Physiological Variation in Collybia butyracea (Bull.) Fr.

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Collybia butyracea (Bull.) Fr. is a very common fungus in Finland growing both in coniferous and deciduous forests. According to physiological experiments (Lindeberg 1946), it is an active litter decomposer which is able to break down both lignin and cellulose, the main constituents of forest litter. In an experiment (Mikola 1954) attention was caught by its marked ability to attack larch needles, which — as has been shown by several authors — are highly resistant to the activity of saprophytic organisms and are therefore decomposed very slowly in the soil. The fungus also actively decomposed leaf litter, but was almost incapable of attacking pine needle litter. Since the strain used (No. 46) had been isolated from a sporophore growing in a larch stand, there was reason to suspect that different physiological races of *Collybia butyracea* exist and that the respective strain represented a race which had become specialized to grow on larch needle litter. In order to confirm or reject this hypothesis the following experiment was undertaken.

In October of 1955 sporophores of *Collybia butyracea* were collected from different stands in Ruotsinkylä Experimental Forest near Helsinki and several strains were isolated. The following 7 strains were used in the experiment:

No.	Date of collecting	Habitat
1.	1. 10. 1955	Pure spruce stand of *Oxalis-Myrtillus* type
4.	5. 10. 1955	Grey alder stand on mull soil
7.	9. 10. 1955	25-year-old larch plantation on *Oxalis-Myrtillus* site
8.	10. 10. 1955	Old pure pine stand of *Vaccinium* type
12.	13. 10. 1955	Mixed stand of aspen and spruce of *Oxalis-Myrtillus* site
14.	13. 10. 1955	Birch stand of *Oxalis-Myrtillus* type
46.	26. 8. 1952	The same stand as No 7.

2 g of dry litter was put into an Erlenmeyer flask of 150 ml capacity and, after autoclaving, 25 ml of sterile water was added. The flask was then inoculated with a piece of mycelium from an agar plate. Six kinds of litter were tested. Each kind of litter was

Table. 1. Weight loss of litters, as percentage of the original, in 148 days when decomposed by 7 strains of *Collybia butyracea*

Collybia strain No.	Kinds of litter											
	Pleurozium schreberi		*Larix sibirica*		*Pinus silvestris*		*Betula pubescens*		*Populus tremula*		*Alnus incana*	
1	40.3	37.6	44.5	35.5	10.2	12.7	37.2	38.6	43.3	40.9	57.5	68.0
4	41.5	48.0	41.7	39.5	12.7	13.3	36.6	41.2	36.0	35.3	58.0	
7	33.5	35.6	41.5	44.9	6.5	11.2	37.8	44.0	40.1	40.2	59.0	41.1
8	43.3	41.6	37.8	37.4	8.1	14.1	20.1	36.5	55.9	52.6	37.3	40.7
12	43.5	40.2	42.8	43.4	10.9	12.8	37.8	32.7	55.7	39.7	61.2	64.0
14	47.0	36.0	40.3	42.6	10.0	11.5	41.8	33.1	38.5	38.9	56.4	54.0
46	40.5	40.8	35.8	39.1	10.9	7.3	33.7	37.3	37.4	40.3	66.5	63.7

put into 32 flasks, and thus each strain-litter combination was represented by four replicates and four flasks served as controls.

The experiment was started in November, 1955. The first two flasks were harvested after 82 days and the other two after 148 days, by removing the flask contents, drying for 2 days at + 60° C and weighing.

In the first harvest no clear differences were observed between the different strains. Therefore, only the data for the second harvest are presented in Table 1. Since the two replicates diverge considerably in some cases, the individual figures are given, without mean values. Even according to the second harvest divergences between different strains of *Collybia* are not conclusive, although very probable. Especially the strains 7 (from a larch stand) and 8 (from a pine stand) behaved in slightly different ways. Thus, strain 8 decomposed moss and aspen litter faster but larch needles slower than strain 7.

Although the action of the different strains resulted in no appreciable differences in loss

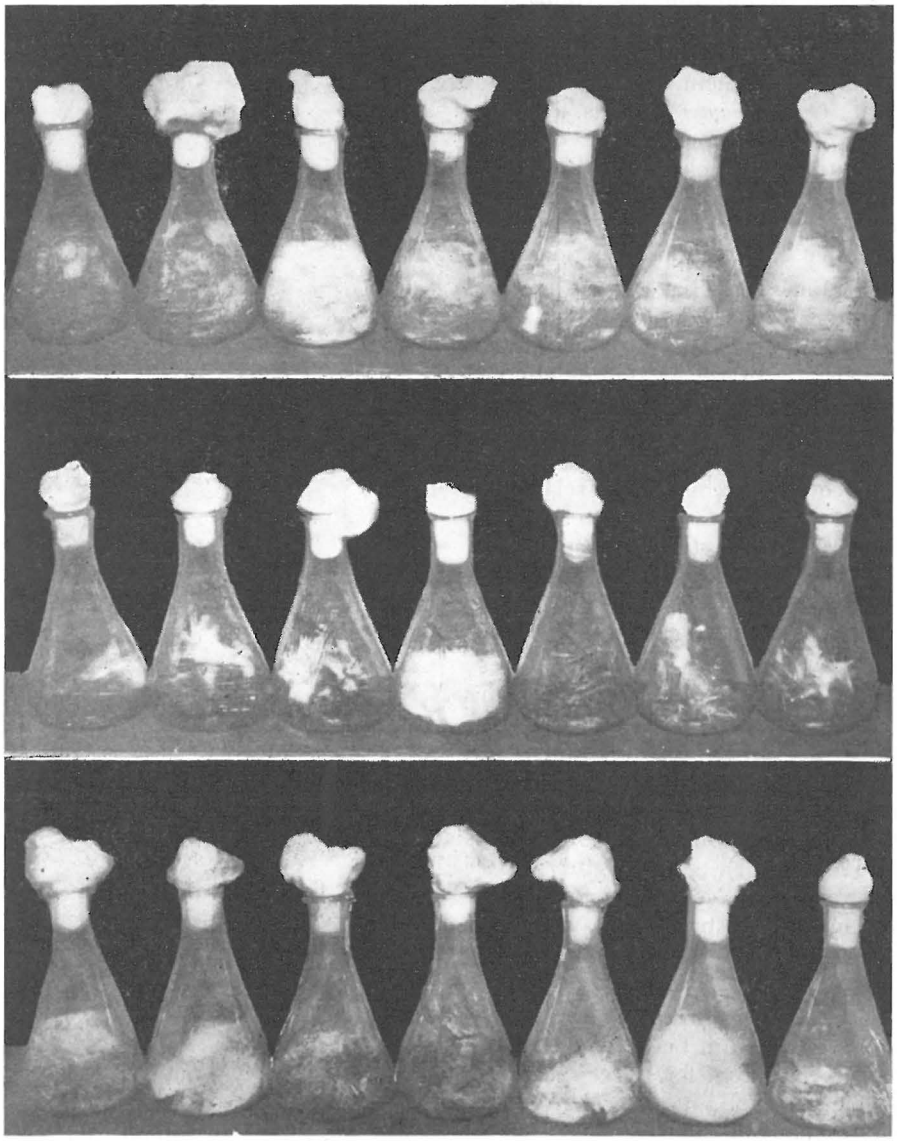

Fig. 1. *Collybia butyracea* growing on litters of larch (above), pine (middle), and alder (below). Strains from left: 1, 4, 7, 8, 12, 14, and 46. Age of cultures 147 days.

of weight of litter, clear differences existed between the growth habits and appearance of the individual strains. In general, on each kind of litter that strain grew best which had been isolated from the stand of the respective tree species. Especially strain 7 on larch needles and strain 8 on pine needles produced a much more profuse aerial mycelium than the other strains (Fig. 1).

Decomposition of litter by *Collybia butyracea* is accompanied by a rapid decolorization, due to decomposition of lignin. The colour changes caused by the different strains were approximately similar; therefore the cellulose and lignin contents were not analyzed at the end of the experiment. In a previous experiment, *Collybia butyracea* was found to decompose cellulose and lignin of birch leaves at approximately the same rate (Mikola 1954), while the strain used by Lindeberg (1946) broke down lignin considerably faster than cellulose.

In connection with harvesting, the pH value of litters was also measured. In this respect no differences between different strains appeared. In the beginning the pH decreased, being 3.0—3.5 in most litters during the first harvesting and then rose by 0.5—1.0 pH units to the second harvesting.

In the second experiment the relation of the same *Collybia butyracea* strains to hydrogen ion concentration was studied. The method and the nutrient solutions were the same as those used by Modess (1941) and Lindeberg (1944). Six replicates were used. The results are presented in Fig. 2.

The pH requirements of the six strains isolated in 1955 were approximately the same, all strains having the optimum round pH 4.0. It can be noticed, however, that at a relatively high pH (6.0) the strains that had been isolated from deciduous forests (Nos. 4, 12 and 14), grew slightly better than the strains from coniferous forests. On the other hand, the strain from the alder stand grew remarkably well also at pH 3.0.

The old strain 46 differed from the other strains, its pH optimum being higher. Since it had been cultured for three years on Hagem agar (pH 5.5), its pH requirements had perhaps changed slightly.

The growth rates of all seven strains on agar were also almost the same, as is shown

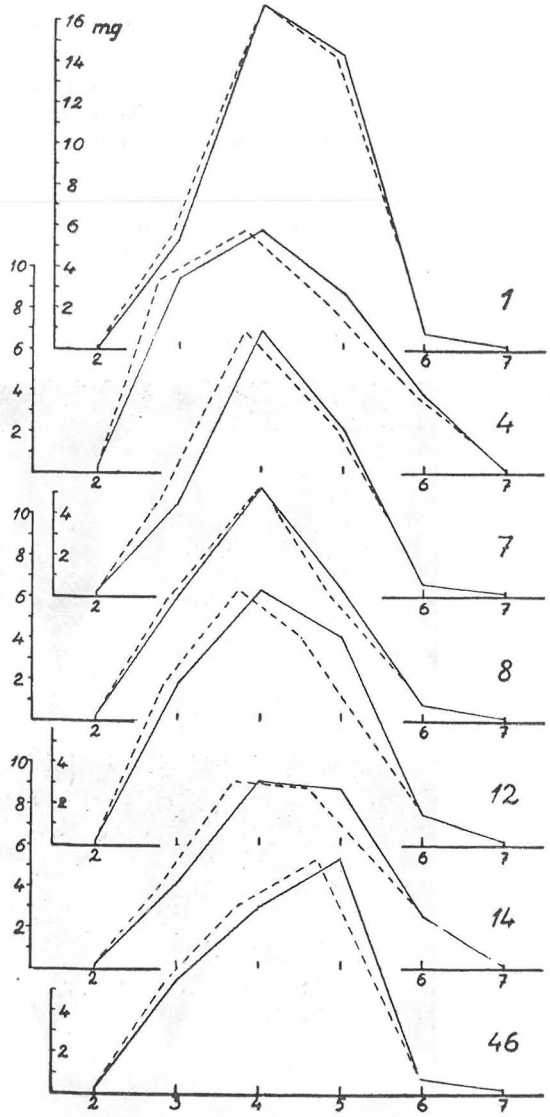

Fig. 2. Relation of seven strains of *Collybia butyracea* to the hydrogen ion concentration of the substrate, plotted against the initial (solid line) and final (dotted line) pH values. Time of incubation: 21 days.

by the following diameters (means of 4 replicates) of colonies at the age of 14 days:

Strain No.	1	4	7	8	12	14	46
Diameter, mm	39.5	50.8	53.8	43.8	54.5	59.0	38.3

Some degeneration, i.e. reduction of growth rate and activity, during prolonged cultivation is a common phenomenon in fungi. The same is seen in strain 46, although in slight degree.

Discussion

Among parasitic fungi physiological races generally exist which differ from each other in regard to their pathogenicity and host species requirements. Corresponding phenomena among saprophytic fungi have been but little studied. Above is described an experiment designed to throw light on whether *Collybia butyracea* growing in larch forest was superior to other strains of the same fungus in decomposing larch needle litter. Differentiation was very slight, however; strains from deciduous forests decomposed larch needles at the same rate as strains from larch forest. The other differences between the seven strains studied were likewise small.

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