SUMMARY
1. *Aspergillus terreus* Thom, a cellulose degrading fungus was isolated from soil on the basis of zone of clearance on cellulose-agar plates and identified at International Mycological Institute, Kew, Surrey, UK (IMI 355964).

2. *A. terreus* produced the three extracellular cellulolytic enzymes viz. endoglucanase (1.54 U/ml), exoglucanase (0.0042 U/ml) and high levels of β-glucosidase (2.21 U/ml) with cellulose (Sigmacell Type 100) on the 7th day. The enzyme production was favoured with the initial pH of the medium in the range of 4.0 to 5.5.

3. Low constitutive levels of the enzyme were detected in Mandel's basal medium devoid of any carbon source and supplementation of cellulose increased the β-glucosidase activity indicating its inducible nature.

4. Soluble sugars failed to induce the β-glucosidase activity. Cellulose (Sigmacell Type 100), an insoluble carbon source at 1.0 % (w/v) concentration was found to be optimum for higher β-glucosidase yield. Low enzyme levels were observed with lignocellulosic substrates.

5. Potassium nitrate (0.03 % N) proved to be best nitrogen source for enzyme production.

6. Among surfactants, Triton X-100, at 0.15 % (v/v) enhanced the β-glucosidase yield (3.7 U/ml).

7. Three bands of β-glucosidase were observed, when the extracellular culture filtrate of *A. terreus* was stained for activity after electrophoresis on native PAGE indicating multiple forms of the enzyme. The three enzyme forms were designated as β-glucosidase I, β-glucosidase II and β-glucosidase III on the basis of their electrophoretic mobility.
8. The three purified extracellular β-glucosidase I, β-glucosidase II and β-glucosidase III of \textit{A. terreus} had approximate molecular weights of 1,30,000, 1,10,000 and 27,000 as determined by gel filtration (Sephadex G-200).

9. The apparent $K_m$ and $V_{\text{max}}$ values of β-glucosidase I, II and III were 0.172 mM and 1.04 U/mg, 2.0 mM and 0.8 U/mg and, 0.909 mM and 0.09 U/mg respectively with PNPG as substrate. With cellobiose as substrate, the apparent $K_m$ and $V_{\text{max}}$ values of β-glucosidase I, II and III were 4.54 mM and 4.16 U/mg, 7.69 mM and 5.0 U/mg and, 0.5 mM and 2.32 U/mg respectively. The $V_{\text{max}}$ for all the three β-glucosidases was greater for cellobiose than for the aryl compound indicating higher rate of hydrolysis for cellobiose.

10. The $K_f$ values for glucose and gluconolactone for β-glucosidase I, II and III were 0.65 mM and 0.017 mM, 2.85 mM and 0.048 mM and, 3.55 mM and 0.021 mM respectively suggesting gluconolactone to be a more potent inhibitor than glucose.

11. The optimum pH for β-glucosidase I and II was 4.8 and for β-glucosidase III was 5.0. Temperature optima of β-glucosidase I was between 65 - 70°C whereas of β-glucosidase II and III was 55°C. The half-life at 60°C for β-glucosidase I, II and III was 60 min., 75 min. and 5 hr while at 65°C was 45 min., 30 min. and 140 min. respectively.

12. The metal ions slightly influenced the activities of β-glucosidase I, II and III. Among inhibitors, SDS and Ag$^+$ significantly affected the β-glucosidase activities. The three enzyme forms were inhibited in the
presence of Hg$^{+2}$ and N-bromosuccinimide, indicating that thiol groups may be present in the active site of the enzyme or that these groups are important in maintaining the enzyme structure. Inhibition by N-bromosuccinimide could indicate involvement of tryptophan residues in the active site.

13. The hydrolysis of cellulosic substrates was maximum at pH 4.8 at 50°C in 48 hr. Among pure cellulosics, 2.5 % (w/v) cellulose (Sigmacell Type 100) resulted in 74 % saccharification in 48 hr. Among lignocellulosic residues, alkali-treated substrates were hydrolysed at a higher rate compared to untreated agro-residues. The extent of hydrolysis of 2.5 % (w/v) pretreated bajra straw and wheat straw was 69 % in 48 hr.

14. The loss of cellulase and β-glucosidase activities of *A. terreus* was higher with lignocellulosic substrate than pure cellulose. The loss of the enzyme activity may be attributed to the adsorption of enzyme onto the substrate as in absence of substrate not much enzyme activity is lost.

15. There was no significant increase in the hydrolysis rate beyond 6.0 U of FPA in the system which may be due to hydrolysis of amorphous regions in the early stage leaving behind more resistant substrate.

16. In cellulosic substrates, maximum saccharification was achieved with 2.5 % (w/v) substrate concentration whereas the amount of reducing sugar was higher with 5.0 % (w/v) substrate concentration.

17. Quantitative and qualitative analysis of lignocellulosic hydrolyzate showed glucose to be the major product (70-75 %) of hydrolysis with no cellobiose which may be due to the high β-glucosidase activity in the culture filtrate.
18. Addition of 6.0 % (w/v) glucose to the saccharification system resulted in only 16.77 % inhibition in reducing sugar formation.

19. The addition of enzyme after 48 hr did not show any significant increase in the hydrolysis which may be because of depletion of amorphous substrate. The addition of substrate after 48 hr resulted in increase in reducing sugar which may be due to hydrolysis of amorphous regions of added cellulose by cellulolytic enzymes.

20. *A. terreus* showed another interesting property of fermenting sugars to ethanol. Maximum ethanol production was achieved with 24 hr-pregrown aerated culture of *A. terreus* at 1.0 % (v/v) concentration yielding 2.44 % (w/v) ethanol with 5.0 % (w/v) glucose on the 5th day of non-aerated fermentation.

21. Alcohol dehydrogenase activity of 4.86 U/mg protein was obtained on the 5th day of ethanol production by *A. terreus*. Single form of *A. terreus* alcohol dehydrogenase was observed on non-denaturing PAGE.

22. The production of ethanol was higher in 1:2.5 ratio of medium volume to flask volume under non-aerated fermentation condition at pH 5.5 at 30°C. *A. terreus* could tolerate up to 7.0 % (w/v) ethanol.

23. Apart from glucose, among hexoses, fructose was efficiently fermented by *A. terreus* yielding 2.16 % (w/v) ethanol. The pentose sugar, xylose was very poorly fermented by *A. terreus* in comparison to arabinose which was fermented to 0.51 % (w/v) ethanol. The fermentation of the disaccharide, cellobiose resulted in 2.34 % (w/v) ethanol.
24. The substrate concentration above 5.0 % (w/v) of glucose and cellobiose proved to be inhibitory for ethanol fermentation. *A. terreus* showed limited ability to ferment xylose irrespective of the low or high substrate concentration.

25. *A. terreus* was capable of fermenting cellulosics, ATCP and Avicel PH 101 at 1.0 % (w/v) concentration yielding 0.29 % (w/v) and 0.2 % (w/v) ethanol respectively. The hydrolyzate obtained from the saccharification of alkali-treated bajra straw was also effectively fermented by *A. terreus* to 1.25 % (w/v) ethanol.