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The Swarming *Bacillus* species in Fishery Products

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The swarming *Bacillus* species that are encountered in fishery products were found to be *B. subtilis, B. coagulans, B. alvei, B. pumilus, B. brevis* and *B. megatarium.* Variation in colony size among individual species was quite evident which could be attributed to strain variation.

Key words : Swarming, *Bacillus* spp., fishery products.

The swarming of bacteria is described as a behavioural response resulting in movement of highly elongated swarm cells across the surface of a solid medium in periodic cycles of movement and consolidation (Williams & Schwarzhoff, 1978). This property is exhibited by some bacterial groups, the prominent being members of the genera *Vibrio, Proteus* and *Bacillus.*

Considerable work has been carried out on the swarming phenomena of *Proteus* spp. and *Vibrio alginolyticus* (Naylor, 1964; Jones & Park, 1967; Henrichsen, 1972; DeBoer et al., 1975; Ulitzur, 1975). However limited information is available on swarming of the *Bacillus* species (Anon, 1980; Sneath, 1984) although it forms a major component of many agricultural products, cosmetics and environmental samples. Effect of various chemical agents on the swarming of *Bacillus* has been studied in detail (Thampuran & Surendran, 1996) and a medium has been formulated, which, by arresting the swarming of *Bacillus*, makes enumeration of bacteria (TPC) of fishery products more accurate (Thampuran & Surendran, 1993). The present paper describes the spreading *Bacillus* species that are commonly encountered in the fishery products.

The fishery products included in the study were dried, cured, pickled or canned fish and prawn. They were procured from the retail stores or the market. These samples were pour plated on tryptone glucose agar medium as per the procedure outlined earlier (Thampuran & Surendran, 1993). From the plates, typical swarming colonies were isolated preferably from the edge of the colony and maintained for further study on nutrient agar slopes. The speciation of the isolates was accomplished by the scheme of Berkley *et al.* (1984). The swarming capacity of the isolate was determined by the method described elsewhere (Thampuran & Surendran, 1996).

Table 1. Swarming *Bacillus* spp. isolated from various types of fishery products

Species	Percentage isolation from		
	Dried/ cured fish	Pickled fish	Canned fish
B. subtilis	30	44	20
B. coagulans	40	28	Nil
B. alvei	10	4	40
B. brevis	5	4	Nil
B. pumilus	5	8	20
B. megatarium	Nil	4	Nil
Unidentified	10	8	20

Swarming *Bacillus* species that are frequently encountered in various types of

fishery products are summarised in Table 1. *B. subtilis*, *B. coagulans* and *B. alvei* were the dominant swarmers present in pickled, dried/cured, and canned fish & prawn, respectively. *B. pumilus*, *B. brevis* and *B. megatarium* were the other members of swarming population that occurred in low numbers.

Table 2. The range of colony diameter observed in different *Bacillus* spp.

Colony diameter	*B. subtilis* %	*B. coagulans* %	*B. alvei* %
Low < 1.0	17	23	-
Medium 1-2	44	39	50
High > 2	39	38	50

The colony diameter of the individual cultures was determined and based on the colony diameter, they were grouped into low, medium and high swarmers. The percentage distribution of the dominant *Bacillus* species categorized on the basis of colony diameter, into three groups is presented in Table 2. It was seen that in the case of *B. subtilis* isolates, majority were high swarmers. All the isolates that belonged to *B. alvei* were either medium or high swarmers. Other members like *B. brevis* and *B. pumilus* which constituted minor fraction showed high levels of swarming. It is clear from the study that swarming tendency of the individual members within each species differed considerably. It has been stated that the surface of colonies of the *Bacillus* vary a great deal depending on environmental factors such as composition of medium, temperature, incubation temperature and humidity (Sneath, 1984). All these conditions having been maintained constant in the present study, the variation in colony size should be attributed to strain variation.

Figures 1 and 2 illustrate the colony morphology of the selected *Bacillus* species.

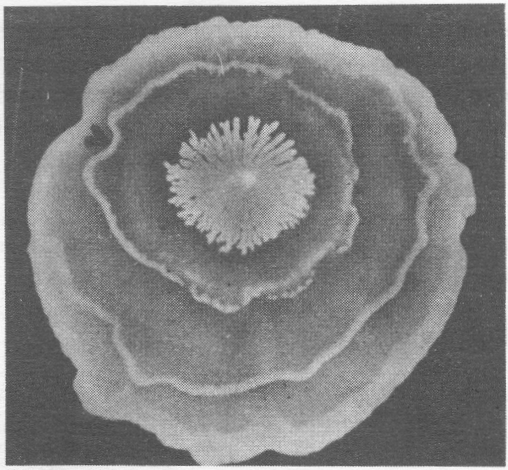

Fig. 1. Active growth of a single colony of *Bacillus subtilis* after incubation for 24 h at 37°C in tryptone glucose agar. Mark (^) indicates swarm band.

The swarm bands seen in the photograph are the result of the zonation phenomenon. The phenomenon described in the case of *Proteus* (Williams & Schwarzhoff, 1978) was clearly noticed in the case of *Bacillus* also.

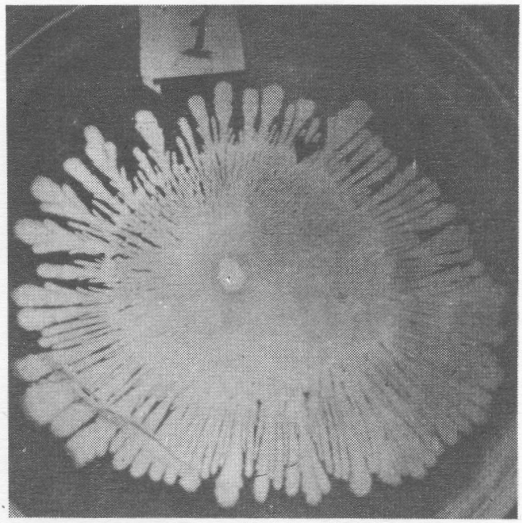

Fig. 2. Active growth of a single colony of *Bacillus coagulans* after incubation for 24 h at 37°C in tryptone glucose agar. Mark (^) indicates swarm band.

Since swarming tendency is a relative function of enhanced growth rate, any

signal physical or chemical, that triggers phenotypic change associated with swarm cell formation (Belas *et al.*, 1986) may lead to the overgrowth and proliferation of these bacteria in the fishery products.

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