Short Paper

Effect of Visible Light on Marine Pigmented and Non-pigmented Bacteria*¹

Various pigmented bacteria have been isolated from sea water as well as terrestrial materials. The carotenoid pigments of microorganisms have been shown to exert a protective effect against lethal photoproducts¹⁾. SIEBURTH²⁾ found in Narragansett Bay of the American Atlantic coast that organisms with orange pigment were more abundant during the periods of maximal solar radiation, those with yellow pigment during the periods of minimal solar radiation. All we know with some certainty is that the toxicity of O₂ to microorganisms can be greatly enhanced if the cells are exposed to light in the presence of air and of certain pigments, known as photosensitizers, and that carotenoid pigments are to act as quenchers of singlet-state oxygen. However, the influence of the sunlight on the viability of microorganisms in sea water is still made clear very little. The authors examined in this experiment the effect of sunlight or mercury-vapor lamp on the viability of pigmented and non-pigmented bacteria isolated from sea water.

Test strains used in this experiment are 7K-606 (*Flavobacterium* sp.), 8K-V2 (*Chromobacterium* sp.) and 1055-1 (*Alteromonas haloplanktis*, identified by DAIKU *et al.*). Strain 7K-606 contains carotenoid pigments, including zeaxanthin (56%) and β -carotene (12%) (personal communication from TANAKA). Strain 8K-V2 produces a violet pigment; absorption maxima in ethanol (580 nm) and in 10% H₂SO₄/ethanol (700 nm) appear to be characteristic of violacein³⁾. Both the strains were isolated from sea water in Kinko Bay. Test strains were grown on ZoBELL 2216E agar medium for 1-3 days at 25°C. Bacterial cells were harvested from agar plates and washed with artificial sea water (ASW). Suspensions in ASW (optical density at 540 nm was about 0.1, pH 7.6) were irradiated in petri dish (90 mm) with a lid to eliminate UV wave in the case of mercury lamp (7,000-10,000 lx) and in Pyrex culture tube (18 × 180mm) with a plastic closure in the case of sunlight (on Jan. 27th, 40,000-70,000 lx). Control plates (tubes) were wrapped with aluminium foil.

The survival curves of test strains during irradiation of sunlight are presented in Fig. 1. Strain 1055-1

Fig. 1. Survival of bacterial suspensions during exposure to sunlight.

—▲—, in the presence of methylene blue (dark);
—△—, (light); —●—, in the absence of methylene blue (dark); —○—, (light).

(non-pigmented) was not killed by exposure (4 h) to sunlight in ASW suspension. However, strain 1055-1 was inactivated by sunlight in the presence of methylene blue (10 µg/ml). Bengal rose, safranin, acridine orange, crystal violet, as well as methylene blue, reacted as exogenous photosensitizers in the experiment by use of mercury lamp. Strain 7K-606 was more resistant than strain 1055-1 to photodynamic action in the presence of methylene blue. On the contrary, 8K-V2 was sensitive to photo-induced cell death among test strains and inactivated by exposure to sunlight without an exogenous photosensitizer. This observation suggests that strain 8K-V2 has endogenous photosensitizer(s). In such case, it is important that further studies will be carried out to determine whether a violet pigment accumulated in the cells reacts as an endogenous photosensitizer.

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References

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