

Potential Use of Rum Distillery Slops as Animal Feed Supplement

I. Mold Growth in Slops¹

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ABSTRACT

Consideration of the nutritional value of slops suggested its use as growth media for the production of fodder molds. Rum distillery slops supported better mold growth than the medium recommended for its growth. Best results were obtained with strain *Aspergillus phoenicis* isolated from contaminated slops in our laboratory.

INTRODUCTION

The revenue from rum sales in Puerto Rico amounts to more than 160 million dollars yearly. It is presently threatened by the industry's inability to dispose properly of its effluents. Yearly a total of 300 million gallons of slops, with a biological oxygen demand (BOD) of 30,000-40,000 ppm are dumped into land and coastal waters. The Environmental Protection Agency (EPA) has ruled that this industry must find a solution to the problem before 1983. Realizing the magnitude of this problem and the catastrophic effect that it could have upon the economy of Puerto Rico, we initiated at the Rum Pilot Plant of the Agricultural Experiment Station several years ago a research and development program in this area.

The high polluting power of rum slops requires intensive methods for their proper treatment. One of these research areas includes the fermentation of slops with fodder yeasts and molds to enrich its protein content for its potential use as animal feed supplement. Consideration of the nutritional value of rum slops suggested its potential as a growth medium for the production of fodder yeasts and molds. These microorganisms are important sources of food because their cell matter is specially rich in most B-group vitamins and in protein which contains essential amino acids.

Mycelial fungi appear to possess certain characteristics such as texture, better protein profile, and relatively easy and cheap harvesting, that make them preferable as starting microorganisms in particular cases (9). Hasseltine (4) reviewed in detail works dealing with food of the world prepared by the fermentation action of fungi on various plants and animal materials. It may vary from the most simple to such highly specialized

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processes as the production of shoya in the Orient. Among the advantages of fungi fermentation is that they presumably enhance the digestibility of foods as a result of enzymatic modifications, increase in vitamin content, and addition of flavor which helps in the acceptability of the product for human consumption.

The use of members of the class Fungi Imperfecti as sources of protein food was investigated by Gray et al. (2). These researchers noted that the amino acid composition of fungal mycelia as a source of essential amino acids with a high caloric value was as satisfactory nutritionally as casein. Gray enthusiastically exposed (3) the growth of fungi on agricultural wastes as a partial solution to the world food problems.

The mycelial fungi species *Aspergillus*, *Fusarium* and *Rhizopus* are among those studied in this regard (1, 5, 6, 7). Working with 23 fungi species, Reade (5) found that *Aspergillus oryzae* was most suitable for fermentation of barley. The fungal protein is closely related to the FAO's standard, and thus represents, in nutritional terms, the first vegetable protein with the biological value of animal protein (8). This fact is very important because millions of people, for religious or other reasons, do not eat meat, and yet need the nutritional benefits of animal protein.

If rum distillery wastes prove valuable for the growth of Fungi Imperfecti, a very economic way of increasing the production of edible protein will be available. In this case, rum slops, instead of being an undesirable waste, would become a valuable agricultural and industrial by-product. Interest in this research area deserves our attention, and the present study constitutes the first such work initiated in Puerto Rico.

MATERIALS AND METHODS

Laboratory scale experiments were conducted to determine growth curves for strains available at the Rum Pilot Plant. The following molds strains were tested for this purpose:

- H-3- *Aspergillus niger*, ATCC 10864
- H-4- *Aspergillus niger*, ATCC 13497
- H-5- *Aspergillus niger*, ATCC 15475
- H-6- *Aspergillus phoenicis*
- H-7- *Aspergillus flavus*, variable strain
- H-8- *Penicillium jenseni*
- H-9- *Penicillium crustosom*
- H-10- *Aspergillus flavus*
- H-11- Predominantly *P. jenseni* but not identical with H-8, extremely variable and overgrown
- H-12- *Aspergillus phoenicis*
- H-13- *Aspergillus phoenicis*

Strains H-6 to H-13 were isolated in the Rum Pilot Plant from contam-

inated slops and identified by Dr. Dorothy I. Fennell from the Northern Regional Research Center, U.S. Department of Agriculture.

Purified cultures of mold strains H-3 to H-7 were transferred from potato dextrose agar (PDA) slants to 50 ml potato dextrose broth (PDB), a nutrient media recommended for mold growth. Samples were agitated continuously at room temperature with a mechanical shaker, and harvested at 0, 1, 2, 3, and 4 days' growth. The mycelium was separated with Gooch filters, and dried in a vacuum oven at 60° C. Dried mycelium weight was determined and a growth curve was traced for each strain studied.

TABLE 1.—Dried mycelium weight of mold strains grown in PDB (mg/50 ml)

Mold strain	Growth days				
	0	1	2	3	4
H-3	13.0	55.2	114.3	125.4	175.5
H-4	13.7	85.3	123.0	102.7	187.5
H-5	11.3	46.0	119.1	100.3	121.1
H-6	8.8	69.8	177.0	173.1	135.7
H-7	6.1	52.8	90.3	107.8	116.4

TABLE 2.—Dried mycelium weight of strains grown in slops (mg/50 ml)

Mold strain	Growth days				
	0	1	2	3	4
H-3	91.4	77.5	219.8	253.5	452.2
H-4	92.7	95.9	223.0	166.1	249.6
H-5	87.1	89.5	311.7	—	275.0
H-6	77.7	96.8	299.6	265.4	468.5
H-7	56.8	40.8	345.6	237.3	566.7
H-8	51.8	44.9	357.8	534.8	596.4
H-9	77.3	28.8	336.3	508.7	580.3
H-10	53.4	222.2	451.7	535.2	622.4
H-11	53.5	52.5	307.5	416.9	544.9
H-12	39.1	214.4	523.2	757.9	815.9
H-13	62.3	134.1	614.8	745.0	857.0

Following the same procedure, growth curves were traced for strains H-3 to H-13 in sterile distillery slops.

RESULTS AND DISCUSSION

Results are presented in tables 1 and 2 and figures 1 and 2. Slops supported better mold growth than potato dextrose broth. Best results were obtained with strains H-12 and H-13, both of which, *Aspergillus phoenicis*, were isolated from contaminated slops in our laboratory. Strain H-7, *Aspergillus flavus*, produced 11.3 g/l of mycelium in slops vs. 2.3 g/l in potato dextrose broth. The maximum mycelium weight obtained in slops was equivalent to 17 g/l vs. 3.5 obtained in PDB.

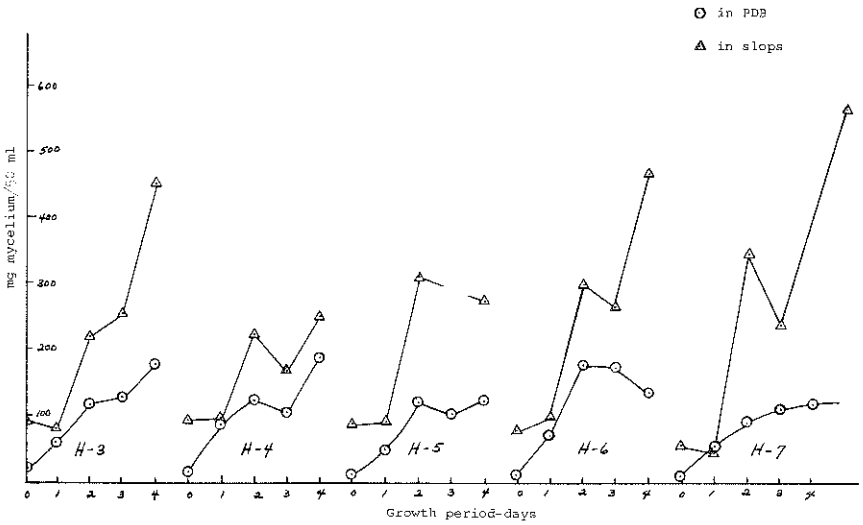


FIG. 1.—Growth of various mold strains.

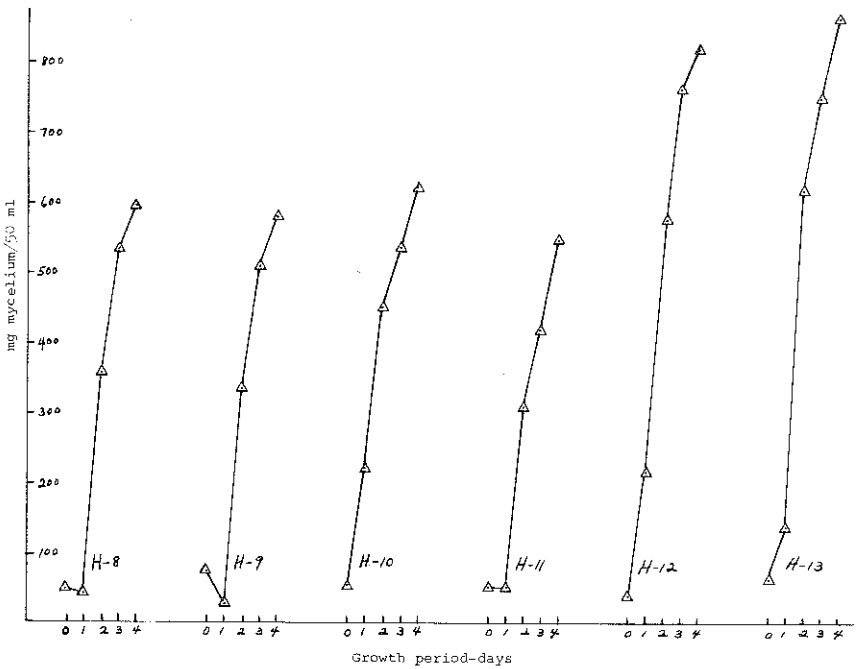


FIG. 2.—Growth curves of various mold strains in slopes.

RESUMEN

Se estudió el potencial nutritivo del mosto como medio de cultivo para el crecimiento de hongos. Se obtuvo mejor crecimiento en mosto estéril que en el medio de cultivo recomendado para crecer estos hongos. De 11 cepas de hongo estudiadas resultó mejor la cepa H-13, *Aspergillus phoenicis*, aislada en nuestro laboratorio de mosto contaminado.

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