The thermozymes are the enzymes having stable activity at higher temperature, which are purified from thermophiles or hyperthermophiles. Various sources of the thermozymes include thermophilic Bacteria, Fungi and Arachea, which were isolated from the terrestrial hot springs, deep-rooted mines, volcanic belts and marine hot environments. These thermozymes have unique properties such as resistance to higher temperature. Apart from temperature stability, thermozymes are resistance to chemical, pH stability and various environmental stressors. The recent developments in the discovery of stable enzymes from thermophiles have resulted in their increased use in organic synthesis, food ingredients, and production of specialty chemicals. The pharmaceutical intermediates and agrochemicals were accelerated by the discovery of enzyme from this class of organisms has helped facilitate the development of new industrial processes. Hence, we put an effort to explore the industrial and astrobiological important thermozymes from novel thermophilic bacteria.

We isolate, purified and characterized thermostable α-amylases and lipase enzymes from novel thermophilic Geobacillus sp. α-Amylase and lipase were purified using biochemical techniques such as, gel filtration, anion exchange and hydrophobic interaction chromatography. The molecular weights of these enzymes were determined to be 43 kDa and 47 kDa respectively. The optimum activity of purified α-amylase and lipase were observed at 90°C and 70°C. Especially, α-amylase was significantly stable above 100°C and at pH 8.0. However, the DSC-TGA thermogram of enzyme revealed only 10% weight loss at 200°C, which was higher than previously reported α-amylases from other sources. The pH stability of the lipase enzyme was 9.0. The activities of these enzymes were observed stable in presence of many metal ions, detergents and
inhibitors. The structural organizations of these enzymes are of higher order conformation was conformed from the analysis of CD, FTIR and Raman Spectroscopy. The high-temperature stability, alkaline pH, and structural integrity of novel α-amylase and lipase enzymes were suitable for potential industrial requirements.

In contrary, the significance of some enzymes has gained potential interest in the astrobiological research. The existing mechanism of radiation resistance in the microorganism was unclear. Some evidence suggested that, certain enzymes involved in the minimization of the radiation effect in microorganism. It was observed that, each microorganism has developed array for the radiation effects. Space radiation experiments on microorganism could serve as a model for these studies. In attempt of this, the stratospheric microorganisms were proved best examples for these experiments. These microorganisms have potential radiation resistance and were exposed to mild space environmental conditions. The extreme radiations, temperature and other stress of the space environment in stratosphere could affect cellular mechanisms in these microorganisms. In this possibility, we investigated the involvement of catalase enzyme in radiation resistance stratospheric bacteria.

A moderate thermostable, radiation induced homotetramer catalase Bskat-1 was purified using biochemical techniques such as, hydrophobic interaction, and gel-filtration chromatography. The native Bskat-1 was a homo tetramer of 28 kDa, composed of four identical subunits forming a molecular mass of 120 kDa. The isoelectric point of the purified enzyme was determined at pH 7.8. The maximum temperature of Bskat-1 was determined to be 55°C, with the optimal temperature of 45°C. The activity of Bskat-1 was shown active over alkaline pH range (pH 10) and
Conclusions

exhibit optimum at pH 9.0. The enzyme was inhibited by hydroxylamine hydrochloride, azide, 3-amino-1, 2, 4-triazole and cyanide in a competitive manner. Except Co$^{2+}$ and Ba$^{2+}$, other metal ions such as, Na$^+$, Mg$^{2+}$, K$^+$, and Mn$^{2+}$ did not affect much on BsKat-1. These results demonstrate that BsKat-1 was a typical monofunctional heme-containing catalase and may play minimum role in the survival strategy of radiation induced oxidative damage in *B. stratosphericus*. The above observation suggests that, antioxidant enzyme systems from stratospheric microorganism were potential candidate for astrobiological research. However, this report on action of catalase in radiation induced oxidative stress in *B. stratosphericus* will help to delineate the physiological role of enzymes in space environment. It hypothesized that; the radiation resistance could be a consequence of an evolutionary process that permitted to the stratospheric bacteria to cope with commonly encountered environmental stressors. It was determined that, ROS in the response of irradiation in these bacteria were shown minimum inhibition by the involvement of these catalase enzymes.

In concise, the purified $\alpha$-amylase enzyme from *Geobacillus* sp. was shown activity at 90°C at pH 9.0. The molecular weight of the purified enzyme was observed to be 43 kDa. The purified $\alpha$-amylase enzyme activity was extremely stable up to 100°C. The purified lipase was also shown significant temperature stable activity at 70°C. The pH stability of the purified lipase enzyme was at 9.0. The molecular weight of the purified lipase enzyme was observed to be 47 kDa. However, catalase, BsKat-1 from *Bacillus stratosphericus* was shown less thermostable when compared other purified thermozymes. The maximum temperature stability of BsKat-1 was to be 55°C, with the optimal temperature of 45°C. The activity of BsKat-1 was active over alkaline
pH 9.0. The purified *B*skat-1 enzyme was a homo tetramer of 28 kDa, composed of four identical subunits forming a molecular mass of 120 kDa. Looking at the observed facts, all the three thermozymes purified were unique and novel compared to the other enzymes of available literatures. Further, these enzymes could have potential application in the field of various industries, biotechnological and astrobiological research.