CHAPTER I
INTRODUCTION

Surfactants are widely used for various purposes in industry, and most surfactants used are mainly chemically synthesized. In the past few decades, biological surface-active compounds (biosurfactants) have gained prominence and have already taken over for a number of important industrial uses, due to their superior properties biodegradability, production from renewable resources and functionality under extreme conditions; particularly those pertaining during tertiary crude-oil recovery. However, high costs of biosurfactants are a main obstruction to their application. At present, their uses are mainly in the oil and petroleum industries, where they are employed primarily for their emulsification capacity in both tertiary recovery and polluted-sites remediation. Although initial interest and applications are primarily in the area of petroleum engineering and enhanced oil recovery, new applications in medicine, cosmetic and food industries have be recognized. Probably the most important advantage of biosurfactants over chemical surfactants is their ecological acceptability. Many chemically synthesized surfactants cause ecological problems owing to their resistance to degradation, toxicity, and accumulation in natural ecosystems. On the other hand, biosurfactants are biodegradable. However, biosurfactants have several drawbacks:

(1) poor yields from raw substrate materials
(2) high capital investment
(3) need for sterilisation
(4) problems in the control of the process, for example, foaming
(5) problems in product recovery and purification
(6) difficulties in analysing the finished products chemically due to their complex nature

Microorganisms which produce biosurfactants, and the structures of produced biosurfactant, are listed in Table 1.1 Certain microorganisms are likely to be found to be better adapted to particular environments, such as oil reservoirs, soils and deep sea. Rhamnolipids produced by *Pseudomonas* and *Bacillus* were reported to be insentived to the change of pH, temperature, salinity, calcium or magnesium at concentrations in excess of those found in many oil reservoirs in Venezuela (Rocha *et al.,* 1992). *Bacillus licheniformis* strain JF-2, isolated from oil field injection water, was found to produce biosurfactants under both aerobic and anaerobic conditions (Jenneman *et al.,* 1983; Javaheri *et al.,* 1985). *Bacillus* strain SP018 was found to tolerate anaerobic conditions at 50°C and < 10% NaCl while producing biosurfactants (Pfiffner *et al.,* 1986). Two biosurfactant-producing *Bacillus* strains, AB-2 and Y 12-B, were also isolated from oil sludge-mixed sand and had the ability to grow on hydrocarbon-containing medium at -<50°C (Banat *et al.*, 1993).

Table 1.1 Various biosurfactants produced by microorganisms

Microorganism	Biosurfactant	Reference
Arthrobacter RAG-1	hetropolysaccharides	Rosenberg *et al.* (1979)
Arthrobacter MIS38	lipopeptide	Morikawa *et al.* (1993)
Arthrobacter sp.	trehalose, sucrose and fructose lipids	Suzuki *et al.* (1974) Itoh *et al.* (1974)
Bacillus licheniformis JF-2	lipopeptides	McInerney *et al.* (1990)
Bacillus licheniformis 86	lipopeptides	Horowitz *et al.* (1990)
Bacillus subtilis	surfactin	Arima *et al.* (1968)
Bacillus pumilus A1	surfactin	Morikawa *et al.* (1992)
Bacillus sp. AB-2	rhamnolipids	Banat (1993)
Bacillus sp. C-14	hydrocarbon–lipid–protein	Eliseev *et al.* (1991)
Candida antarctica	mannosylerthritol lipid	Kitamoto *et al.* (1992)
Candida bombicola	sophorose lipids	Gobbert *et al.* (1984)
Candida tropicalis	mannan–fatty acid	Kappell and Fiechter (1976)
Candida lipolytica Y-917	sophoros lipid	Lesik *et al.* (1989)
Clostridium pasteurianum	neutral lipids	Cooper *et al.* (1980)
Corynebacterium hydrocarbolastus	protein–lipid–carbohy.	Zajic *et al.* (1977)
Corynebacterium insidiosum	phospholipids	Akit *et al.* (1981)
Corynebacterium lepus	fatty acids	Cooper *et al.* (1979)
Strain MM1	glucose, lipid and hydroxydecanoic acids	Passeri (1992)
Nocardia erythropolis	neutral lipids	MacDonald *et al.* (1981)
Ochrobactrum anthropii	protein	Wasko and Bratt (1990)
Penicillium spiculisporum	spiculosporic acid	Ban and Sato (1993)
Pseudomonas aeruginosa	rhamnolipid	Robert *et al.* (1989)
Pseudomonas fluorescens	lipopeptide	Neu *et al.* (1990)
Phaffia rhodozyma	carbohydrate–lipid	Lesik *et al.* (1991)
Rhodococcus erythropolis	trehalose dicorynomycolate	Shulga *et al.* (1990)
Rhodococcus sp. ST-5	glycolipid	Abu-Ruwaida *et al.* (1991*a*)
Rhodococcus sp. H13-A	glycolipid	Singer and Finnerty (1990)
Rhodococcus sp. 33	polysaccharide	Neu *et al.* (1992)
Torulopsis bombicola	sophorose lipids	Inoue and Ito (1982)

Biosurfactants are mainly classified in to four categories, glycolipid, phospholipid, lipopeptide, 4.polymeric, based on the structure of their hydrophilic part. Among these biosurfactants, glycolipid biosurfactants have been most intensively studied because their production yields are much higher than those of other types of biosurfactants. The production of biosurfactants suitable for specific applications and the development of high added value properties is the central part of the future research development project (Figure 1.1), reinforced by structured screenings and computational monetization.

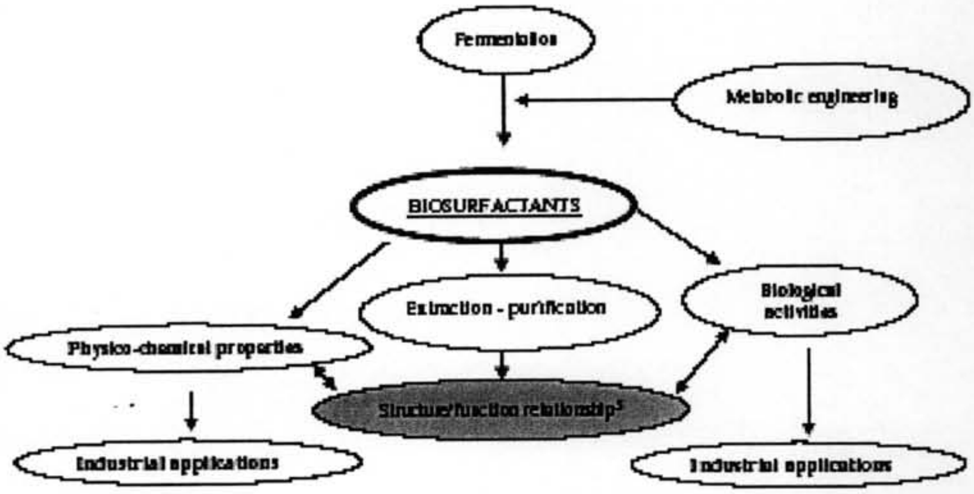

Figure 1.1 Pathways for biosurfactants production and applications

The objective of the present work were to isolate biosurfactant-producing bacteria from oil sludge and to characterize the produced biosurfactants. In addition, the effectiveness of the produced biosurfactants toward oil recovery was investigated.