

A Comparative Study of Certain Fungi Cultivated on Carbohydrate Media

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This study was undertaken in the hope that some further light may be thrown on the reaction of fungi to certain carbohydrates when they are grown in a carbohydrate medium.

Many years ago Knudson, 1917, working in the laboratories at Cornell University, discovered that the roots of green plants become discolored and partially disintegrate when they are grown on an agar medium containing galactose as a component, but on the other hand no deleterious effects were observed when other sugars such as sucrose and glucose were used as an agar ingredient.

Because of the nature of their cell wall, fungi often react somewhat differently from the ordinary green plant in their behaviour toward certain ingredients found in their immediate culture media.

For that reason six species of fungi from as many genera were selected for this study. To provide as great a variety over as wide a range as possible the fungi were chosen to represent the Phycomycetes, the Ascomycetes and the Fungi Imperfecti. *Phytophthora cactorum* and *Saprolegnia ferox* were selected to typify the Phycomycetes in this study, *Sclerotinia cinerea* and *Phylospora cydoniae* represented the Ascomycetes, while *Alternaria* and *Rolfisia* covered the Fungi Imperfecti.

The three basic media chosen for the experiment were those of Czapek, Waksman, and Sabouraud. The principal ingredients in these media are:

| Czapek | Waksman | Sabouraud |
|---|---|-------------|
| 2 NaNO ₃ | 5 Peptone | 10 Peptone |
| 1 KH ₂ PO ₄ | 1 KH ₂ PO ₄ | 15 Agar |
| .5 MgSO ₄ .7H ₂ O | .5 MgSO ₄ .7H ₂ O | 10 Sugar |
| .01 FeSO ₄ | 15 Agar | Litre Water |
| 15 Agar | 10 Sugar | |
| 10 Sugar | Litre Water | |
| Litre Water | | |

The four carbohydrates, selected as ingredients in each of the basic media chosen, were glucose, sucrose, galactose and starch. Galactose being the supposedly toxic carbohydrate was chosen in contrast to the simple non-toxic carbohydrates, namely glucose, sucrose and starch.

The rate of growth of the fungi and the abundance of mycelium produced on the galactose media were compared with the rate of growth and abundance of mycelium when the fungi were grown on a non-galactose but carbohydrate media.

In the beginning the main difficulty was to establish a method to grow the fungi under uniform conditions of temperature and moisture and to record the data at approximately uniform intervals.

The fungi were developed in medium sized petri dishes. Sets of six cultures were prepared for every different test made. Readings were taken daily and graphs were made from the average of readings from every set of six similar cultures. The cultures were grown in the dark in an incubator at a constant temperature of 25°C.

On recording the data as to rate of growth in equivalent increments of time it was found, that unlike the results obtained when green plants were grown on galactose media, and their roots, according to Knudson and others, showed evidence of toxic effects, the fungi here tested showed no discoloration of mycelium nor any indication of disintegration of hyphae.

In most cases tested the abundance of mycelium produced was slightly less when the fungi were grown on a galactose agar media than the quantity of growth that resulted when the fungi were grown on glucose, sucrose or even starch agar media.

The rate of growth was also slightly less in most cases and there was some indication of irregularities in the mycelial hyphae as was evidenced by swellings that appeared in various cells of the fungous filaments when the fungi were grown on galactose agar media. The size of the colony and the width of the hyphal threads were less in all cases in growths made on galactose agar cultures.

Horr (1936), working at the University of Kansas, and investigating *Aspergillus niger* and *Penicillium glaucum*, found that the mycelium was produced more abundantly and more quickly when the fungi were grown on glucose agar than when the fungi were cultivated on a galactose agar media. He ascribed the reduction in the quantity of growth and the presence of abnormal structures in the hyphal threads to the toxic effect of the galactose in the agar media.

However, Horr limited his work to the study of two species of fungi and furthermore made his experiments by growing the fungi in liquid media. He then collected the mycelium, dried the hyphal mass and estimated the gain or loss on a percentage basis. Under those conditions Horr found that the galactose media always proved to be a toxic or at least a slightly inhibitory culture media.

The results of the present study, obtained by using a greater number and variety of fungi, parallel in many respects the fungous changes observed by Horr in his studies on *Aspergillus niger* and *Penicillium glaucum*, but in addition the results also seem to indicate that galactose as an ingredient of an agar media does not exert the same definitely deleterious effect on the mycelium of fungi as it does on the roots of green plants, such as the garden pea. The difference in behavior toward galactose between green plants and fungi may be due in part to the nature of the fungous wall, to the manner of feeding by the fungus or to the ability by the fungus to more readily utilize the galactose.

In all cases observed there was some slight retardation in the rate of fungous growth, a slight depreciation in the abundance of mycelium formed, a slightly narrower hyphal thread, some reduction in the size of colony formation, and an increase in the abnormal structures formed.

The fungi are slightly retarded in their growth responses in the presence of galactose in the media, but there is no prolonged retardation of growth, either in rate, or in abundance of mycelium, and there is never any evidence of discoloration or disintegration of the mycelium. This may be due to resistance on the part of the fungus or to its manner of securing and synthesizing food materials.

Several suggestions have been made to explain the deleterious effect of galactose on the growth and development of plants in artificial culture. Knudson suggests in his studies on pea that the toxicity might be due to the oxidation products of galactose. Maximov on the other hand believes that the retardation in growth is due to the slower utilization of galactose by plants due to the peculiar structural configuration of galactose. Horr working with *Aspergillus niger* and *Penicillium glaucum*, thinks that the retardation in growth and the development of abnormal structures are due to the fact that galactose is a poor source of carbon.

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