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The ratio of K to Ca in thalli of several species of lichens occurring on various trees

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Abstract:

The per cent contents of K and Ca in 7 species of lichens and in the bark of trees and extracts from this bark were determined. The ratio K : Ca was calculated. In the particular species of lichens collected from the treee the K : Ca ratio varies from 0.05 to 4.93. In the thalli of one species collected from various species of trees the content of cations varies, but the K : Ca ratio is more or less constant in particular species.

Tree bark is a typical habitat for epiphytic lichens. This habitat has an insufficient amount of moisture. Plants occurring in this habitat can only use atmospheric water, absorbing it either during rain or directly from the air in the form of water vapour, fog or dew. Epiphytic lichens have several properties which facilitate absorption and storage of water, but they nevertheless loose it quickly. Absorption and evaporation of water from lichen thalli are physical processes (Barkman 1958). However, many lichens can stand periodical drying very well, e.g. *Parmelia physodes,* which attains full assimilation quickly after water is again supplied (Ried 1953). Many authors (Halicz 1959, Hilitzer 1927, Klement 1951, 1955, Kuziel 1964, Sulma 1935 and others) distinguish the following types of lichens depending on the microclimatical conditions of their habitats: xerophytes, mesophytes, psychrophytes, eurotypes. Papers dealing with the requirements of lichens in respect to conditions of humidity in the habitat are based mainly on physiographic and morphological data. These investigations are only a margin of floristic and floristic-phytosociological studies and their aim is to explain the reasons of occurrence of particular species or of whole associations on given stands.

One of the factors determining the resistance of cells to dehydration, besides the osmotic potential of the cell sap, is the equilibrium between some antagonistic ions. It determines the physicochemical properties of the protoplast and the permeability of cytoplasmic membranes, which in turn determine the degree of the cell hydration. This ratio is that of potassium and calcium ions. Both Ca^{++} and K^{+} are important for hydration and permeability of the plasm and thus they determine the water balance. Potassium increases an uptake of water by the cell and decreases its loss. Calcium, as an antagonist of potassium, has a dehydrating effect on the cell and increases the viscosity of the plasm, which shows a tendency to coagulate.

Numerical relationships of calcium and potassium may thus be an indication of the tendency of the protoplast to maintain or to loose water. On the other hand, it is known that the nature of xeromorphism is based, among other things, on the ability of the cell to survive under conditions of strong dehydration, in which metabolic processes still occur. Zukal (quoted by Abbayes 1951) is of the opinion that a considerable concentration of calcium oxalate in the lichen thalli could help water retention by decreasing evaporation.

The aim of this work was to examine Ca and K content, and to determine their ratio in several species of epiphytic lichens occurring on various trees.

Several species of foliaceous and crustaceous lichens were taken into consideration. Some of these have a wide range of occurrence and may be found in the stands of varying degrees of humidity. Others are less frequently found, their occurrence is limited to certain habitats both in respect to substratum and to the conditions of humidity.

MATERIAL AND METHODS

The thalli of the following lichen species were investigated: *Parmelia physodes* (L.) Ach., *P. sulcata* Taylor., *P. furfuracea* (L.) Ach., *Ramalina fastigiata (Liljecl.)* Ach., *R. fraxinea* (L), Ach., *Evernia prunastri* Ach., *Usnea hirta* (L.) Fr., and the bark of trees from which they were collected. The above-mentioned lichens were collected from the bark of the following tress: *Acer platanoides* L., *Betula verrucosa* Ehrh., *Fraxinus excelsior* L., *Populus alba* L., *Sorbus aucuparia* L., *Salix* sp., *Tilia* sp., These trees grow besides roads in the environs of Giżycko and Mikołajki in Masuria.

The contents of Ca and K were determined in extracts from bark in 1% citric acid and in the lichen thalli.

The bark samples were carefully washed with distilled water, dried and then powdered in a mill. Another batch of bark from the same trees was at first powdered, then left in 1% citric acid for 3 days. After filtration the extract was evaporated to dryness. Dried thalli of the lichens were also powdered.

Ca and K contents were estimated in the obtained samples by the flame method using a photometer. These analyses were performed in the chemical laboratory of IUNG in Gorzów Wielkopolski.

The obtained results are presented in diagrams as per cent contents of the two elements under examination. The numerical data are an average of 5—10 analyses.

RESULTS AND DISCUSSION

Diagram I presents the results of K and Ca determination in the samples of the bark of trees from which the lichens were collected. Diagram II shows the contents of these cations in the extracts from the bark. It is characteristic that K and Ca contents are higher in the extracts than in the bark. This apparent paradox may be explained by the fact that much dust coming from neighbouring areas (roads, cultivated fields etc.) is present on the bark of trees growing by a road.

The data concerning the per cent content of K and Ca in the thalli of the lichens under examination seem to be interesting. These results are presented in diagrams III—XII.

Different K and Ca contents may be observed in the thalli of different species of lichens collected from the same tree (Diagrams III—VI) The ratio K : Ca in the examined thalli fluctuates from 0.05 to 4.93.

Diagrams VII—XII present the per cent contents of K and Ca in the thalli of respective species of lichens collected from various trees. In the thalli of one species different amounts of these two cations may be found depending on the habitat (tree). However, the ratio of the ions in one species collected from various habitats varies only slightly.

K : Ca ratio in thalli of the examined lichens

Parmelia physodes	0.05 — 0.18
Evernia prunastri	0.58 — 0.79
Parmelia sulcata	0.80 — 1.22
Parmelia furfuracea	1.01 — 1.17
Ramalina fastigiata	2.02 — 2.47
Ramalina fraxinea	2.53 — 3.76
Usnea hirta	4.93

The numbers representing the K : Ca ratio seem to be related to the species of lichen, the habitat however is of secondary importance.

EXPLANATIONS OF DIAGRAMS

Diagram I. K and Ca content in the bark of trees from which thalli of the examined lichens were collected

a — *Fraxinus excelsior;* *b* — *Salix* sp.; *c* — *Sorbus aucuparia;* *d* — *Acer platanoides;* *e* — *Populus alba;* *f* — *Tilia* sp.; *g* — *Betula verrucosa*
K — potassium; Ca — calcium

Diagram II. K and Ca content in the bark trees mentioned in Diagram I

Explanations as in Diagram I

Diagram III. K and Ca content in thalli of lichens collected from *Acer platanoides:*

a — *Parmelia furfuracea,* *b* — *P. sulcata,* *c* — *P. Physodes,* *d* — *Evernia prunastri,* *e* — *Ramalina fastigiata,* *f* — *R. fraxinea*

Diagram IV. K and Ca content in thalli of lichens collected from *Tilia* sp.

a — *Parmelia furfuracea,* *b* — *P. sulcata,* *c* — *Romalina fastigiata,* *d* — *Evernia prunastri,* *e* — *P. physodes,* *f* — *R. fraxinea*

Diagram V. K and Ca content in thalli of lichens collected from *Populus alba:*

a — *Parmelia sulcata,* *b* — *Ramalina fastigiata,* *c* — *R. fraxinea*

Diagram VI. K and Ca content in thalli of lichens collected from *Betula verrucosa:*

a — *Parmelia furfuracea,* *b* — *P. sulcata,* *c* — *P. physodes,* *d* — *Ramalina fastigiata,* *e* — *Evernia prunastri*

Diagram VII. K and Ca content in thalli of *Parmelia physodes collected from:*

a — *Betula verrucosa,* *b* — *Acer platanoides,* *c* — *Tilia* sp.

Diagram VIII. K and Ca content in thalli of *Evernia prunastri* collected from:

a — *Salix* sp., *b* — *Acer platanoides,* *c* — *Betula verrucosa,* *d* — *Tilia* sp.

Diagram IX. K and Ca content in thalli of *Parmelia furfuracea* collected from:

a — *Acer platanoides,* *b* — *Tilia* sp., *c* — *Betula verrucosa*

Diagram X. K and Ca content in thalli of *Parmelia sulcata* collected from:

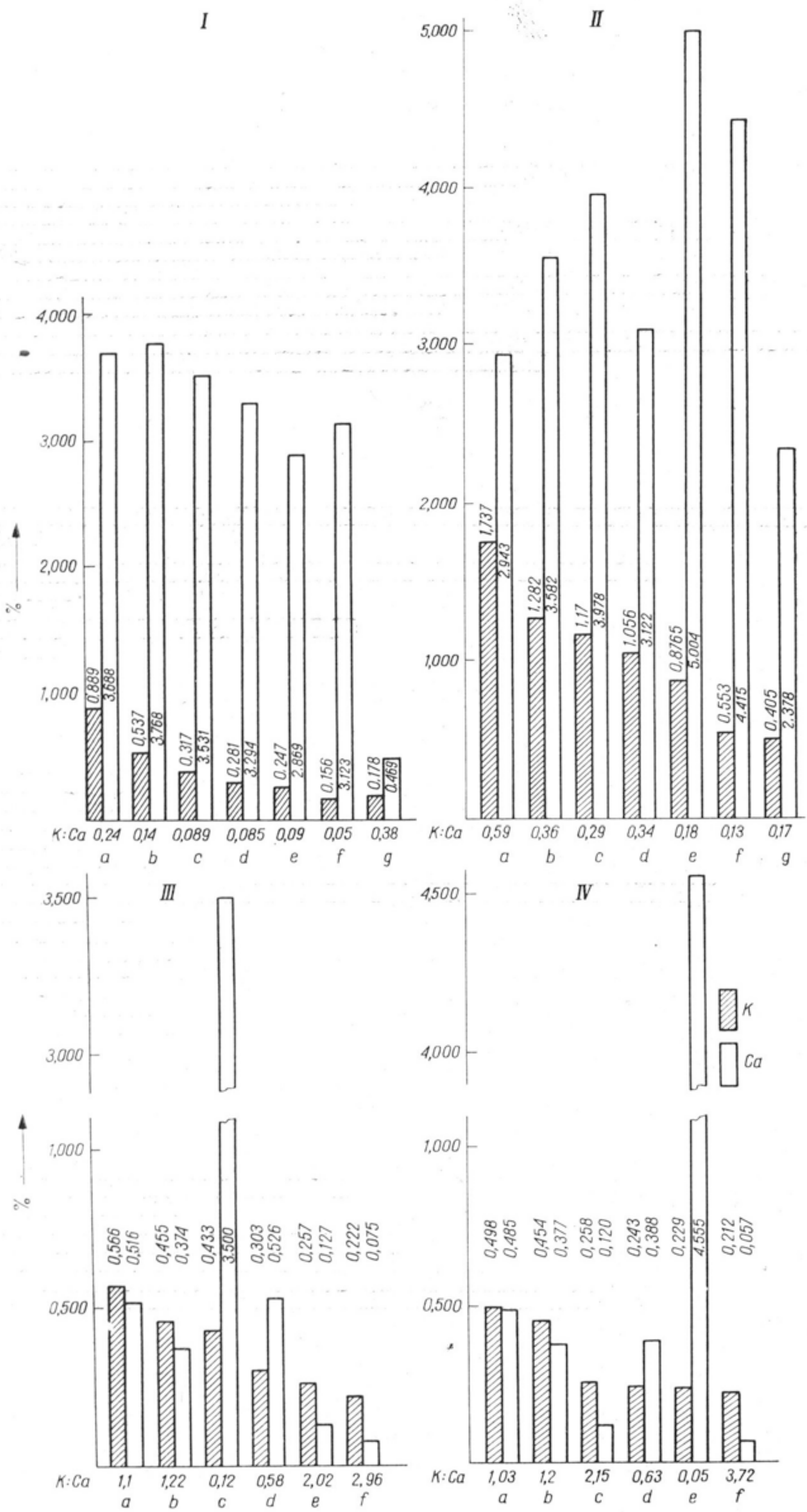
a — *Acer platanoides,* *b* — *Tilia sp.,* *c* — *Populus alba,* *d* — *Betula verrucosa* — *e Sorbus aucuparia*

Diagram XI. K and Ca content in thalli of *Ramalina fastigiata* collected from:

a — *Salix* sp., *b* — *Betula verrucosa,* *c* — *Populus alba,* *d* — *Tilia* sp., *e* — *Acer platanoides*

Diagram XII. K and Ca content in thalli of *Ramalina fraxinea* collected from:

a — *Populus alba,* *b* — *Acer platanoides,* *c* — *Tilia* sp., *d* — *Sorbus aucuparia,* *e* — *Fraxinus excelsior*


I
4,000
3,000
2,000
1,000
%
0,889 3,688
0,537 3,768
0,317 3,531
0,281 3,294
0,247 2,869
0,156 3,123
0,178 0,469
K:Ca 0,24 0,14 0,089 0,085 0,09 0,05 0,38
a b c d e f g
II
5,000
4,000
3,000
2,000
1,000
1,737 2,943
1,282 3,582
1,17 3,978
1,056 3,122
0,8765 5,004
0,553 4,415
0,405 2,378
K:Ca 0,59 0,36 0,29 0,34 0,18 0,13 0,17
a b c d e f g
III
3,500
3,000
1,000
0,500
%
0,566 0,516
0,455 0,374
0,433 3,500
0,303 0,526
0,257 0,127
0,222 0,075
K:Ca 1,1 1,22 0,12 0,58 2,02 2,96
a b c d e f
IV
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4,000
1,000
0,500
0,498 0,485
0,454 0,377
0,258 0,120
0,243 0,388
0,229 4,555
0,212 0,057
K:Ca 1,03 1,2 2,15 0,63 0,05 3,72
a b c d e f
K
Ca

Diagram I — IV

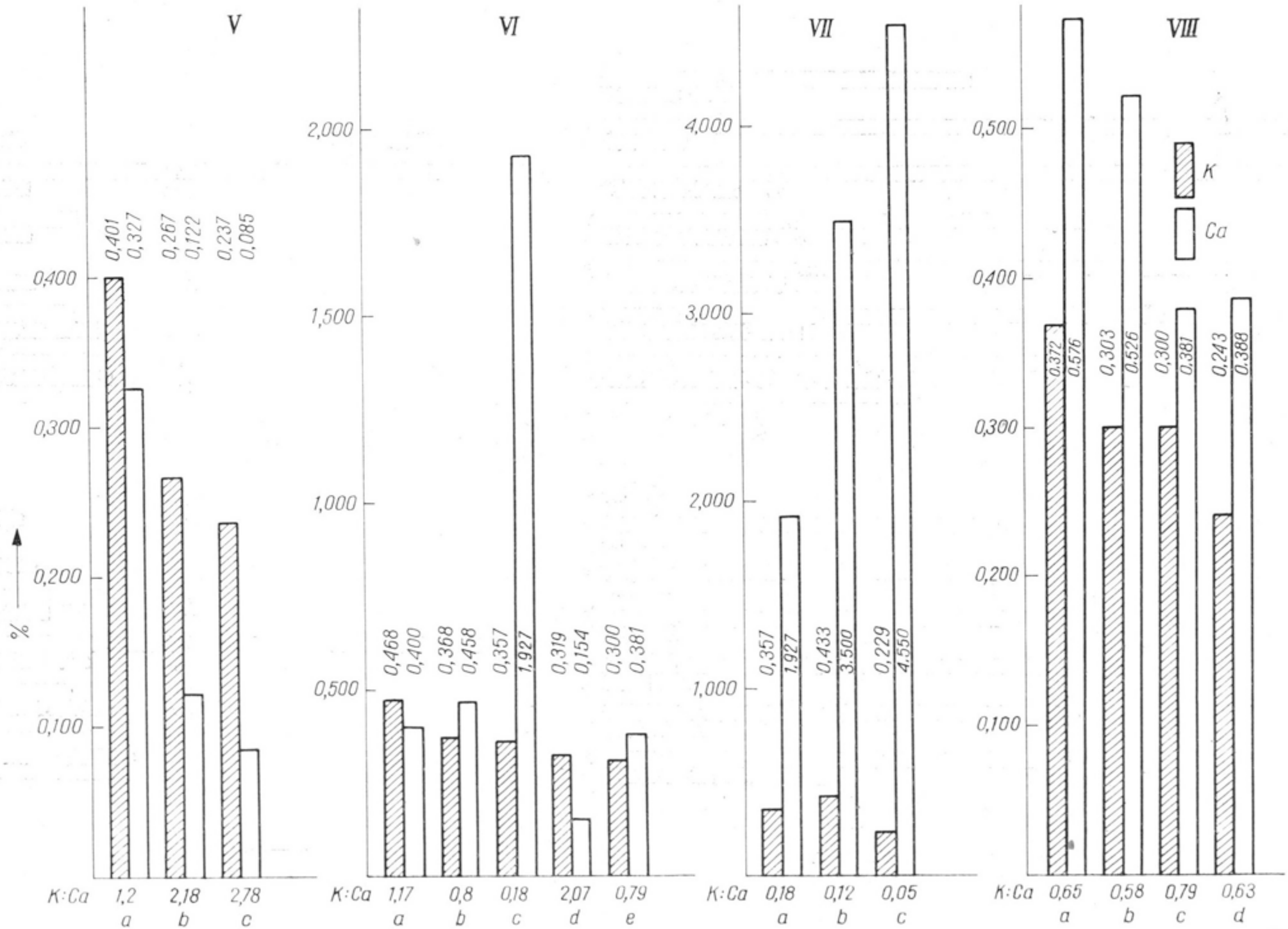

Diagram V — VIII

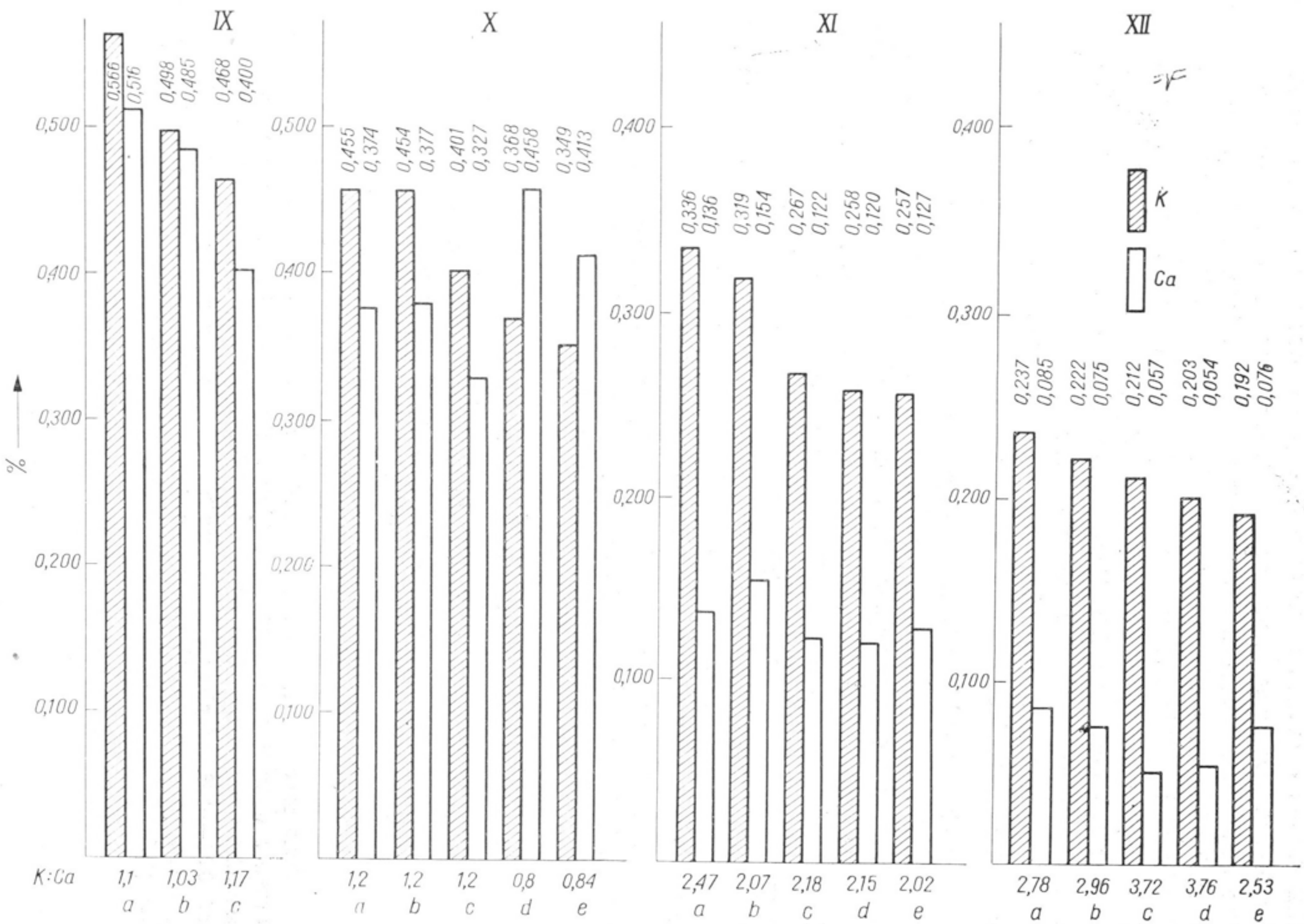

Diagram IX — XII

In the thalli of *Parmelia physodes*, regardless of tree genus on which this lichen occurred a considerable preponderance of Ca over K may be found. *Parmelia physodes* is a leafy lichen and is in contact with the substratum with its whole down-side surface. The second of the examined species which deserves a special notice is *Ramalina fraxinea*. In its thalli collected from various trees an inverse phenomenon, i.e. the preponderance of K over Ca may be observed. The K : Ca ratio is always greater than 2.0 (Diagram XII). Other examined lichens give also an interesting information on the content of the two cations. The thalli of *Parmelia physodes* and of *Ramalina fraxinea* are the two extreme examples.

Parmelia physodes is an eurotypic species with a wide geographical range, it may occur on various substrata, even on stones and crags, and also on the trees exposed to strong winds (spruces in the mountains). On the other hand *Ramalina fraxinea* is a mesophyte and requires better humidity conditions. It occurs most numerously on the bark of *Acer, Populus, Sorbus* and other trees the bark of which has a considerable water capacity (Barkman 1958). It must also be stressed that the occurrence of this species is related not only to the humidity of the habitat but also to the humidity of the atmosphere.

The remaining species have intermediate values of the K : Ca ratio which is in agreement with observations of their occurrence and their requirements for particular air conditions of humidity.

Stosunek K do Ca w plechach kilku gatunków porostów występujących na różnych drzewach

Streszczenie

Oznaczono procentową zawartość K i Ca u 7 gatunków porostów oraz w korze drzew i w wyciągach z tej kory. Obliczono stosunek K : Ca. W plechach różnych gatunków porostów zebranych z tych samych drzew stosunek K : Ca waha się od 0.05 — 4.93. W plechach poszczególnych gatunków zebranych z różnych drzew procentowa zawartość badanych kationów jest różna, ale stosunek K : Ca wyraża się mniej więcej stałymi liczbami u poszczególnych gatunków.

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