LIST OF FIGURES, PLATES AND TABLES.

List of Figures

Fig. 2.1.A1 pH Scale.
Fig. 2.1.A2 Extremophilic groups at various pH ranges.
Fig. 2.2.A Schematic representation of the possible mechanism involved in the function of alkaline saline lake.
Fig. 2.3.A Schematic representation of cytoplasmic pH regulation.
Fig. 2.4.A A diagrammatic summary of properties of alkaliphilic bacilli relating to their bio-energetics.
Fig. 2.1.B Chemistry of starch.
Fig. 2.2.B Reaction mechanisms of various amylases.
Fig. 2.3.B Enzymatic action of β-amylase on amylose and amylopectin.
Fig. 2.1.C Part structure of dextran.
Fig. 2.2.C Structure of extracellular polysaccharide of *X. Campestris* according to Jansson *et al*.
Fig. 2.3.C Pathway for the biosynthesis of an exopolysaccharide.
Fig. 2.4.C Possible mechanism for the synthesis and assembly of bacterial EPS.
Fig. 3.1 % Distribution of enzyme activity in alkaliphiles.
Fig. 3.2 % Distribution of multiple enzyme production by alkaliphiles.
Fig. 3.3 Total multiple enzyme production by alkaliphiles.
Fig. 4.1 Growth profile of SB-D in different media at pH 10.3 & 25°C.
Fig. 4.2 Growth profile of SB-W in different media at pH 10.3 & 25°C.
Fig. 4.3 Growth profile of SB-W at 25°C and 55°C.
Fig. 4.4 Growth profile of SB-W in Horikoshi I medium at pH 7.4 and 10.3 at 25°C and 55°C.
Fig. 4.5 Effect of Glucose and starch concentrations on growth of SB-D and SB-W at 25°C.
Fig. 4.6 Concentration of glucose and starch in Horikoshi medium during growth of SB-D and SB-W at 25°C.
Fig. 4.7 Growth profile of SB-D in presence or absence of Sodium in Horikoshi I medium.
Fig. 4.8 Growth profile of SB-W in presence or absence of Sodium in Horikoshi I medium.
Fig. 4.9 Change of external pH during growth of SB-D and SB-W in Horikoshi medium.
Fig. 4.10 Volume of KOH required for change of 1 pH unit by alkaliphiles and neutrophiles.
Fig. 4.11 Volume of KOH required for change of 1 pH unit by facultative and obligate alkaliphile.
Fig. 5.1 Growth profile of SB-D and SB-W in Horikoshi II medium.
Fig. 5.2 Residual starch during growth of SB-D and SB-W in Horikoshi II medium.
Fig. 5.3 Starch utilised during growth of SB-D and SB-W in Horikoshi II medium.
Fig. 5.4 Effect of temperature on growth of SB-D and SB-W and residual starch.
Fig. 5.5 Effect of pH on growth of SB-D and SB-W and residual starch.
Fig. 5.6 Effect of agitation rate on growth of SB-D&SB-W & residual starch.
Fig. 5.7 Effect of inoculum density on growth of SB-D and SB-W and residual starch.
Fig. 5.8 Effect of yeast extract concentration on growth of SB-D and SB-W and residual starch.
Fig. 5.9 Effect of starch concentration on growth of SB-D and SB-W.
Fig. 5.10 Relation between residual starch and reducing sugar.
Fig. 5.11 Effect of pH on purified amylase activity of SB-D and SB-W.
Fig. 5.12 Effect of temperature on purified amylase activity of SB-D & SB-W.
Fig. 5.13 pH stability of SB-D amylase after one hour at 25°C.
Fig. 5.14 pH stability of SB-W amylase after one hour at 55°C.
Fig. 5.15 Thermostability of SB-D amylase.
Fig. 5.16 Thermostability of SB-W amylase.
Fig. 5.17 Activity of amylase from SB-D and SB-W in presence of organic solvents.
Fig. 5.18 Activity of amylase from SB-D and SB-W in presence of detergent additives.
Fig. 5.19 Activity of amylase from SB-D & SB-W in presence of metal ions.
Fig. 6.1 Effect of static, shaker & shaker+static condition on growth of SB-D.
Fig. 6.2 Effect of static, shaker and shaker + static conditions on cell mass of SB-D.
Fig. 6.3 Effect of static, shaker and shaker + static conditions on viscosity during growth of SB-D.
Fig. 6.4 Effect of static, shaker and shaker + static conditions on total yield of EP during growth of SB-D.
Fig. 6.5 Effect of static, shaker and shaker + static conditions on change in pH during growth of SB-D.
Fig. 6.6 Effect of agitation rate and incubation at different time intervals under static conditions on cell mass.
Fig. 6.7 Effect of agitation rate and incubation at different time intervals under static conditions on viscosity.
Fig. 6.8 Effect of agitation rate and incubation at different time intervals under static conditions on yield of EP.
Fig. 6.9 Effect of agitation rate on pH at different time intervals of static conditions.
Fig. 6.10 Relationship of incubation period, cell mass production and appearance of G2 in SB-D.
Fig. 6.11 Effect of flask size to volume ratio on cell mass, viscosity and G1 production.
Fig. 6.12 Effect of inoculum size on cell mass, viscosity and G1 production.
Fig. 6.13 Effect of Glucose concentration on cell mass, viscosity and G1 production.
Fig. 6.14 Effect of Yeast extract concentration on cell mass, viscosity and G1 production.
Fig. 6.15 Gas chromatogram of standard sugars.
Fig. 6.16 Gas chromatogram of alditol acetate derivatives of hydrolysed EP (G1) of Bacillus alkalophilus SB-D.
Fig. 6.17 Gas chromatogram of alditol derivatives of hydrolysed EP (G2) of Bacillus alkalophilus SB-D.
List of Plates

Plate 3.1  Samples from Zuari Industries Limited, Goa.
Plate 3.2  Samples from Deodani Kyars Sambar Salt Lake, Rajasthan.
Plate 3.3  Characteristic salt precipitation at pH 10.5.
Plate 3.4.1-3.4.12  Morphological characteristics of Alkaliphilic isolates.
Plate 4.1.1-4.1.2  SEM of Triton untreated and treated Bacillus alkalophilus SB-D.
Plate 4.1.3-4.1.4  SEM of Triton untreated and treated Bacillus coagulans SB-W.
Plate 4.2  SDS-PAGE Profile of Whole cell proteins extracted from Bacillus coagulans SB-W and Bacillus alkalophilus SB-D before and after Triton treatment.
Plate 4.3  SDS-PAGE Profile of Whole cell proteins extracted from Bacillus coagulans SB-W and Bacillus alkalophilus SB-D.
Plate 4.4  SDS-PAGE Profile of Whole cell proteins extracted from Bacillus alkalophilus SB-D grown on different media.
Plate 4.5  Endospores of Bacillus alkalophilus SB-D.
Plate 4.6  Needle like crystals and Capsules of Bacillus alkalophilus SB-D.
Plate 5.1  Amylase activity of SB-D and SB-W at neutral and alkaline pH.
Plate 5.2  Amylase activity of culture supernatant of Bacillus alkalophilus SB-D on starch agar during growth (h).
Plate 5.3  SDS-PAGE profile of amylase enzyme.
Plate 6.1  Alcian Blue adsorption assay for cell bound/cell free exopolymers.
Plate 6.2.1-6.2.2  Viscosity of culture broth of Bacillus alkalophilus SB-D under unoptimised conditions.
Plate 6.2.3-6.2.4  Viscosity of culture broth of Bacillus alkalophilus SB-D under optimised conditions.
Plate 6.3  Zones of S1 and S2 on starch agar indicating amylase activity.
Plate 6.4.1  Emulsification activity of culture supernatant of Bacillus alkalophilus SB-D.
Plate 6.4.2  Emulsification activity of cells of Bacillus alkalophilus SB-D.
Plate 6.5  Adhesive property of viscous exopolymer G1.

List of Tables

Table 1.1  Microorganisms under extreme environments.
Table 1.2  Industrial applications of extremophiles.
Table 1.3  Selected companies with extremophile organism or molecular program.
Table 2.1.A  Ecological niches showing presence of alkaliphiles.
Table 2.2.A  Diversity of alkalophilic bacteria.
Table 2.3.A  Intracellular pH values in alkaliphiles at different external pH values.
Table 2.1.B  Enzymes produced by alkaliphiles.
Table 2.2.B  Sources of amylases.
| Table 2.3.B | Characteristics of bacterial amylases under extreme conditions. |
| Table 2.1.C | Commercially important polysaccharides. |
| Table 2.2.C | Exopolymer producing extremophiles. |
| Table 2.3.C | Composition of bacterial exopolymers. |
| Table 2.4.C | Downstream processes for recovery of important exopolymers and biosurfactants. |
| Table 2.5.C | Established applications of microbial exopolysaccharides. |
| Table 3.1 | Description of alkaline samples from treatment tank of an Agrochemical factory, Goa. |
| Table 3.2 | Effect of diluent on viable count of samples from Agrochemical factory. |
| Table 3.3 A | Total viable cell counts of alkaliphiles from natural alkaline environments. |
| Table 3.3 B | Total viable cell counts of alkaliphiles from manmade alkaline environments. |
| Table 3.3 C | Total viable cell counts of alkaliphiles from non alkaline environments. |
| Table 3.4 | Description of samples from Deodani Kyars Sambhar Salt Lake, Rajasthan. |
| Table 3.5 | Total viable cell counts of alkaliphiles and haloalkaliphiles from Sambhar Salt Lake samples. |
| Table 3.6 | A comprehensive presentation of the results on prevalence of alkaliphiles in diverse econiches. |
| Table 3.7 | Distribution and characterisation of alkaliphiles. |
| Table 3.8 | A comprehensive analysis of enzyme activity of alkaliphiles. |
| Table 3.9 | Multiple enzyme production by alkaliphiles. |
| Table 4.1 | Intracellular pH of SB-D and SB-W. |
| Table 4.2 | Volume of KOH required for change of pH by one unit by alkaliphiles and neutrophiles. |
| Table 4.3 | Buffering capacities of alkaliphiles and neutrophiles. |
| Table 4.4 | Effect of medium composition on buffering capacities of SB-D and SB-W. |
| Table 4.5 | Effect of incubation period on buffering capacities of SB-D and SB-W grown in Horikoshi I medium. |
| Table 4.6 | Protein content of Triton untreated and treated cells of SB-D and SB-W. |
| Table 4.7 | Chemical composition of permeabilisation extracts. |
| Table 4.8 | Cultural, biochemical and Chemotaxonomic characteristics of SB-D and SB-W. |
| Table 5.1 | Qualitative analysis of the amylolytic potential of SB-D and SB-W on Horikoshi II medium. |
| Table 5.2 | Monitoring of growth of SB-D and SB-W in various formulations of Horikoshi II medium. |
| Table 5.3 | Effect of different Carbon sources (1%) on growth of SB-D and SB-W. |
| Table 5.4 | Effect of different Nitrogen sources (0.5 %) on growth of SB-D and SB-W. |
| Table 5.5 | Optimized cultural conditions for growth of SB-D and SB-W in Horikoshi II medium. |
| Table 5.6 | Effect of purification on amylase activity of Bacillus alkalophilus SB-D and Bacillus coagulans SB-W. |
Table 6.1 Alcian blue adsorption assay for exopolymers.
Table 6.2 Effect of holding time of static conditions on cell mass, pH, viscosity and polymer production before optimisation.
Table 6.3 Optimised conditions for maximum G1 production by B.alkalophilus SB-D.
Table 6.4 Comparison of polymer production in Horikoshi I medium by SB-D under optimised and unoptimised conditions.
Table 6.5 Yield of soluble and cell associated polymer (G1) in Horikoshi I medium on optimisation.
Table 6.6 Physical characteristics of G1 and G2.
Table 6.7 Chemical analysis of G1 and G2.
Table 6.8 Emulsifying activity of supernatant, cells, EP G1 and G2 of B.alkalophilus SB-D culture in Horikoshi I medium.

Scheme 1 Schematic representation for isolation of sheaths, capsules and slimes.

Scheme 2 Schematic representation for isolation and purification of G1 and G2.