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STUDIES ON THE NUTRITION OF FUNGI

Effect of Various Combinations of Monosaccharides on the Growth of Five Different Fungi

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Effect of four monosaccharides, glucose, xylose, fructose and galactose and their different combinations, on the growth of *Helminthosporium nodulosum* (Berk. et Curt.) Sacc., *Curvularia verruculosa* Tandon et Bilgrami, *Aspergillus nidulans* (Eidam) Wint., *Phaeoramularia* sp. and *Paecilomyces varioti* Bain, was determined in liquid culture medium. It was observed that combination of these sugars yielded better growth than the individual sugars alone. It may be postulated that a certain sugar can be better utilized in the presence of another sugar or one sugar supplements the utilization of another sugar.

Introduction

It is recognized that species of fungi vary in their ability to utilize different sugars for growth and development. In natural conditions fungi rarely, if ever, come in contact with single sugars. Studies on the utilization of various sugars have been carried out in these laboratories for the past two years. Effect of different sources and concentrations of carbon on the growth of different fungi had been studied.[1–3] Combined effect of different sugars on various fungi have also been studied by some workers.[4,5] It was therefore, considered proper to study the conbined effect of these sugars on the growth of certain fungi so as to compare and study the differences, if any, between the utilization of a single sugar and a mixture of few of them. To begin with, the effect of a mixture of various monosaccharides was studied and the results were compared with the utilization of the individual sugars of the mixture.

Materials and Methods

The following fungi were used:

(1) *Paecilomyces varioti*, *Aspergillus nidulans*, *Phaeoramularia* sp. *Curvularia verruculosa* and *Helminthosporium nodulosum*. The constituents of the culture medium, were sodium nitrate 2.0 g, potassium dihydrogen phosphate 1.0 g, potassium chloride 0.5 g, magnesium phosphate 0.5 g, ferrous sulphate 0.01 g, distilled water to make 1000 ml.

To this basal Czapek's medium the mixture of monosaccharides was added instead of sucrose. The percentages of monosaccharides were calculated with the help of molecular weights of the respective sugars and a carbon concentration of 2% was used for each sugar. Glucose, xylose, fructose and galactose were used as representative members of monosaccharides. Combinations of sugars employed were:—

(1) Glucose+xylose, (2) galactose+glucose, (3) xylose+galactose, (4) fructose+glucose, and (5) fructose+galactose.

The fungi were grown on Czapek's solid medium which served as a source of inoculum. 50 ml of Czapek's liquid medium were poured into 250-ml flasks. Mixture of different sugars was added into the flasks. The same percentage was used throughout the experiment. The flasks containing Czapek's medium and sugars were autoclaved at 15 pound pressure for 15 min at 121°C and were allowed to cool at room temperature and then inoculated with 4 mm discs cut from the growing edges of a 4-day old culture of different fungi. The pH of the medium was adjusted to 6.5 and the flasks were incubated at room temperature.

After incubation the mycelial mat was filtered on preweighed filter papers. The mycelium was dried at 60°C for 24 hr and filter papers were reweighed. The difference of the two weights gave the net weight of the mycelium. The experiment was replicated three times and the results presented in this paper are mean of three readings.

Results

The utilization of different carbon compounds and their mixture by different fungi was determined after 10 days. Sucrose was replaced by other monosaccharides or their mixtures. Caramalization of the sugars was largely avoided by careful autoclaving, although this usually occurred to some extent. The pH value of the resultant solutions after the addition of the monosaccharides was adjusted to 6.5. Among five fungi *Helminthosporium nodulosum* proved to be the best fungus in sugar utilization followed by *Curvularia verru-*

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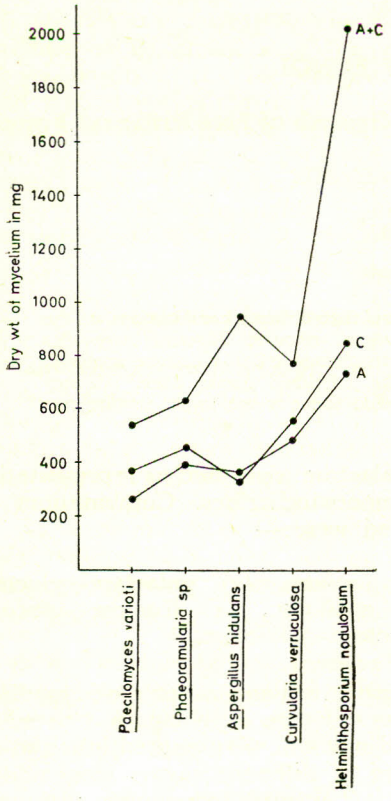

Fig. 1.—Effect of glucose + fructose along with their individual effect on the growth of five fungi (A glucose; C fructose).

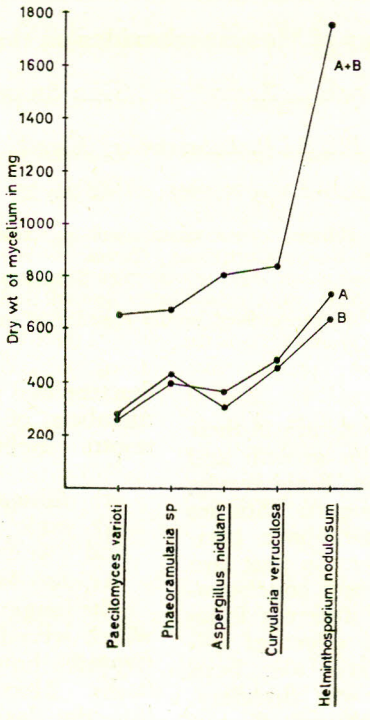

Fig. 2.—Effect of glucose + xylose (A glucose; B xylose).

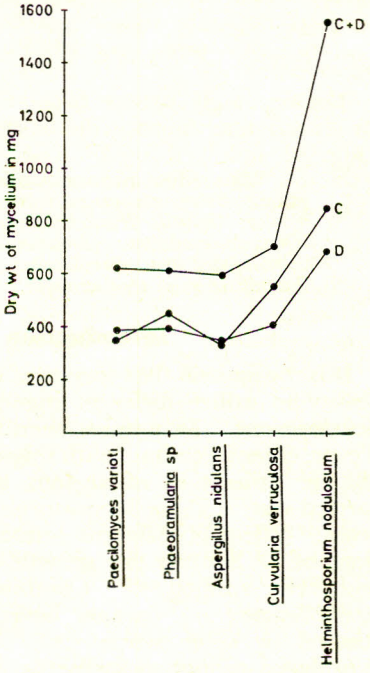

Fig. 3.—Effect of fructose + galactose: (C fructose; D galactose).

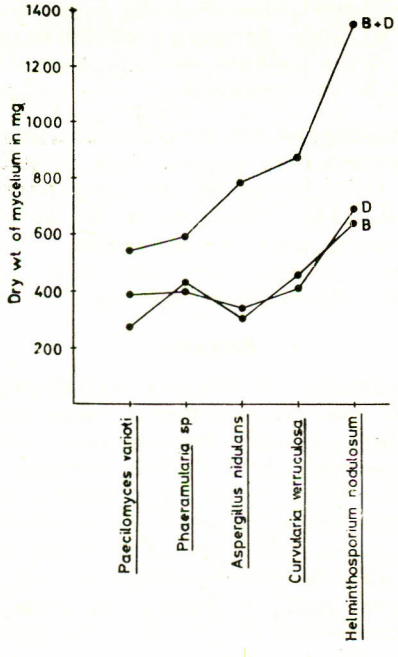

Fig. 4.—Effect of xylose + galactose (B xylose; D galactose).

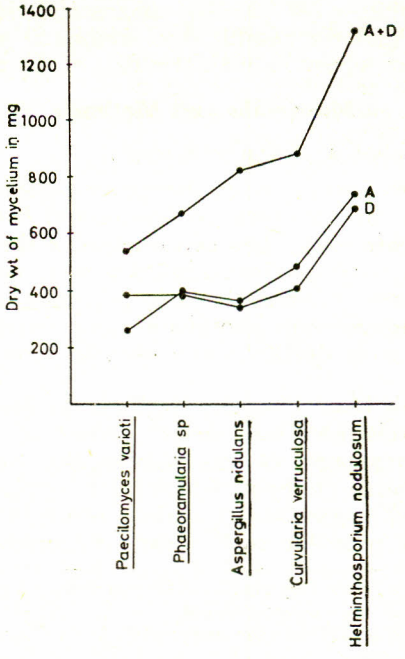

Fig. 5.—Effect of glucose + galactose (A glucose; D galactose).

culosa, *Aspergillus nidulans*, *Phaeramularia* sp. and *Paecilomyces varioti*. Fructose+glucose (Fig. 1) produced the maximum growth of *Helminthosporium nodulosum* 2027 mg followed by glucose+xylose (Fig. 2) 1763 mg, galactose+fructose (Fig. 3) 1557 mg, xylose+galactose (Fig. 4) 1354 mg, and galactose+glucose (Fig. 5) 1319 mg.

Among single sugars *Helminthosporium nodulosum* produced maximum growth in fructose 850 mg (Fig. 1), followed by glucose 736 mg (Fig. 2), galactose 683 mg (Fig. 4), and xylose 639 mg (Fig. 4).

The mixture of galactose+glucose (Fig. 5) yielded 878 mg of *Curvularia verruculosa* mycelium followed by xylose+galactose (Fig. 4) 867 mg, glucose+xylose (Fig. 2) 844 mg, fructose+glucose (Fig. 1) 770 mg, and fructose+galactose (Fig. 3) 702 mg. The amount of mycelium produced by *Curvularia verruculosa* with individual sugars was in the following order: fructose 555 mg, glucose 484 mg, xylose 454 mg, and galactose 404 mg.

Fructose+glucose (Fig. 1) produced the highest amount of growth of *Aspergillus nidulans* 925 mg, followed by galactose+glucose (Fig. 5) 821 mg, glucose+xylose (Fig. 2) 807 mg, xylose+galactose (Fig. 4) 784 mg, and galactose+fructose (Fig. 3) 594 mg. Among individual sugars glucose produced the highest amount of growth of *Aspergillus nidulans* 363 mg, followed by galactose 348 mg, fructose 330 mg, and xylose 301 mg.

Galactose+glucose (Fig. 5) yielded 667 mg of mycelium of *Phaeramulria* sp. followed by glucose+xylose (Fig. 2) 665 mg, fructose+glucose (Fig. 1) 629 mg, galactose+fructose (Fig. 3) 610 mg and xylose+galactose (Fig. 4) 587 mg. Fructose individually produced 453 mg of mycelium followed by xylose 428 mg, glucose 396 mg, and galactose 394 mg.

The last set of experiment was that of *Paecilomyces varioti*. The amount of growth was considerably less throughout the experiment. The combination of glucose+xylose (Fig. 2) produced 653 mg of mycelium. The other results were in the following order. Galactose+fructose (Fig. 3) 619 mg, xylose+galactose (Fig. 4) 545 mg, galactose+glucose (Fig. 5) 542 mg and fructose+glucose (Fig. 1) 536 mg. Among the individual sugars galactose produced 388 mg, fructose 366 mg, xylose 274 mg, and glucose 260 mg.

Discussion and Conclusion

The present investigation demonstrated that the fungi used in the present studies showed a tendency towards better utilization of a mixture of two sugars than the individual sugars alone. This probably may be due to the fact that one sugar supplements the other which results in better utilization of the mixture or in other words a certain sugar can be better utilized in the presence of another sugar and this fact has also been proved by other workers.[4]

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