Antimicrobial Activity of the Ornithine-containing Lipid Isolated from *Gluconobacter cerinus*

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Ornithine-containing lipids have been found in a wide range of bacterial species. However, the physiological function of these lipids remains unclarified. In our previous works, the occurrence of three ornithine-containing lipids was found in the bacterial cells of *Gluconobacter cerinus*; one of the three lipids was identified as N$\gamma$-3-hydroxypalmitoylornithine, to the fatty acid moiety of which 2-hydroxy fatty acid is linked by an ester linkage, and another, as 2-hydroxy fatty acid ester of N$\gamma$-3-hydroxypalmitoylornithyllaurine. In a further examination to know the physiological function of the three lipids, we have found that all the three lipids have a capacity of inhibiting the cell growth of various species of microorganisms. This communication describes the antimicrobial effect of the major one of the three ornithine-containing lipids.

The major lipid, 2-hydroxy fatty acid ester of N$\gamma$-3-hydroxypalmitoylornithine, was isolated from the lyophilized cells of *Gluconobacter cerinus* IFO 3267 by the method described previously. The lipid preparation, dissolved in a mixture of chloroform-methanol (2:1) and stored at -20°C until required, was used for the antimicrobial assay.

The antimicrobial spectrum of the lipid is shown in Table I. The ornithine-containing lipid has a broad spectrum of antibacterial effect on a number of gram-negative and gram-positive bacteria. Especially, the growth of *Alcaligenes faecalis*, *Bacillus subtilis*, *Escherichia coli* and *Pseudomonas aeruginosa* was intensely inhibited at the concentration used. In addition, this lipid showed a growth-inhibitory effect on a variety of yeasts and fungi such as *Candida albicans*, *Cryptococcus neoformans*, *Saccharomyces cerevisiae* and *Aspergillus niger*. The effect of the lipid on the bacterial species were examined with a synthetic liquid medium (Fig. 1). The cell growth of *E. coli* and *P. aeruginosa* was completely inhibited at the concentration of 360 and 480...
FIG. 1. Effect of the Ornithine-containing Lipid on the Bacterial Growth.

The bacterial cells of E. coli IAM 1264 (A) and P. aeruginosa IFO 3445 (B) were grown with shaking at 30°C in 5 ml of a synthetic medium containing glucose 1%, KH₂PO₄ 0.1%, (NH₄)₂SO₄ 0.1%, NaCl 0.5% and MgSO₄·7H₂O 0.04% (pH 7.0). The ornithine-containing lipid was added to the medium, when the bacterial cells were inoculated. ○, no lipid; ●, 240 µg/ml; △, 360 µg/ml; ▲, 480 µg/ml. Above the concentration, all the bacterial cells were killed in the incubation.

The transmethylation of this lipid with 0.5 N sodium methoxide in methanol solution gave two compounds, a decylated lipid and a methyl ester of fatty acid. The decylated lipid, N₃-3-hydroxypalmitoylornithine, was also found to possess an inhibitory activity and its antimicrobial spectrum was almost identical with that of the native compound.

It has been known that a chemically synthesized amino-lipid, N-lauroyl-L-valine, inhibits the growth of plant pathogenic fungi such as Rhizoctonia solani and Pyricularia oryzae. Siolipin A, a lysine-containing lipid from Streptomyces sioyaensis, was reported to have a similar effect on the growth of Bacillus subtilis, but no inhibition was observed in other bacteria. To our best knowledge, there are no reports concerning such a growth-inhibitory effect in the ornithine-containing lipids of other bacteria. Therefore, our interest lies in the study on relationship between the antimicrobial activity and the structure of these ornithine-containing lipids, and it is now in progress.

The detailed description of this work will be presented later.

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