CONCLUSION

Of the fifty strains of *Xanthomonas axonopodis* pv. *citri*, four strains were selected for pectinolytic enzymes production after screening. The strains of *Xanthomonas axonopodis* pv. *citri* were isolated and characterized by morphological and biochemical test as per mentioned in Table- 2, 3 and 4. The strains produced various types of pectinolytic enzymes (PG, PMG, PnL and PgL) as well as extracellular polysaccharides in the form of xanthan gum. There are many applications of both pectinolytic enzymes and xanthan gum in the industries. Due to the potential and wide applications of pectinases and xanthan gum, it was studied in detail. Although, there was variation among all the fifty strains for production of pectinolytic enzymes, four strains were used for optimization study as these strains were efficient viz. *Xan* 4, *Xan* 13, *Xan* 28 and *Xan* 43.

It was clear that the production of pectinolytic enzymes was affected by various parameters like incubation time, temperature, pH, carbon sources and nitrogen sources. Pectinolytic enzyme production process was optimised by using various parameters. The different parameters were used in this study as incubation time (24 hrs, 48 hrs, 72 hrs, 96 hrs, 120 hrs and 144 hrs), temperature (25°C, 30°C, 35°C, 40°C and 45°C), pH (6.5, 7, 7.5, 8 and 8.5) and different carbon sources (glucose, sucrose, starch, maltose and pectin) and different nitrogen sources (yeast extract, ammonium nitrate, ammonium sulphate, potassium nitrate, peptone). Pectinolytic enzymes synthesized by strains (*Xanthomonas axonopodis* pv. *citri*) *Xan* 4, *Xan* 13, *Xan* 28 and *Xan* 43 showed maximum production at 48 hrs of incubation and therefore incubation time of 48 hrs was the optimum incubation period for production of pectinolytic enzymes. 48 hrs of incubation time, the maximum pectinolytic enzymes isolated by all four strains as *Xan* 4, *Xan* 13, *Xan* 28 and *Xan* 43 were in the range of PG (0.6-0.8
Conclusion……

U/ml), PMG (0.5-0.7 U/ml), PnL (1-1.5 U/ml), and PgL (0.7-1 U/ml). The maximum production of enzymes was obtained at 30°C temperature and it is observed that further increase in temperature led to decrease in the production hence 30°C temperature was chosen as an optimum temperature for all enzymes while PnL, showed maximum production at 35°C, hence optimum temperature for PnL production was 35°C. The strains as Xan 4, Xan 13, Xan 28 and Xan 43 showed production of pectinolytic enzymes as PG (0.7-0.9 U/ml), PMG (0.5-0.8 U/ml) and PgL (0.8-1 U/ml) at 30°C whereas of PnL (1-1.5 U/ml) showed at 35°C. When pH of the media was adjusted to pH 7, maximum pectinolytic enzymes production was synthesized by strains Xan 4, Xan 13, Xan 28 and Xan 43. Although, there was slight variation among the production of enzymes but the similarity observed in the optimization. Hence the optimum pH value was chosen as 7. At pH 7 the maximum pectinolytic enzyme production was recorded as PG (0.7-0.9 U/ml), PMG (0.5-0.8 U/ml), PnL (1-1.5 U/ml), and PgL (0.8-1 U/ml). It is clear that pectinolytic enzymes PG, PMG, PnL and PgL by strain Xan 4, strain Xan 13, strain Xan 28 and strain Xan 43 was maximum in media contained pectin as a carbon-source. Hence pectin was considered as most suitable Carbon –source for production of pectinolytic enzymes. Maximum production of all four pectinolytic enzymes synthesized by these strains was, PG (0.7-0.9 U/ml), PMG (0.5-0.8 U/ml), PnL (1-1.5 U/ml), and PgL (0.8-1 U/ml) in the pectin containing medium. Of various nitrogen sources used - yeast extract, ammonium nitrate, ammonium sulphate, potassium nitrate, peptone, the maximum pectinolytic enzyme production was recorded in yeast extract containing medium. PG, PMG, PnL and PgL enzymes synthesized by strain Xan 4, strain Xan 13, strain Xan 28 and strain Xan 43 showed maximum production was PG (0.6-0.8 U/ml), PMG (0.5-0.7 U/ml), PnL (1-1.5 U/ml), and PgL (0.7-1 U/ml).

Strains of Xanthomonas axonopodis pv. citri produced higher amount of xanthan gum. These strains were isolated from different parts of plants. For the optimization of production
of xanthan gum various parameters were used such as incubation time 24 hrs, 48 hrs, 72 hrs, 96 hrs, 120 hrs and 144 hrs; at temperature 25°C, 30°C, 35°C, 40°C and 45°C and at pH 5, 5.5, 6, 6.5, 7, 7.5 and 8. The effect of different carbon sources and nitrogen sources were also studied. Different carbon sources as starch, sucrose, glucose, lactose, and maltose and different nitrogen sources as peptone, yeast extract, ammonium sulphate, ammonium nitrate, and potassium nitrate were used to study their effect on xanthan gum production. A slight variation was observed among fifty strains of *Xanthomonas axopodis* pv. *citri* for xanthan gum production. From these fifty strains, four strains were used as more effective strains for xanthan gum production. It was reported that the maximum production of 15.18 g/L was reported by strain *Xan* 7, by strain *Xan*18 was reported 14.97 g/L, by strain *Xan* 22 was 15.21 g/L and by strain *Xan* 36 was 14.51g/L. Although, there was difference in the production of xanthan gum but all isolates showed maximum production at 72 hrs of incubation time. The maximum production of xanthan gum was observed at 35°C temperature and it is observed that further increase in temperature led to decrease in the production hence 35°C temperature was chosen as an optimum temperature for xanthan gum. Strain *Xan* 7 showed the maximum xanthan gum production of 15.12 g/L whereas strain *Xan* 18 showed production 14.89 g/L, strain *Xan* 22 showed production 15.19 g/L and by strain *Xan* 36 production observed 15.01g/L. When pH of the media was adjusted to pH 6, maximum xanthan gum production was synthesized by strains *Xan* 7, *Xan* 18, *Xan* 22 and *Xan* 36. Although, there was slight variation among the production of xanthan gum but the similarity observed in the optimization. Hence the optimum pH value was chosen as 6 and the maximum production observed at pH 6 was 15.20g/L, 14.81g/L, 15.22g/L and 15.17 g/L by strains *Xan* 7, *Xan* 18, *Xan* 22 and *Xan* 36 respectively. In the study of effect of different carbon sources, sucrose was found to be the best carbon source for production of xanthan gum. The maximum production of xanthan gum observed by strains *Xan* 7, *Xan* 18, *Xan* 22 and *Xan* 36 was15.23
g/L, 14.88 g/L, 15.11 g/L and 14.16 g/L respectively in sucrose containing media. Of various nitrogen sources used - yeast extract was recorded as the suitable nitrogen source for maximum production of xanthan gum. The maximum xanthan gum production 15.19 g/L, 14.92 g/L, 15.17 g/L and 14.82 g/L was observed by strains Xan 7, Xan 18, Xan 22 and Xan 36 respectively.

The functional group of synthesized product were compared with the commercial xanthan by FT-IR spectra. Thus from results of the spectra obtained from FT-IR, it was concluded that the xanthan synthesized in this study was same with the spectra of FT-IR obtained by commercially produced xanthan gum.