9. SPETA F., 1960, Stapfia, 7, 1-72.
10. SZABÓ T.A., 1979, Not.bot.hort.agrobot.Cluj., X, 89-99; 1981, Idem, XI, 61-68.
11. VICKERY R.K., 1972, Range of climatic tolerance as an indication of evolutionary potential in Mimulus (Scrophulariaceae).Symp. Biol.Hung., 12, 31-42.

INSTITUTUM AGRONOMICUM "DR.PETRU GROZA" CLUJ-NAPOCA (ROMANIA)
NOTULAE BOTANICAE HORTI AGROBOTANICI 1983, XIII.

CAROTENOID PIGMENTS IN THE FUNGUS OF COLTSFOOT (COLEOSPORIUM TUSSILAGINIS)

G.NEAMȚU, Gh.ILLYÉS, Maria OȚOIU

Abstract: NEAMȚU G., ILLYÉS GH., OȚOIU M. 1983. Carotenoid pigments in the Fungus of Coltsfoot (Coleosporium tussilaginis) Not. bot.hort.agrobot.,Cluj, XIII, 45-49. Investigations were carried out on the carotenoid pigments in the fruiting bodies of the parasitic fungus Coleosporium tussilaginis (Pers.) Kleb., harvested in autumn from the lower side of the leaves of coltsfoot (Tussilago farfara L.). The fructification of this fungus held only γ-carotene and β-carotene. There were found no xanthophylls, epoxides; neither carboxyl nor carboxyl groups. The content of γ-carotene was of 22 mg/100 g of dry matter and that of β-carotene of 15 15 mg/100 g D.M. The content of both carotenoids was 10-12 times higher in comparison with their content in carrots. The fructification bodies of Coleosporium tussilaginis represents an important natural source of γ- and β-carotene.

Key words: Coleosporium tussilaginis, Tussilago farfara, γ- and β-carotene.

Address: Inst.Agr."Dr.Petru Groza", Dept.Chemistry, 3400 Cluj-Napoca, str.Mănăștur 3, R.S.Romania.

Both macroscopic and microscopic fungi constitute an important source for the biosynthesis of carotenoid pigments (1, 2, 3). In contrast to higher plants, the fungi contain fewer carotenoid pigments, but their content is higher, more specific and more characteristic for the various species, genera and families of fungi, so that a part of the identified pigments, present carotenotaxonomical importance (4, 5, 6).

The fungi possessing carotenoids are easily recognized, as the colour of their carotenoids is not overlapped by the presence of chlorophylls, as it happens in the green tissues (leaves, stalks, buds) of higher plants.

We are dealing, in the present paper, with the carotenoid pigments from Coleosporium tussilaginis (Pers.) Kleb of coltsfoot, a fungus which according to our knowledge has not been investigated from the standpoint of carotenoid pigments, in spite of the fact that in autumn it is abundantly found on the lower side of the coltsfoot leaves (Tussilago farfara L.).

Material and Method

The plant material (i.e. leaves of coltsfoot), with red-orenge spots on their lower side, was harvested in the autumn of 1981-1982, in the surroundings of the town Cluj-Napoca. The attack of fungus was more severe in the 1981 autumn, when, on the lower side of leaves, appeared fructifications of an intense red-orange colour.

The extraction of carotenoids from the fruiting bodies of the fungus was readily carried out by washing the coltsfoot leaves with a mixture of neophaline and cetone in a 9:1 ratio, but without the maceration of leaves. By this method it was avoided any contamination of the fungal pigments by those from the chloroplasts of leaves. Also the leaves which were not attacked by the fungus were treated with the same mixture, but no carotenoids were extracted from them.

The separation, identification and determination of carotenoids were fulfilled by the same chromatographic and spectrophotometric methods as described in previous paper (7-8). For the mixture chromatograms, purified carotenoids extracted from the leaves of Convallaria majalis were used.

Results and Discussion

The fructification of Coleosporium tussilaginis contained only γ-carotene and β-carotene. The chromatogram of pigments from the fructification of the fungus Coleosporium tussilaginis is given in fig.1.

In spite of the fact that the separation and identification of carotenoids were repeated, still in the fructification of the fungus there were not identified xanthophylls, epoxides, carotenoids having carbonyl or carboxyl groups, nor any other categories of pigments.

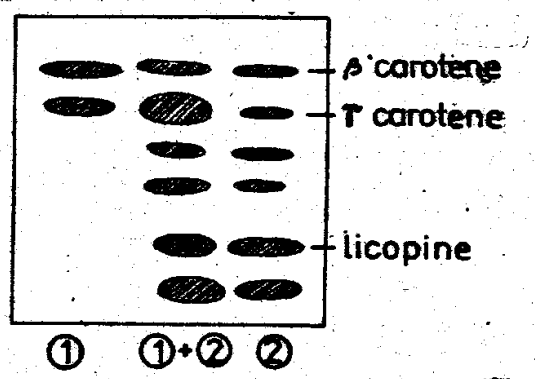

Fig.1. The chromatogram of pigments from the fructification of fungus Coleosporium tussilaginis (Pers.) Kleb.①; as compared to pigments from the berries of Convallaria majalis L. ② on MgO thin layer irrigated with mixture of light petroleum-chloroform-ethanol (3o:2:1 v/v).

Owing to the fact that Coleosporium tussilaginis contain but a scarce number of carotenoids, their content is relatively high. In this way, the γ-carotene which is the principal pigment, is of 22 mg/1oo g of dry matter and the content of β-carotene is of 15 mg/1oo g D.M. The overall content of both pigments is 1o-12 times higher than the content of these carotenoids in carrots.

The carotenoid pigments from fungi might be used in the alimentary and pharmaceutical industries and in cosmetics, for dyeing of some alimentary products (butter, margarine, different sorts of cheese, alimentary pastes), of medicines or in cosmetics for the preparation of various creams, sprays, lipsticks, ointments etc., as they possess a red-orange colour, are not toxic and enhance the biological and nutritive value of products in that they are the principal A provitamins.

However, in some of the cosmetic preparations, in the feeding of animals, or even in some alimentary preparations, it is possible to use directly the fruiting bodies themselves, sparing thus the operations of extraction and purification of carotenoids.

From a genetic standpoint, based on own researches, we could remark that the content of carotenoid pigments depends on the number and variety of carotenoids which are biosynthetized by a given organism. It seems that between the content of carotenoids on one side and their number and variety on the other, there is an inverse ratio. Further researches concerning the genetic determinism of carotenoids in fungi, could confirm or invalidate this allegation. The maxima of absorption of the identified pigments were similar to the findings presented (5,6). Thus, the β-carotene in petroleum ether had its maxima at 427, 451, 483 nm, while in ethilic ether, at 421, 45e, 475 nm. The γ-carotene had its maxima of absorption in petroleum ether at 437, 462, 492 nm, and in ethilic ether at 434, 463, 49o nm.

The separation of γ-carotene from β-carotene was easily carried out by means of the chromatographic plate or column, as γ-carotene has two more double bonds than β-carotene, being thus more intensely adsorbed. It might be that the fungus would produce initially only γ-carotene, which is the prevailing pigment, while the β-carotene could be formed only subsequently, as the growth of fruiting bodies proceeds, by the cyclization of γ-carotene (fig.2).

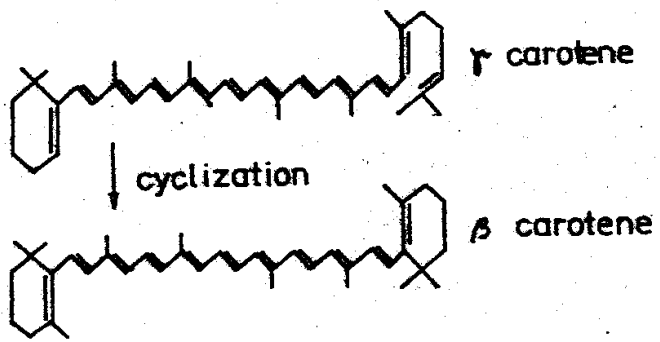

Fig.2. The structure relation of β-and γ-carotene

In conclusion, Coleosporium tussilaginis, has a simple and efficient genetic carotenogenesis system. We suggest the utilization of fruiting bodies of Coleosporium tussilaginis as natural source for obtaining γ- and β-carotene.

References

1. GOODWIN T.W., 1954, Stravitelnaia Biohimia Karotinoidov, Izdatelistvo Inostranoi Literaturî, Moscova, p.13.

2. RUHLAND W., 1958, Encyclopedia of Plant Physiology, Springer Verlag, Berlin-Göttingen-Heidelberg, X., 186.

3. ISLER O., 1971, Carotenoids, Birkhauser Verlag Basel und Stuttgart 577.

4. SWAIN T., 1966, Comparative Phytochemistry, Acad.Press, London and New York, 121.

5. GOODWIN T.W., 1976, Chemistry and Biochemistry of Plant Pigment, Acad.Press, London and New York, 127.

6. BODEA C., PARCAŞAN V., NICOARA E., SLUŞANSCHI H., 1964, Tratat de biochimie vegetală, Editura Academiei RSR, Bucureşti, I. 548.

7. ILLYÉS GH., NEAMŢU G., BODEA C., 1976, Cercetări chemotaxonomice la plante inferioare. I.St.Cerc.Biochim., 19, 81.

8. NEAMŢU G., ILLYÉS Gh., POP ECATERINA, 1981, Notulae Botanicae Horti Agrobotanici, XI, p.57.