CHAPTER 5

CHEMICAL CHARACTERISTICS OF DISCOLICHENS

Lichens produce a great variety of secondary metabolic products, known collectively as 'lichen substances', which are, for the most part, a unique group of compounds not found in other organisms. These substances can be of systematic value at species and at higher taxon levels, because of the many parallels observed between morphological and chemical variation. An overview of lichen chemistry and its application to lichen systematic is given in Elix (1992, pp. 23-29) and White and James (1985, pp. 1-41).

The information on the chemical contents can be obtained by applying simple chemical reagents to the lichen thallus and observing the color changes (Elix 1994, pp. 2-3). The color reactions of some lichen substances with K, C, KC and P reagents are listed in Table 5.

Most lichen substances are colorless and not as easily detected as the pigments. The identification of these substances is done by a combination of thin layer chromatography and high performance liquid chromatography. Thin layer chromatography application method according to the standard method of Elix and Ernst-Russell (1993, pp. 23-29).

Twenty-two substances have been detected in this study. Each substance shows characteristic properties of a spot as shown in Figure 14-16. An alphabetical list of these substances is presented in Table 6.

Abbreviations for microchemical tests are as follows:

Or	= orange	Pur	= purple
R	= red	Y	= yellow

Abbreviations for substances are as follows:

2'-*O*-methyl = 2'-*O*-methylperlatolic acid

Alec	= alectoronic acid	Atr	= atranorin
Art	= arthothelin	Chry	= chrysophanol
Fum	= fumarprotocetraric acid	Gang	= gangaleoidin
Hae	= haematommone	Isopla	= isoplacodiolic acid
Lichex	= lichexanthone	Nor	= norrussulone
Par	= parietin	Placo	= placodiolic acid
Protoce	= protocetraric acid	Russ	= russulone
Sphae	= sphaerophorin	Usn	= usnic acid
Zeo	= zeorin		

Table 5

Characteristics of Lichen Substances Found in Discolichens Detected by Spot Test and TLC

Chemical substances	Rf class			Spot color after 10%	Color test				UV	UV
	A	B'	C	sulphuric acid and heat 110 °C	K	C	KC	PD	before heat	after heat
2'-*O*-methylperlatolic acid	52	62	55	yellow	-	-	-	-	-	green
alectoronic acid	30	31	17	yellow	-	-	-	red	-	blue
arthothelin	43	45	37	orange	-	-	-	-	-	green
atranorin	75	73	79	orange	y	-	-	y	orange	orange
chrysophanol	75	77	83	yellow	-	-	-	-	-	-
fumarprotocetraric acid	2	25	7	grey	y	-	-	r	-	purple
gangaleoidin	64	40	54	yellow	-	-	-	-	-	orange
haematommone	50	60	40	yellow	-	-	-	-	-	pink
isosphaeric acid	43	69	53	yellow	-	-	-	-	-	blue
isoplacodiolic acid	48	62	65	gray	brown	-	-	-	-	-
lichexanthone	72	66	80	yellow	-	-	-	-	-	blue
norrussulone	41	32	29	yellow	-	-	-	-	-	-
parietin	75	71	82	yellow	pur	-	-	-	-	orange

Table 5 (continued)

Chemical substances	Rf class			Spot color after 10%	Color test				UV	UV
	A	B'	C	sulphuric acid and heat 110 °C	K	C	KC	PD	before heat	after heat
placodiolic acid	65	60	67	orange	y	-	y	-	-	purple
protocetraric acid	3	19	5	grey	-	-	-	-	-	purple
russulone	63	35	51	yellow	-	-	-	-	-	pink
sphaerophorin	45	74	55	yellow	-	-	-	-	orange	green
unknown anthraquinone	-	-	-	-	-	-	-	-	-	-
unknown 52, 38, 48 orange	52	38	48	orange	r	-	-	or	-	-
usnic acid	70	66	71	green	-	-	y	-	-	green
Xantholepinones	-	-	-	-	-	-	-	-	-	-
zeorin	52	43	41	purple	-	-	-	-	-	-

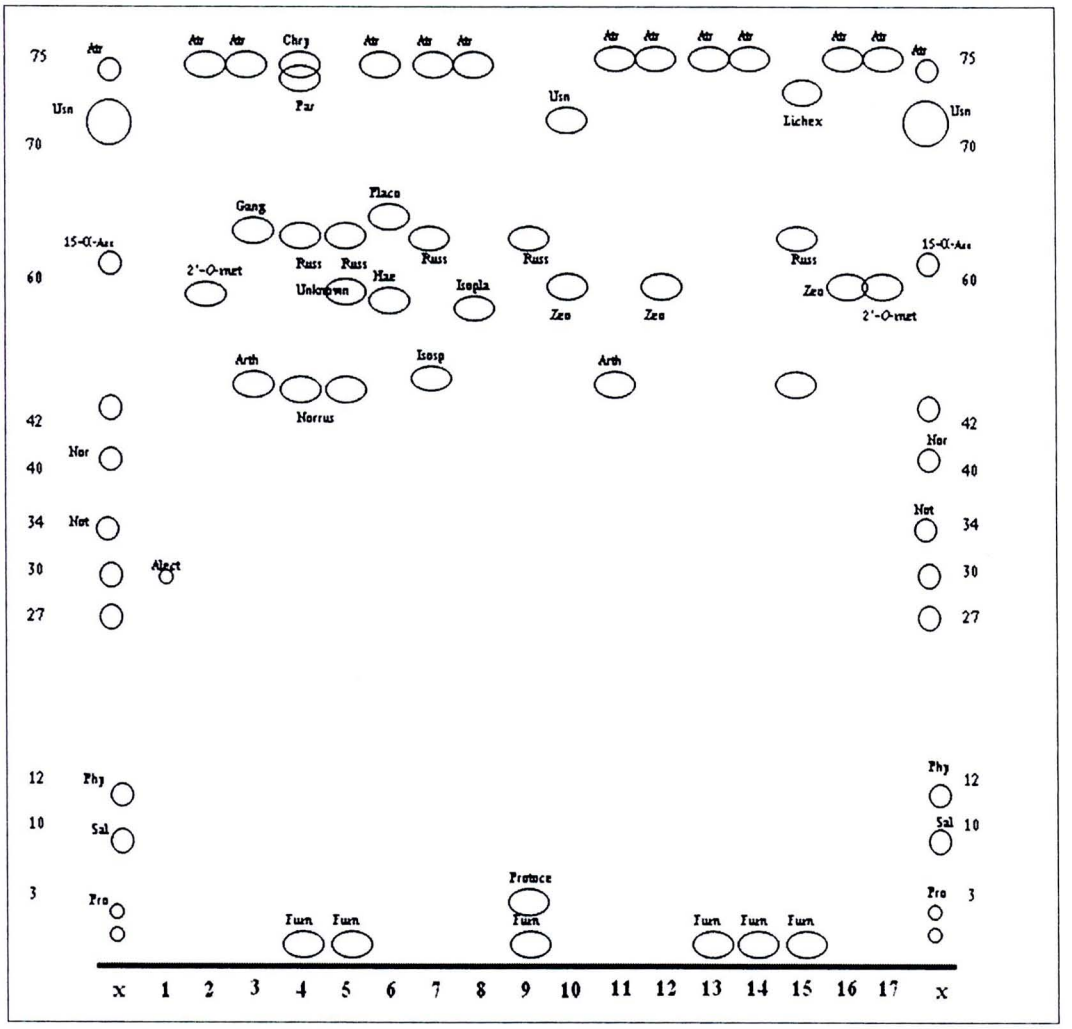

Figure 14 Lichen substances on TLC-plate developed in solvent system A

Note. X = Standard-R*f* (mixture substances), 1 = *Maronina orientalis*, 2 = *Vainionora flavidorufa*, 3 = *Lecanora argentata*, 4 = *Ramboldia* cf. *siamensis*, 5 = *Ramboldia deficiens*, 6 = *Haematomma* cf. *africanum*, 7 = *Haematomma collatum*, 8 = *Haematomma* PL.1, 9 = *Ramboldia* PL.1, 10 = *Megalospora tuberculosa*, 11 = *Lecanora flavoviridis*, 12 = *Malmidea bakeri*, 13 = *Catillochroma melanotropa*, 14 = *Lecidella capathica,* 15 = *Ramboldia russula,* 16 = *Lecanora subimmersa*, 17 = *Lecanora helva*

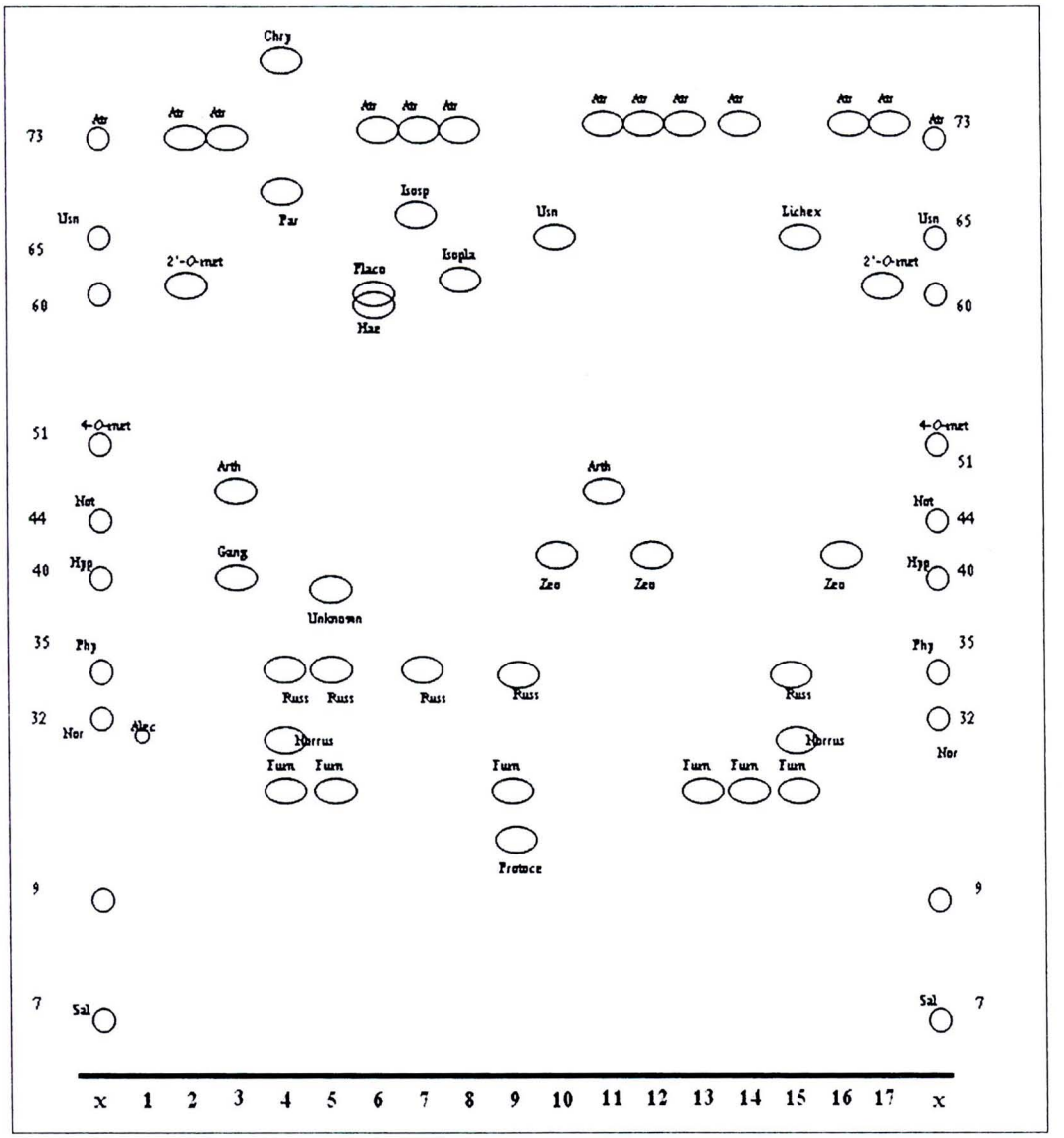

Figure 15 Lichen substances on TLC-plate developed in solvent system B'

Note. X = Standard-R*f* (mixture substances), 1 = *Maronina orientalis,* 2 = *Vainionora flavidorufa*, 3 = *Lecanora argentata*, 4 = *Ramboldia* cf. *siamensis*, 5 = *Ramboldia deficiens*, 6 = *Haematomma* cf. *africanum*, 7 = *Haematomma collatum*, 8 = *Haematomma* PL.1, 9 = *Ramboldia* PL.1, 10 = *Megalospora tuberculosa*, 11 = *Lecanora flavoviridis*, 12 = *Malmidea bakeri*, 13 = *Catillochroma melanotropa*, 14 = *Lecidella capathica,* 15 = *Ramboldia russula,* 16 = *Lecanora subimmersa*, 17 = *Lecanora helva*

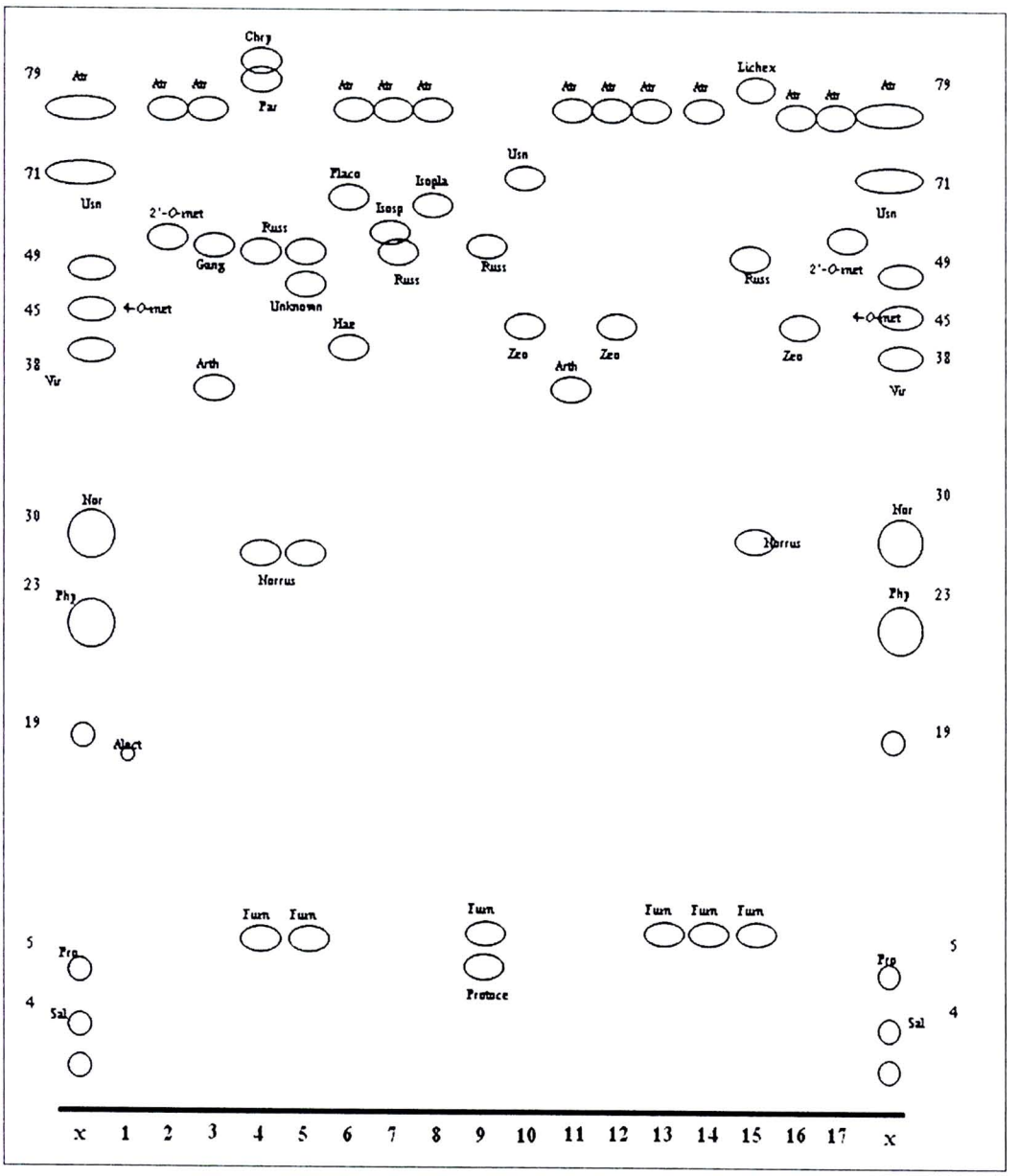

Figure 16 Lichen substances on TLC-plate developed in solvent system C

Note. X = Standard-R*f* (mixture substances), 1 = *Maronina orientalis*, 2 = *Vainionora flavidorufa*, 3 = *Lecanora argentata*, 4 = *Ramboldia* cf. *siamensis*, 5 = *Ramboldia deficiens*, 6 = *Haematomma* cf. *africanum*, 7 = *Haematomma collatum*, 8 = *Haematomma* PL.1, 9 = *Ramboldia* PL.1, 10 = *Megalospora tuberculosa*, 11 = *Lecanora flavoviridis*, 12 = *Malmidea* 15 = *Ramboldia russula,* 16 = *Lecanora subimmersa*, 17 = *Lecanora helva*

Table 6

The List of Lichen Substances Found in Various Species of Discolichens

Lichen substances	Species
2'-*O*-methylperlatolic acid	*Lecanora helva, L. toroyensis* and *Vainionora flavidorufa*
Alectoronic acid	*Maronina orientalis*
Arthothelin	*Lecanora argentata, L. austrotropica* and *Lecanora flavoviridis*
Atranorin	*Bacidia subannexula, Bellemerea* PL.1, *Brigantiaea leucoxantha, Catillochroma melanotropa, Haematomma* cf. *africanum, H. collatum, H. flexuosum, H.* PL.1, *H. wattii, Lecanora achroa, L. argentata, L. austrotropica, L. flavoviridis, L. helva, L. leprosa, L. phaeocardia, L. subimmersa, L. toroyensis, L. tropica, L. vainioi, Lecidella capathica, L. elacochroma, Letrouitia domingensis, Malmidea bakeri, M. coralliformis, M. duplomarginata, M. eeuuae, M. piae* and *Vainionora flavidorufa*
Chrysophanol	*Ramboldia* cf. *siamensis*
Dehydroalectoronic acid	*Maronina orientalis*
Fumarprotocetraric acid	*Bellemerea* PL.1,*Catillochroma melanotropa, Lecidella capathica, Ramboldia deficiens, R. heterocarpa, R. russula, R. siamensis, R.* cf. *siamensis* and *Ramboldia* PL.1
Gangaleoidin	*Lecanora argentata* and *L. leprosa*
Haematommone	*Haematomma* cf. *africanum, H. wattii* and *H. flexuosum*
Isosphaeric acid	*Haematomma collatum*

Table 6 (continued)

Lichen substances	Species
Isoplacodiolic acid	*Haematomma* PL.1
Lichexanthone	*Bellemerea* PL.1, *Ramboldia heterocarpa, R.* cf. *siamensis, R. siamensis, Ramboldia* PL.1 and *R. russula*
Norrussulone	*Ramboldia deficiens, R. heterocarpa, R. russula, R. siamensis, R.* PL.1 and *R.* cf. *siamensis*
Parietin	*Caloplaca bassiae, C.* aff. *ferruginea, C. flavorubescens, C. testaceorufa, Ramboldia deficiens, R.* cf. *siamensis* and *R. siamensis*
Placodiolic acid	*Haematomma* cf. *africanum* and *H. wattii*
Protocetraric acid	*Ramboldia* PL.1
Russulone	*Ramboldia deficiens, R. heterocarpa, R. russula, R. siamensis, R.* cf. *siamensis, Ramboldia* PL.1 and *Haematomma collatum*
Sphaerophorin	*Haematomma collatum*
Unknown anthraquinone	*Brigantiaea leucoxantha, Letrouitia domingensis, L. transgressa* and *L. vulpina*
Unknown 52, 38, 48 orange	*Ramboldia deficiens*
Usnic acid	*Lecanora achroa* and *Megalospora tuberculosa*
Xanthone	*Lecanora flavoviridis*
Xantholepinones	*Malmidea bakeri, M. piae* and *Malmidea* PL.1
Zeorin	*Catillochroma melanotropa, Lecanora subimmersa, L. tropica, L. vainioi* and *Megalospora tuberculosa*
No lichen substance	*Bacidia connexula, B. incongruens, Caloplaca* PL.1, *Malmidea microspora, M. perplexa* and *Micarea melaena*