AND TOTAL LIPIDS IN SEABUCKTHORN FALSE FRUIT AND FRUIT

NICOLETA BĂDĂLUŢĂ[1], ZENOVIA OLTEANU[2], LĂCRĂMIOARA OPRICĂ[2], GOGU GHIORGHIŢĂ[1]

Keywords: *Hippophae rhamnoides*, carotenoid pigments, total lipids.

Abstract: In this study we present the biosynthesis of carotenoid pigments and total lipids from the seabuckthorn "fruit" and "seeds" harvested from the spontaneous flora in 2009 year. The amount of total lipids was determined by the gravimetric method and the content of carotenoids by the spectrophotometric method.

After the analysis performed on the biotypes of seabuckthorn collected spontaneously, the carotenoid pigments values are according with the data from literature. The total lipids content is different depending on the nature of the analyzed material and the abiotic conditions of the ecosystem from which plants were harvested.

INTRODUCTION

The seabuckthorn (*Hippophae rhamnoides* L.) represents a valuable biological material in terms of medical, nutritional and influencing the microenvironment. The chemical complex composition of the sea buckthorn fruits depends on many factors.

The complex chemical structure of the seabuckthorn varies with the origin, environmental conditions and extraction methods used. In general, *Hippophae rhamnoides* contains vitamin C, minerals, monoglucids, organic acids, amino acids, large amounts of carotenoid pigments and vitamin E, various volatile compounds, fat acids, triacilglicerol, glicerofosfolipides, phytosterol esters of zeaxanthin, α- tocopherol, phenolic compounds etc. In assessing the qualitative and quantitative composition of the seabuckthorn are taken into consideration the geographical area of habitat, development within specific genetic characteristics of plant, soil structure, climatic conditions and other factors difficult to predict and record (Kaminskas et al., 2006).

The carotenoid pigments involved in the photosynthesis process, having both role in absorbing the light energy and the protection from self destruction of the chlorophylls or other bioactive substances (cytochrome, peroxidase, catalase, flavonoid pigments, vitamin B12, vitamin E, vitamin K etc.). Because they can fix the oxygen, forming less stable oxygenate compounds, the carotenoid pigments appear in the processes of oxidoreduction. They also can form intermediate metabolites with a stimulative or inhibiting role in the plant evolution.

From the approximately 600 known carotenoid pigments, 39 were identified in the "fruit" of the seabuckthorn where the most important quantities are α-carotene, β-carotene, lycopene and zeaxanthin. The carotenoid pigment content in the "fruit" of fresh seabuckthorn ranges between 1mg/100g and 120mg/100g. The largest amount of carotenoids was found in the shell, followed by pulp and the smallest amount was detected in "seed” (Yang and Kallio, 2007).

The seabuckthorn "fruit" have colours ranging from yellow to red shades. The "fruit" colour is connected with the content of the carotenoid pigments. Thus, the highest carotene content was recorded in the seabuckthorn oil extracted from the red "fruit" (872mg/100g ÷ 1270mg/100g), followed by the orange-red "fruit" (487mg/100g ÷ 1240mg/100g), the "orange fruit" (425mg/100g ÷1250 mg/100g) and yellow the "fruit" (360mg/100g ÷ 571mg/100g) (Singh, 2007).

The carotenoid pigments have an antioxidant role, normalize the metabolism, regenerate tissues, accelerate epithelization processes, have anticancer properties etc.

The carotenes are accumulated in the sea buckthorn "fruit" in direct light conditions, high air temperature, relatively low precipitation, low air humidity, conditions met especially in May, June and partly July. The optimal time to harvest the "fruit" to get a maximum carotene content is November, before the first frost (Novruzov, 2007).

The traditional use of the sea buckthorn oil for healing skin diseases (eczema, burns, skin suffering due to the effects of sun radiation, radiation therapy, cosmetic interventions with laser etc.) and membranes diseases is in according with modern clinical studies that consider the importance of medicinal classifications of *Hippophae*.

The seabuckthorn oil contains carotenoid pigments, fat acids, phospholipids, tocopherols and sterols. The fresh false fruit of seabuckthorn contain oil on average from 1,4% to 13,7%. In the yellow and the yellow-orange false fruit was determined a higher oil content compared to the orange and the orange-reddish false fruit (Bekker *et al*., 2007). The amount of oil varies between 10% ÷ 15% in the "fruit", and between 29% ÷ 48% in "the seed". The application of inorganic fertilizer in spring increases the oil content and decreases the carotenoids concentration in seabuckthorn oil. Most often, the oil content in the dry pulp is 10% but the highest amounts were determined at the *turkestanica* and *caucasica* subspecies (30% ÷ 39%) and a minimum 4% ÷ 12% at the *sinensis* subspecies.

The researches showed that the seabuckthorn oil stored 360 days at temperatures between 0°C and -20°C did not significantly alter their chemical composition. The oil stored at -20°C contained more linoleic acid than that stored at 0°C (Kaminskas et al., 2006).

MATERIAL AND METHODS

The analysed plant material is represented by the seabuckthorn "fruit" and the "seeds" from 17 biotypes of which:

- 13 biotypes harvested from the spontaneous flora in mid-October 2009, from Bacău county, villages: Buhoci (Coteni 1, Coteni 2, Coteni 3, Coteni 4, Coteni 5), Letea (Letea 1, Letea 2, Letea 3, Letea 4, Letea 5, Letea 6), Ungureni (Viforeni), Balcani (Schitu-Frumoasa);
- 4 biotypes from spontaneous flora, grown on the field of S.C. FRUTEX S.A. Bacău (Roşu Albastru, Vibratina, Delta 60M, Coteni).

The fruit, randomized harvested at biological maturity on the shoots were processed to determine the biochemical indicators. In order to dose the carotenoid pigments we used the soft parts of the "fruit", namely the shell and the pulp, and for determining the content for total lipids we used "fruit" and "seeds".

The amount of total lipids is determined by the Soxhlet gravimetric method which consists, in principle, in the total lipid extraction from the analyzed material, in warm conditions, with specific organic solvents. The total lipids are calculated according to the weight of the degreased test and the results are expressed as g/100g dry biological material (Artenie et Tănase, 1981). The most efficient extraction is achieved with light petroleum (Cenkowski et al., 2006).

The carotene content is determined by the spectrophotometric method. In principle, the plant material crumbles with a mixture of reactive dyes which hold the coloured substances except the carotenes and which prevent the decomposition of the carotenes. The carotenes are extracted with acetone and petroleum ether from the homogenate mixture. From the resulted extract the analyzed pigments are determined spectrophotometrically.

RESULTS AND DISCUSSIONS

The analysis of the results regarding the carotenoid pigments content shows a variability of the values determined by the analyzed biotype. Presented graphically, the values records a maximum in the noted conventional Letea biotype 5 (24.31mg %) and a minimum at Coteni biotype 2 (5.79mg %) (Fig. 1).

The literature refers to the case of the species *Hippophae rhamnoides* L. as having carotenoid containing pigments (β-carotene) in the false fruit of approximately 7,5mg/100g fresh material (Brad et al., 1970), values which according to other authors may range from 3,5mg/100 g and 10mg/100g (Pârvu, 2002). In the case of the analyses made by us, we believe that the biotypes are divided into four groups according to the ability to biosynthesised carotenoid pigments:

- the biotypes Red Light, Coteni 1 Coteni 2, Letea 2 and Viforeni containing carotenoid pigments at around 7,5mg/100g;
- the biotypes Red Light, Vibratina and Letea 4 containing carotenoid pigments at around 11mg/100g;
- the biotypes Delta 60M, Coteni, Coteni 3 Coteni 5, Letea 1 Letea 3 Letea 6 and Schitu-Frumoasa containing carotenoid pigments at around 16mg/100g;
- the biotypes Letea 4 and Letea 5, Coteni containing carotenoid pigments at around 23mg/100g.

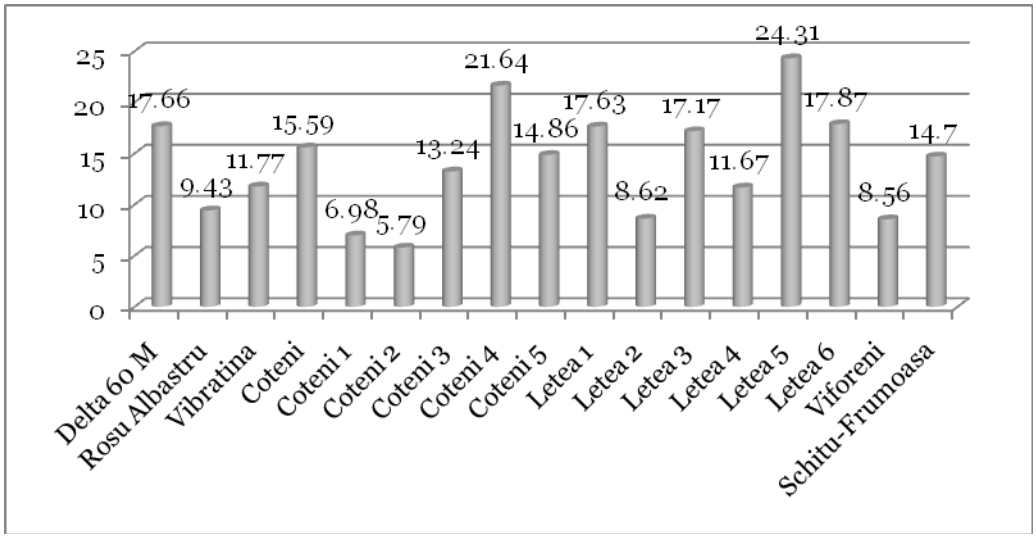

Fig. 1. The variation of the carotene pigment content at the seabuckthorn "fruit" harvested from the spontaneous flora biotypes

The seabuckthorn contains considerable amounts of lipids both in the the false fruit and in the fruit itself. The resulted biological material, after determining the amount of dry substance, grounded to obtain a fine powder, is used to determine the total content of lipids.

The amount of total lipids from the seabuckthorn "fruit" derived from the extraction with ether oil is between 26,31g/100g and 53.44g/100g dry matter.

The largest amount of total lipids was found in the "fruit" of Letea 1 biotype. Also, high values appeared at the biotypes Coteni 449,51g/100g dry matter), Letea 5 (49,21g/100g dry matter) and Letea 6 (49,86g/100g dry matter). The smallest amount of total lipids was noticed at the seabuckthorn "fruit" of the biotype Delta 60M (26,31g/100g dry matter) (Fig. 2).

Delta 60M biotype, harvested from S.C. FRUCTEX S.A., showed low values for both biochemical parameters analyzed at the seabuckthorn "fruit" .

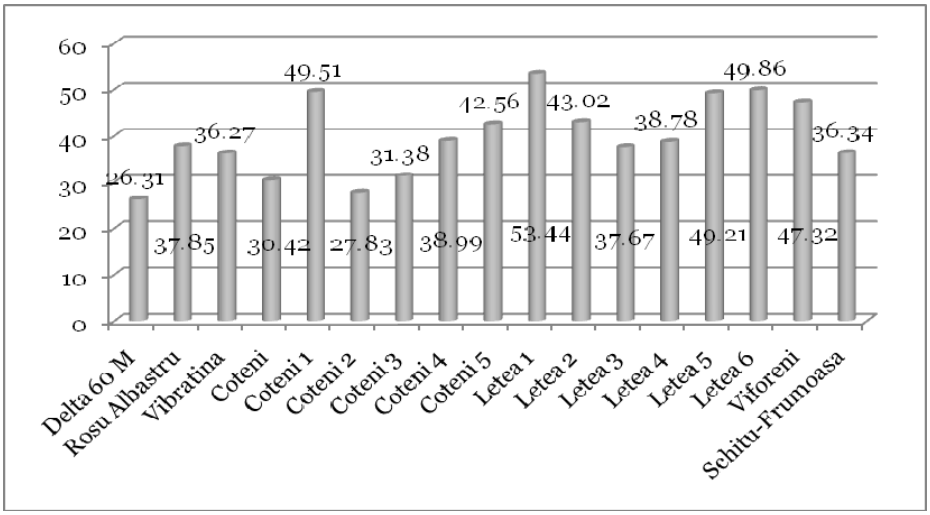

Fig. 2. The variation of the lipids content at the false seabuckthorn "fruit" harvested from spontaneous flora biotypes

The "seeds" of the seabuckthorn alo presents rich lipid content. The highest total lipid content of 53,76g/100g dry matter was determined at the biotype Schitu-Frumoasa and the lowest content of 19,95g/100g dry matter at the "seeds" from the biotype Coteni (Fig. 3).

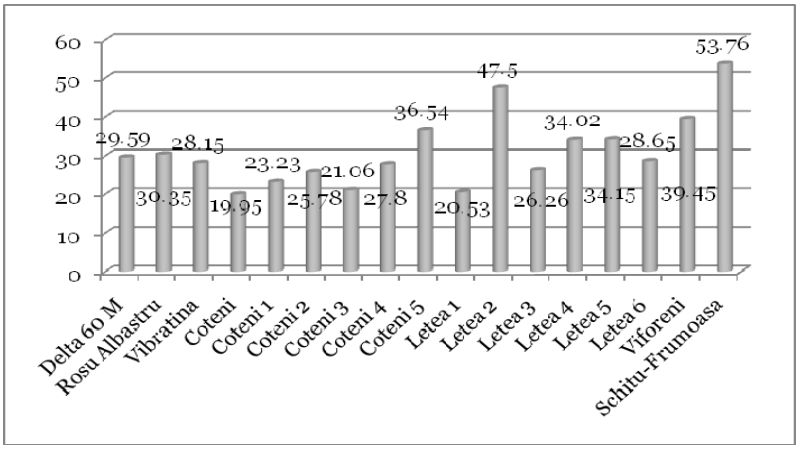

Fig. 3. The variation of the lipids content at the seabuckthorn "fruit" of harvested from spontaneous flora biotypes

As an average, the amount of lipids from the seabuckthorn "seeds" is located around 25g/100g dry matter.

CONCLUSIONS

The literature mentions amounts of carotenoid pigments in the fresh seabuckthorn "fruit" that vary between 1mg/100g and 120mg/100g and oil amounts that vary between 10% ÷ 15% in the "fruit" and 29% ÷ 48% in the "seed".

Following the analysis performed on the biotypes of seabuckthorn harvested spontaneously, the values of the carotenoid pigments content are according with the data from literature. The total lipid content is different depending on the nature of the analyzed biological material and the abiotic conditions of the ecosystem from which plants were harvested.

The largest amount of carotenoids was found at the biotype Letea (24,31mg%), and the smallest quantity at the biotype Coteni 2 (5,79mg%).

The amount of total lipids from the seabuckthorn "fruit" derived from the extraction with ether oil is between 26,31g/100g and 53,44g/100g dry matter. The largest amount of total lipids was discovered in the "fruits" of the biotype Letea 1, and the smallest amount in the "fruits" of the Delta 60M biotype (26,31g/100g dry matter).

The highest total lipid content of 53,76g/100g dry matter was determined at the Schitu-Frumoasa biotype "seed" and the lowest content of 19,95g/100g dry matter at the Coteni biotype "seeds".

The high values obtained for the two analyzed biochemical parameters, indicating a good exposition of the "fruit" to direct light, warm summer months (the year 2009 was a torrid year) with relatively low precipitation.

REFERENCES

Artenie, V., Elvira Tănase, 1981. *Practicum de biochimie generală*, Ed. Universităţii “Alexandru Ioan Cuza”, Iaşi.
Bereşiu I., Bendorf F., Frumuşelu L., 1983. *Materii prime vegetale pentru prelucrarea industrială şi casnică*, Ed. Ceres, Bucureşti.
Cenkowski, S., Yakimishen, R., Przybylski, R., Muir, W.E., 2006. *Canadian Biosystems Engineering*, 48(3) 9-16.
Hager A, Meyer-Bertenrath T., 1966., *Planta*, 69, 198-217.
Kaminskas A., Briedis V., Budrioniene R., Hendrixon V., Petraitis, R., Kučinskiene Z., 2006. *Biologija*, 2, 39-41
Novruzov E., 2007. *Seabuckthorn (Hippophae L.) a Multipurpose Wonder Plant, vol. II: Biochemistry and Pharmacology*, Daya Publishing House, Delhi.
Pârvu C., 2002. *Enciclopedia plantelor*. vol. I, Ed. Tehnică, Bucreşti.
Rongsen L., 2007. *Seabuckthorn (Hippophae L.) a Multipurpose Wonder Plant, vol. II: Biochemistry and Pharmacology*, Daya Publishing House, Delhi.
Singh V., 2007. *Seabuckthorn (Hippophae L.) a Multipurpose Wonder Plant, vol. II: Biochemistry and Pharmacology*, Daya Publishing House.
Yang B., Kallio H., 2007. *Seabuckthorn (Hippophae L.) a Multipurpose Wonder Plant, vol. II: Biochemistry and Pharmacology*, Daya Publishing House, Delhi.
Yang B., Kallio H., 2007. *Seabuckthorn (Hippophae L.) a Multipurpose Wonder Plant, vol. II: Biochemistry and Pharmacology*, Daya Publishing House, Delhi.

1 - „Vasile Alecsandri” University, Faculty of Science, Biology Department, Calea Mărăşeşti no. 57, Bacău.
2 - „Alexandru Ioan Cuza” University, Faculty of Biology, B-dul Carol I, 20 A, 700505, Iasi.
*nicoletadogaru@yahoo.com