

sp. Strain 3B (Petrova, 2006) and pathogenic *Vibrios*. The study reveals the potential use of this enzymes in the fish processing industry to convert waste to wealth and the possibility of new strain or species among the Subtilis group.

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Immobilization and sulphur oxidation capability of sulphur oxidizing bacteria

Ranjit Kumar Nadella, Basha K.A., Muthulakshmi T. and Prasad M.M.

ICAR-Central Institute of Fisheries Technology, Cochin

Sulphur oxidizing bacteria (SOB) are one group of beneficial bacteria capable of utilizing toxic form of sulphur produced by a group of bacteria called sulphur reducing bacteria (SRB) in natural environment during anoxic conditions (Friedrich *et al.*, 2001). The autotrophic SOB plays an important role in sulphur cycle in maintaining the levels of hydrogen sulphide. The count

of these bacteria in water and soil are usually very low and depend on the availability of the sulphur compounds in oxidized state. Natural polymers such as chitin, alginate, cellulose and chitosan are commonly used as carrier materials for immobilization of microorganisms where the bacterial cells are trapped. However, there is no such study on the immobilization of SOB. The present study is carried out to immobilize

the SOB using alginate and to characterize their oxidation potential.

Autotrophic SOB was isolated from mangrove soils near Ernakulam, Kerala by employing Starkeys mineral salt medium (MSM) (Veerender *et al.*, 2014). Out of 96 bacterial cultures, four isolates (SC-10, DN-5, SB-1 and SD-6) were selected for immobilization studies based on their pH reduction ability. Sodium alginate (100 ml) solution was prepared as per Smidsord and Skjak-Break (1990) with the addition of freshly grown SOB bacterial isolates (2×10^6 CFU ml⁻¹) into a strong cationic solution of 0.1 M strontium chloride solution (Himedia, Mumbai, India). Round beads formed in the solution are collected into a separate beaker with strontium chloride and left undisturbed for 1 h for complete hardening. The beads consist of the SOB trapped inside it. The beads were washed with sterile distilled water for several times and stored at 4°C for further studies.

The sulphur oxidation potential of the beads was studied by inoculating the immobilized beads in various numbers (10, 50 and 100) in triplicates into 100 ml of MSM broth added with BPB to monitor the pH change. After inoculation the flasks were incubated at 30 °C for a period of one week and monitored the pH change using a pH meter (Eutech Instruments, Mumbai, India). Sulphur oxidation capability of these bacterial isolates was measured in terms of sulphate

ion (SO₄²⁻) produced in the medium by using spectrophotometer (O.D.₄₅₀ nm).

When inoculated with 10, 50 and 100 number of immobilized beads, isolate SD6 showed maximum sulphate ion production (18.79, 19.04 and 21.95 mg ml⁻¹, respectively). The colour change is observed from blue to yellow during the growth of bacteria which is an indication of reduction in pH. Similarly, pH values are recorded in the range of 2.98 (Isolate SC-10; 100 beads) to 3.20 (Isolate SB-1; 10 beads). The size of beads ranged from 0.5 to 0.7 mm (Fig. 1). When the bacteria are immobilized by using suitable carrier material they have several advantages i.e. more tolerance to environmental conditions, optimized cell density, prolonged retention time and adequate protection from growth inhibitory substances such as antibiotics. Immobilized bacteria can also enhance the rate of sulphur oxidation which occurs slowly in normal conditions. Therefore, the use of immobilized SOB may be used as bio-inoculants in aquaculture farms to control the hydrogen sulphide toxicity thus providing a low cost management of eco-friendly technique.

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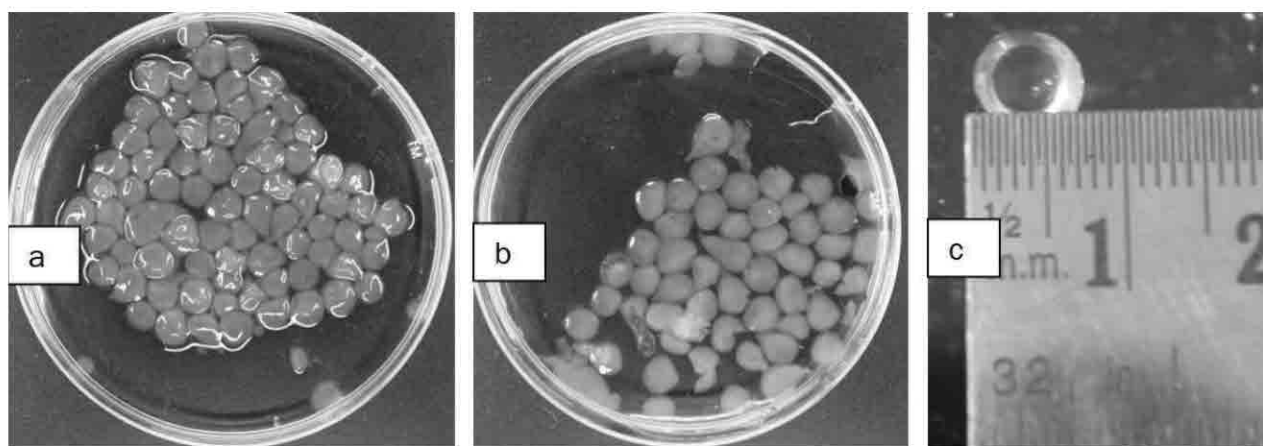


Fig. 1. Images of beads prepared with 3% sodium alginate. a) Control beads b) SOB immobilized beads c) showing size of bead

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“CIFTFISHPRO” - An information system on ICAR-CIFT value added fish products

Joshy C.G., Shyla N.C., George Ninan and Ravishankar C.N.

ICAR-Central Institute of Fisheries Technology, Cochin

ICAR-CIFT, being a technology institute, has developed different types of value added fish products meant to enhance the livelihood of the society. These technologies are being transferred to the stakeholders through teaching and training. As a part of this, the knowhow about the technologies are printed in hardbound forms like leaflets, brochures, bulletins etc. As our country is progressing towards digital India, time has come to move from hardbound informations to digital information systems. This would allow the users to access the tangible information in their fingertips easily, irrespective of the location. By keeping this in view, ICAR-CIFT has developed “CIFTFISHPRO” - an information system on ICAR-CIFT value added fish products.

CIFTFISHPRO is an interactive information system with simple and easy navigation to access the contents. The system starts with an introduction about value added fish products, and further provides information on series of fish products. It gives an introduction about the product, information about ingredients required and step-wise method of preparation of the product. The series of fish products includes coated fish products like fish cutlets, fish fingers, fish burger, fish balls etc.; marinated products like fish and prawn pickles; extruded products like fish kure and noodles; wrapped fish products like fish momos, fish kebabs, fish samosa and fish rolls; cured products like dried fish and prawn

and other products like fish sausage and prawn chutney powder. This also contains a contact form through which user can post any query by just mentioning name, e-mail id and content of the query; this would enable the experts from ICAR-CIFT to give reply to the query immediately.

Another interactive feature of CIFTFISHPRO is that the system will help the user to upscale the production of each product by automatically calculating the ingredients requirement for a given quantity of raw fish. The system also gives an option to the user to enter the input cost of the ingredients. This would give the user a broad idea about the total cost incurred while up-scaling the production of the product.

CIFTFISHPRO is available in the URL <http://ciftfishpro.cift.res.in>. This system has a home page, which contains product banners, an introduction, list of fish products, a contact form and contact us; the inner page contains list of fish products with a hyperlink to each product and up-scaling page for each product with a hyperlink. The home page of CIFTFISHPRO is developed in hypertext preprocessor (PHP) and hypertext markup language (HTML), the inner page is developed in HTML and up-scaling page is developed by using HTML and JAVA script. CIFTFISHPRO is a dynamic system as it can interact with the users and it can be updated at any time.