Inhibition by Adenine of \textit{Staphylococcus aureus} Growth in a Nutrient Medium Free from Guanine, Guanosine, or Hypoxanthine

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In this note, we report the inhibition of \textit{S. aureus} growth by adenine or adenosine, and the ability of guanine, guanosine, or hypoxanthine to overcome this inhibition.

This investigation initiated from an observation that, on plates containing a minimal medium free from guanine, growth of \textit{S. aureus} colonies was partially inhibited in the presence of adenine. In a subsequent study, \textit{S. aureus} Wood 46 was grown in Roux bottles in a nutrient medium free from nucleic acids or their metabolites (J. de Repentigny, S. Sonnea, and A. Frappier, J. Bacteriol. 88:844, 1964); purine bases or their ribosides were added to the medium, at a concentration of 0.25 umole/ml. Growth was estimated by optical density measurements at a wavelength of 500 nm, with a Coleman Junior spectrophotometer, and also by viable-cell counts on plates containing nutrient agar (Difco). Typical results are presented in Table 1. After 7 or 11 hr of growth, the optical density and the viability of staphylococci grown in the presence of adenine were about half those of the control. This degree of inhibition could not be increased with higher concentrations of adenine. No changes were observed when guanine or hypoxanthine was added to the minimal medium, but normal growth was almost completely restored by guanine in the presence of adenine. Hypoxanthine had a similar restoring effect, although to a lesser degree.

The purine ribosides could also produce similar effects: adenosine decreased the growth in the same way as adenine, and guanosine or hypoxanthine could restore normal growth in the presence of adenosine (Table 2).

\begin{table}[h]
\centering
\begin{tabular}{|c|c|c|}
\hline
\textbf{Substances added} & \textbf{Effect after 7 hr} & \textbf{Effect after 11 hr} \\
\hline
none & \text{OD} & \text{Viable units} & \text{OD} & \text{Viable units} \\
\hline
adenine & 0.37 & $5.4 \times 10^6$ & 0.67 & $1.2 \times 10^9$ \\
adenine + guanine & 0.29 & $5.0 \times 10^6$ & 0.62 & $0.9 \times 10^9$ \\
adenine + hypoxanthine & 0.24 & $4.7 \times 10^6$ & 0.58 & $0.7 \times 10^9$ \\
\hline
\end{tabular}
\caption{Effect of purines on the growth of \textit{Staphylococcus aureus} Wood 46}
\end{table}

\begin{table}[h]
\centering
\begin{tabular}{|c|c|c|}
\hline
\textbf{Substances added} & \textbf{Optical density} \\
\hline
none & 0.37 & 0.67 \\
adenosine & 0.18 & 0.41 \\
guanosine & 0.35 & 0.64 \\
adenosine + guanine & 0.33 & 0.62 \\
adenosine + guanosine & 0.20 & 0.63 \\
adenosine + hypoxanthine & 0.25 & 0.60 \\
\hline
\end{tabular}
\caption{Effect of purine ribosides on the growth of \textit{Staphylococcus aureus} Wood 46 in the absence or in the presence of purines}
\end{table}

These results show that adenine or adenosine can inhibit the growth of a strain of \textit{S. aureus} in the minimal medium employed, and that guanine,
guanosine, or hypoxanthine can overcome this inhibition. We later obtained similar results with *S. aureus* strain 18.

It is already known that the purines may be determinants of virulence in some bacterial species (G. A. Bacon, T. W. Burrows, and M. Yates, Brit. J. Exptl. Pathol. 32:85, 1951); thus, it seems possible that the particular pattern of purine utilization by *S. aureus* may influence the severity of staphylococcal infections.

**ADDENDUM IN PROOF**

Recently, we observed that inosinic acid and inosine can also restore normal growth of *S. aureus* Wood 46 in the presence of adenine.

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