

## THE RESPIRATORY QUOTIENT IN LICHENS AND MOSSES

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The respiratory quotient was determined by the manometric method in some lichen and mountain moss species. In the lichens *Evernia prunastri* Ach. and *Usnea dasypoga* Röhl. the respiratory quotient was 0,83, and in *Peltigera canina* Willd., *Peltigera variolosa* Gyel. and *Collema* sp. it was 0,74. In the moss leaflets of *Rhytidiadelphus triquetrus* (L.) Warnst., *Pleurozium Schreberi* (Willd.) Mitten., *Dicranum scoparium* (L.) Hedw. and *Mnium undulatum* (L.) Weis. the respiratory quotient is comprised between 0,95 and 0,97 showing practically aiming to unity.

The determination were performed at 25°C and a thallus moisture between 80 and 90 per cent was maintained. The subunitary values in lichens are explained by the fungus respiration, in some macromycetes a quotient of roughly 0,70 being stated by the author. It is suggested that during their respiration the lichens oxidize a substratum built up of a mixture of lipidic, proteic, and other so far unknown substances.

The moss leaflets show the same behaviour as higher plants, which have a respiratory quotient close to unity.

The most numerous investigations on the respiratory quotient were carried out on the higher plant organs, particularly on seeds. Among the lower plants, the algae have been most frequently studied. For lichens and fungi the respiratory quotient was comparatively scarcely studied; as far the moss, we found no bibliographical mention.

The present work reports the results obtained during the summer of 1967 by experiments, aiming to demonstrate the respiratory quotient of some lichens and mountain mosses from the Sinaia area.

The respiratory quotient was determined by the Warburg's manometric method, which proved to be very fitted for a study of the gas exchange, in lichens and mosses. As experimental plants were used



*Evernia prunastri* Ach., *Usnea dasypoga* Röhl., *Peltigera canina* Willd., *Peltigera variolosa* Gyel. and *Collema* sp. among mosses *Rhytidiadelphus triquetrus* (L.) Warnst., *Pleurozium schreberi* (Willd.) Mitten, *Dicranum scoparium* (L.) Hedw., and *Mnium undulatum* (L.) Weis.

In lichens the experiments were performed with whole thalluses or fragments of them, and in mosses with leaflets. The experiment temperature was 25°C, while the moisture of the material was comprised between 80 and 90 per cent.

Table 1

*The respiratory quotient in lichens*

Nr.	Species	t°C	The moisture of the thalluses per cent	The respiratory quotient
1	<i>Evernia prunastri</i>	25°	84,30	0,83 0,83
2	<i>Usnea dasypoga</i>	25°	82,50	0,83 0,83
3	<i>Peltigera canina</i>	25°	80,77	0,74 0,74
4	<i>Peltigera variolosa</i>	25°	80,07	0,74 0,72
5	<i>Collema</i> sp.	25°	90,91	0,74 0,74

The results are synthetized in tables 1 and 2. Thanks to the appropriate data obtained on determinations the tables comprise only two results for each test. As one sees from table 1, in the lichens *Evernia prunastri* and *Usnea dasypoga* the respiratory quotient is 0,83; in *Peltigera canina*, *Peltigera variolosa* and *Collema* sp. it varies between 0,72 and 0,74. As for mosses, as it results from the table 2, their respiratory quotient is comprised between 0,95 and 0,97. that is they aim to unity.

Table 2

*The respiratory quotient in mosses*

Nr.	Species	t°C	The moisture of the thalluses per cent	The respiratory quotient
1	<i>Rhytidiadelphus triquetrus</i>	25°	85,73	0,97 0,97
2	<i>Pleurozium schreberi</i>	25°	83,39	0,97 0,97
3	<i>Diacranum scoparium</i>	25°	85,20	0,95 0,95
4	<i>Mnium undulatum</i>	25°	86,09	0,95 0,95



In the rather scarce literature on this topic we find that in non-gelatinous lichens H. JUMELLE (1892) stated the values of the respiratory quotient, comprised between 0,73 and 0,89 ; in the gelatinous lichens the author found values even less than 0,60. Some what recently J. L. HARLEY and D. C. SMITH (1956) report in *Peltigera polydactyla* a respiratory quotient of 0,69. A. ENSGRABER (1954) also demonstrates a subunitarian quotient in lichens, which — as this author states — is tending to unity when the thalluses are maintained under moisture conditions. The low respiratory quotient during dryness may be explained by a fat development, while in moisture conditions sugars are built up.

The results of our experiments also show in lichens a subunitarian respiratory quotient. Although these results should be interpreted very cautiously, some discussion is useful as regards the lichens.

The lichen respiration is induced by the activity of the organisms : alga and fungus. We know nothing about each partner's quantitative input in the overall respiration, but we have at our disposal some data on each partner's free behaviour.

It is well known that in algae, as W. O. JAMES (1953) states, the respiratory quotient amounts to 1, the algae consumming glucidic substances during their respiration. Experimental data show that in a glucid underlayer oxidation the respiratory quotient amounts to 1, while in proteins and lipids the values are 0,85 and 0,70, respectively.

In fungi, A. MAC MILLAN (1956) and R. G. OWENS (1955) found a subunitarian respiratory quotient. In this respect we made also some respiratory quotient determinations in several macromycetes of the genus *Cortinarius* sp., *Coprinus* sp., and *Hydnum coralloides*, resulting in values between 0,70 and 0,71. These values are consistent with those of lipid oxidation. It is well known that the fungus cell cytoplasm contains high lipid amounts. V. M. COCHRANE (1958) reports the occurrence of high lipid values (20 per cent of the dry weight).

Starting from these data, it is fairly probable, in our opinion, that the subunitarian values of the lichen respiratory quotient are due to the fungus respiration. On the other hand, the fact that the respiratory quotient we found are comprised between 0,74 and 0,83, proves that there is no matter of only lipid consuming by respiration, but of using a substratum built up by a mixture of lipidic, proteic, and possibly other unknown substances.

The chemical substratum of the lichen respiration is not yet known. B. LINDBERG (1960) and more recently G. PUEYO (1960) have pointed out the occurrence in lichens of appreciable amounts of carbohydrates and polyalcohols but we have no knowledge of the role these are playing in the respiratory process.

Nevertheless, if there is rather easy to understand a subunitarian respiratory quotient in heteromorous lichens, where the fungus prevails, this is more difficult to explain in the homeomorous lichens, where the two partners contribution is at least equal, if the gelatinous mass of the *Cyanophyceae* is not even larger than the fungus mass, as in case of *Collema*.

From our data no significant differences result between the respiratory quotient in non-gelatinous and gelatinous lichens. No could be



verified by our experiments. A. ENSGRABER's statements (1954) that moisture conditions result in a respiratory quotient increasing up to unity. Indeed, we maintained during some weeks before the experiment performance the optimum thallus moisture (80 to 90 per cent), but the respiratory quotient did not show values approaching to unity.

The moss respiratory quotient which was found to be close to unity, requires no discussion, because the moss leaflets have the same behaviour as the green leaves in higher plants, where the basic substratum oxidized during the respiration is built up of glucids.

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#### COEFICIENTUL RESPIRATOR LA LICHENI ȘI MUȘCHI

##### Rezumat

S-a determinat coeficientul respirator cu metoda manometrică la câteva specii de licheni și mușchi montani. La lichenii *Evernia prunastri* Ach. și *Usnea dasypoga* Röhl., coeficientul respirator găsit a fost de 0,83, iar la *Peltigera canina* Willd., *Peltigera variolosa* Gyel. și *Collema* sp., de 0,75. La frunzulițele mușchilor *Rhytidiadelphus triquetrus* (L.) Warnst., *Pleurozium Schreberi* (Willd.) Mitten., *Dieranum scoparium* (L.) Hedw. și *Mnium undulatum* (L.) Weis. coeficientul respirator este cuprins între 0,95 și 0,97, tinzând practic spre unitate. Determinările s-au efectuat la 25°C și la o umiditate a talurilor cuprinsă între 80% și 90%.

Valorile subunitare de la licheni sînt explicate prin respirația ciupercilor, al căror coeficient respirator a fost găsit la unele macromicete, și de către autor, în jur de 0,70. Este sugerată părerea că lichenii oxidează în respirație un substrat format dintr-un amestec de substanțe lipidice, proteice și altele încă necunoscute. Frunzulițele mușchilor se comportă ca și frunzele plantelor superioare al căror coeficient respirator este aproape de unitate.