A Research Note

Effect of Glucose Concentration on Recovery of Fungi from Foods

JOHN A. KOBURGER* and M. F. RODGERS

Food Science and Human Nutrition Department
University of Florida, Gainesville, Florida 32611

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ABSTRACT

Glucose was added to Standard Methods agar in amounts between zero and 2.0% to determine its effect on recovery of fungi from 49 food samples. Analysis of the data showed highly significant differences between glucose concentrations; with the best recovery of fungi occurring when the medium contained between 0.1 and 0.5% glucose.

During an earlier study (4) of media used for fungal counts in foods, one of the factors that appeared to influence recovery was glucose concentration. Of the five media investigated, the two representing the extremes in glucose concentration, zero and 2.0%, ranked lowest in recovery. With the growing concern among microbiologists of the presence of fungi and their metabolites in foods, any factor which might enhance recovery of these organisms seemed worth pursuing. Therefore, a study was initiated in which only the glucose concentration was altered in an otherwise adequate recovery medium. Glucose concentrations between zero and 2% were selected because culture media used in fungal enumeration most often contain concentrations in this range (2), and addition of greater amounts would not have yielded any usable information.

MATERIALS AND METHODS

The 49 food samples used in this study consisted of fish, beef, nuts, flour, water, fruits, vegetables and spices and were obtained in the Gainesville, Florida area. The basal medium was Standard Methods agar made from the separate ingredients. Only the glucose concentration was changed. A basal broth was prepared to minimize mixing errors and contained distilled water, 0.5% tryptone and 0.25% yeast extract. The broth was then divided into five portions; glucose was added; depending on the concentration desired: 0.0, 0.1, 0.5, 1.0, 2.0 (w/v) and 1.5% (w/v) agar was added to each portion. The media were adjusted to a pH of 7 ± 0.1 and sterilized at 121 C for 15 min. Preparation and plating of the samples and addition of the antibiotic solution to give a final concentration of 100 mg each of chloramphenicol and chlorotetracycline/liter followed the method outlined in the Compendium (1). Dilutions were plated in triplicate to minimize plating errors and incubated at 25 C for five days.

RESULTS AND DISCUSSION

The fungal count (mostly yeasts) for each of the 49 samples was observed and the log averages calculated for the various treatments (Table 1). The analysis of variance revealed highly significant differences between glucose concentrations. To best determine a trend in the differences between concentrations, we performed a quadratic regression analysis using the dependent variable \( Y = \log \text{(counts)} \) and the independent variable \( X = \log (1 + 10 \times \text{dilution}) \). The choice of \( Y = \log \) (counts) was made to equalize the variance within high and low counts. The choice of \( X = \log (1 + 10 \times \text{dilution}) \) was made to obtain values of \( X \) which were as equally spaced as possible and thereby to reduce the bias in the regression curve.

The analysis of variance showed significant linear and quadratic effects. A test for lack of fit of the quadratic regression was not significant at the .05 level.

The equation of the quadratic curve is

\[
Y = 3.0747 + 0.0635 X - 0.0250 X^2
\]

The fact that the coefficient on \( X \) (0.0635) is positive and that on \( X^2 \) (-0.0250) negative indicates that the counts increase with increasing glucose concentration, reached a maximum, and then decreased as the glucose concentration was further increased. Tests of significance that

<table>
<thead>
<tr>
<th>Percent glucose</th>
<th>0.0</th>
<th>0.1</th>
<th>0.5</th>
<th>1.0</th>
<th>2.0</th>
</tr>
</thead>
<tbody>
<tr>
<td>Log averages CFU/g</td>
<td>3.08</td>
<td>3.10</td>
<td>3.12</td>
<td>3.08</td>
<td>3.03</td>
</tr>
</tbody>
</table>

\(^1\)Florida Agricultural Experiment Stations Journal Series No. 1261.
the linear and quadratic coefficients were positive and negative were conducted and were highly significant \((p < .01)\) for both tests. This is strong statistical evidence that, in fact, the counts increased initially, reached a maximum, and then decreased as the glucose concentration increased. Figure 1 shows a plot of the fitted curve \(Y = \log \text{ (count) }\) plotted against glucose concentration.

The data indicate that glucose concentration is an important variable in recovery of naturally occurring fungal populations from foods. Concentrations between 0.1 to 0.5% glucose resulted in better recovery than the more frequently used 1.0 to 2.0% glucose. Numerous factors have been shown to affect the recovery of microorganisms (3-8), however, the mode of action of glucose in this study cannot be stated with certainty. Interpretation of the data from a practical standpoint indicates some rather unexpected findings. While actual differences may seem small, recovery at the 0.5%-glucose level was approximately 20% greater than at the 2.0% level of addition; the amount found in Potato Dextrose agar. Recovery at zero and 1.0% glucose was comparable; although we tend to think of fungi as requiring carbohydrates for growth. Natural populations of fungi responded to the effect of glucose addition, indicating that the observed response may be broadly based within this group for microorganisms. This study points out the need for additional investigation into the factors affecting fungal recovery from foods.

**ACKNOWLEDGMENTS**

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**REFERENCES**


Figure 1. A fitted curve for \(Y = \log \text{ (count) }\) plotted against glucose concentration.