The Carotenoids of *Gagea lutea* (L.) Ker-Gawl.

ARNULV STABURSVIK *

Department of Chemistry, Agricultural College of Norway, Vollebekk, Norway

Very little is known about the carotenoids of the plant family Liliaceae. Apart from an investigation of *Narthecium ossifragum* (L.) Huds.[1] it seems that only scattered and isolated finds have been reported. Lycopene has thus been shown to be present in *Convallaria majalis* L.,[2] rhodoxanthin in *Haworthia coarctata var. kraussi* Resende,[3] and in *Aloe vera* L. and *Bulbine annua* (L.) Willd.[4]

In *Narthecium* 15 of the 22 carotenoids recorded were epoxidic in nature, according to the ether-hydrochloric acid test for 5,6- or 5,8-epoxides. Epoxidic carotenoids (antheraxanthin and violaxanthin) have also been reported from several *Lilium* species.[5,6] Other Liliaceae, *viz. Tofieldia pusilla* (Michx.) Pers. and *Phormium tenax* Forst., are rich in epoxidic carotenoids. (Unpublished results).

* Present address: Makerere University College, Kampala, Uganda.

Gagea lutea (L.) Ker-Gawl. is another liliaceous plant in which epoxidic carotenoids are dominating, qualitatively as well as quantitatively. With the exception of fraction 10 (lutein), fraction 12 (probably cryptoxanthin), and fractions 13–15 (β-carotene, α-carotene, and phytofluene, respectively), all fractions listed in Table 1 gave a more or less pronounced blue colour when dissolved in ether and treated with hydrochloric acid.

The fractions 1 and 2 contained substances corresponding in their properties to neoxanthin and auroxanthin, respectively. The fractions 3 and 4 were relatively stable towards dilute acids, excluding the presence of 5,6-epoxides; the substances presumably were flavoxanthin and chrysanthemaxanthin, respectively. Fraction 5 displayed the spectrum of violaxanthin; on acid treatment it gave a substance corresponding to fraction 2. The zones 6–8 contained carotenoids displaying spectra of the auroxanthin (6–7) and flavoxanthin (8) types, however, these zones were much less strongly adsorbed to the columns than the auroxanthin and flavoxanthin in zones 2 and 3. Fraction 9 seemed to be lutein epoxide.

Experimental. Fresh plant material (inflorescences) of *Gagea lutea* (L.) Ker-Gawl., collected at Ås, Norway, was extracted with

Table 1. Carotenoids of *Gagea lutea* (L.) Ker-Gawl. Zones numbered in order of decreasing adsorptivity.

Zone No.	Adsorption maxima, mμ. Solvent benzene			Tentative identification
1	478	447	420	Neoxanthin
2	435	408	385	Auroxanthin
3	458	430	407	Flavoxanthin
4	460	431	408	Chrysanthemaxanthin
5	484	453	425	Violaxanthin
6	435	409	388	
7	436	409	388	
8	459	433	410	
9	482	453	425	Lutein epoxide
10	487	457	432	Lutein
11	485	456	432	
	Solvent petroleum ether			
12	475	445	425	Cryptoxanthin (?)
13	477	448		β-Carotene
14	475	447		α-Carotene
15	368	348	330	Phytofluene

cold acetone. The extracts were concentrated and the lipids transferred to peroxide free ether. After saponification with 10 % ethanolic potassium hydroxide, the carotenoids were partitioned between petroleum ether and 90 % methanol. After evaporation to dryness much colourless material was removed by dissolving in acetone and cooling to −60°C, when sterols and fatty alcohols precipitated and were filtered off. All operations were carried out in a nitrogen atmosphere.

The hypophasic carotenoids were chromatographed on columns of precipitated calcium carbonate (Riedel-de Haën) and developed with benzene. The epiphasic carotenoids were chromatographed on calcium hydroxide and developed with petroleum ether (b.r. 60−80°C). The individual zones were cut out and their absorption spectra measured on a Beckman DB recording spectrophotometer. The spectra were measured again, after the fractions had been rechromatographed on kieselgur-containing paper (xanthophylls) [7] or aluminium oxide-containing paper (carotenes).[8]

A grant from *Norges Almenvitenskapelige Forskningsråd* is gratefully acknowledged. The author is indebted to Miss Eva Skilnand for skilful technical assistance.

1. Stabursvik, A. *A Phytochemical Study of Nathecium ossifragum (L.) Huds., Norges Tekniske Vitenskapsakad. Ser. 2, No. 6,* (1959) pp. 33−46.
2. Winterstein, A. and Ehrenberg, H. *Z. physiol. Chem.* **207** (1932) 25.
3. Romariz, C. *Portugaliae Acta Biol.* **1** (1946) 235.
4. Lippmaa, T. *Ber. Deut. Bot. Ges.* **44** (1926) 643.
5. Karrer, P. and Oswald, A. *Helv. Chim. Acta* **18** (1935) 1303.
6. Tappi, G. and Menziani, E. *Atti Soc. Nat. e Mat. Modena* **85** (1954) 28.
7. Jensen, A. and Liaaen Jensen, S. *Acta Chem. Scand.* **13** (1959) 1863.
8. Jensen, A. *Acta Chem. Scand.* **14** (1960) 2051.

Received June 27, 1969.