SUMMARY

The use of genetically modified organisms is poorly accepted by consumers and is also limited by many legal restrictions, especially in the food industry. Therefore, an adaptive evolution approach (a non-genetic engineering process) has been used as an effective strategy for the selection of non-genetically modified (non-GM) strains with specific phenotypes. Adaptive evolution defines a set of mutations that occur in response to a specific challenge and that are advantageous to some mutants under conditions in which an increase of fitter variants occurs because of natural selection.

The unavoidable decline of non-renewable energy sources and environmental worries of scorching fossil fuels has created amplified requirement for the development of ecological, renewable energy sources such as ethanol and biogas. Today the mankind needs durable energy sources which do not affect our environment adversely the biogas and ethanol appear as the utmost capable energy sources which is storable, transportable. The biogas plants are in use all over the country but their low efficacy restricts their required spread. In the present study a cost effective modified biogas digester is proposed, which will be fed with pretreated slurry to increase the methane yields by anaerobic digestion. New modification in digester tank includes magnetic field treatment to speedup anaerobic digestion. Maximizing the productivity of biogas production is significant to increasing its efficacy as a long-term renewable energy source. Magnetic field enhanced fermentation has been proposed as a method to increase the efficiency of ethanol production. In the present study the experiments were conducted on magnetic field (MF) induced adaptive evaluation of Ethanol Tolerance in the Yeast Saccharomyces cerevisiae. Study of Magnetic Field Treatment on Rhizosphere at low to high frequency
magnetic field that can affect the growth dynamics of bacteria it was observed that a the magnetic field 1700- 4200 µT resulted in a positive effects on the dynamic growth. Soil bacteria partaking valuable effect on plant health are generally referred to plant growth promoting rhizobacteria (PGPR). PGPR promote directly and indirectly plant growth but the exact mechanisms involved have not all been well characterized. PGPR fix atmospheric nitrogen, produce siderophore, phytohormones, solubilize phosphate, potassium and zinc, alleviate the various stress by secreting ACC (1-aminocyclopropane-1-carboxylate) deaminase enzyme and control disease by suppressing or killing the phytopathogens. Generally 2–5% of rhizosphere bacteria are PGPR. Manmade chemical combinations used to inhibit plant pest and disease symptoms or to fertilize plants can be harmful to human health and they may also endure in natural ecosystems. In the previous decade there has been a push to use organic agents such as micro-organisms (bacteria and mycorrhizal fungi) to switch conventional chemical products. Indeed, inorganic agriculture arrangements the use of synthetic chemical products is outlawed. Bacillus spp. is studied to be the harmless microorganisms that hold amazing abilities for producing a vast range of beneficial substances. The influence of the magnet is one of the utmost basic influences in nature. We recognize that magnetism itself was an element in the primitive soup from which the universe and our planet originate downward. Magnetism is the energy that keeps order in the galaxy, allowing stars and planets to spin at significant velocities. And in a sense, our own planet's magnetic field is responsible for protecting all life on earth. Numerous living microbes contain tiny amounts of ferromagnetic material utmost commonly magnetite that position the host in the geomagnetic field. The influence of magnetic field was mutable depending on the nature
of the microbes and field. Norak et al (2007) explain that magnetic field has important effect on bacteria's cell as well as on its life and they added that the influence of magnetic field surrounded in cell membrane. Another objective of this research was to facilitate the growth of a bioengineering center of excellence within the department of engineering by completing cutting edge bioengineering research that required skills and resources from both the life sciences and engineering.

The selected bacterial strains need their exposure to magnetic field of various strength for which a device (Machine) was develop by the author. The magmatic field generating device provides an apparatus capable of generating a homogeneous magnetic field strength in the range of 100µT to 4500 µT for use in microbial strain modification. In one embodiment, the magmatic field generating device comprises of a hollow cylindrical core surrounded by a copper winding of about 3000 turns, a plated iron frame supporting the edges of the hollow cylindrical core that reduces the loss of the magnetic flux in the hollow cylindrical core and also strengthens the main magnetic field; iron plates covering the hollow cylindrical core to increase the magnetic strength inside the hollow core; a sample loading site possessing space for a 50 ml test tube and a variable DC power supply in the range of 1-35V to adjust the magnetic field strength. The microorganism was grown in a suitable growth medium at a temperature in the range of 24-30°C at 80-150 rpm in a culture vessel after which the microorganism was subjected to a magnetic field by placing the culture vessel in the sample loading site of the magmatic field generating device. Magnetic stimuli of 500 -3000 µT was given to the microbial culture for duration of 15 minutes at 2 hour intervals for 48 hours. The microorganisms are referred to as the “1st modified microorganism generation. The 1st modified
microorganism generation obtained was sub-cultured on suitable growth medium agar plates and fresh suitable nutrient broth medium as well and grown at a temperature in the range of 24-30°C at 80-150 rpm in a culture vessel and again subjected to magnetic stimuli of 500 -3000 µT for duration of 15 minutes at 2 hour intervals for 48 hours. The microorganisms at this stage are referred to as the “2nd modified microorganism generation. The 2nd modified microorganism generation so obtained was sub-cultured on suitable growth medium agar plates and fresh suitable nutrient broth medium as well and grown at a temperature in the range of 24-30°C at 80-150 rpm in a culture vessel and again subjected to magnetic stimuli of 500 -3000 for a duration of 15 minutes at 2 hour intervals for 24 hours. The microorganisms at this stage are referred to as the “3rd modified microorganism generation. The 3rd modified microorganism generation so obtained was sub-cultured on suitable growth medium agar plates. 1st, 2nd and 3rd modified microorganism and parental microorganism (control) were subjected to perform experiment with respect to different stress tolerance parameter. Adaptive evaluation also track timely in each microorganisms, After 42th generations of adaptive evolution, the death rates of Saccharomyces cerevisiae strains in the evolving populations was lesser than 50 %, and more than 90 % in the parental strain population. Residual sugar levels in the magnetic field induced adaptive evolution fermentations carried out using the mixed cultures from the 40th and 45th generations were below 7 g/L, lower than the result for the parental (controls) strain 10.3 g/L. These outcomes specified that the magnetic field induced adaptive evolved mutants were better able to complete the fermentation process. The magnetic field treatment within fermentation and magnetic field induced adaptive evolved strains had a definite impact on the growth of Saccharomyces cerevisiae during
fermentation. The amplification in yeast cells resulted in additional sugar being consumed at a better rate. The signify magnetized cultures biomass increased more than the parental (controls), evidencing a magnetic field induced increase in alcohol tolerance in the experimental strain. In conclusion, magnetic field stimulation appears to be a technique with genuine potential in *S. cerevisiae* fermentation, deserving additional studies in order to apply this technique for industrial purposes.

The study aimed to investigate the effects of magnetic field on the metabolites of Bacillus sp (Cubc1) bacterium as well as bacterial growth studies under different stress like NaCl, pH and temperature. The magnetic treatment significantly improves the bacterial population with shorter generation time under different stress like NaCl, pH and temperature. This increased population of Bacillus sp. will increase the nitrogen fixing efficiency thus leading to greater yield. The enzyme activities and metabolites (IAA, ACC and Siderophore Production) were also improved under in the influence of magnetic treatment. The magnetic fields affect the cells whichever of two ways. The major is through the cell wall and would contain the expression and production of proteins and metabolites, such as enzymes, the second is affecting the cells intracellular and engaged the affect within the cell. The applicable magnetic field is applied for a time period and an intensity, which is based on the recipient of the field, the medium and the desired result. Experiments in this study showed 1700 μT magnetic field range quit good for further research on Bacillus sp.

The study of improved biogas generation through magnetic field modified anaerobic digestion Two (200 L) airtight plastic drums equipped with pH probe, stirrer, sampling ports and temperature controller (bobbin element with temperature control unit) were
used as digester. MFF (Magnetic field facility) recycled laminated transformer core which was made out of cast iron and were assembled in ‘E’ shape, submersible 16 gage copper wire coiled on ‘E’ shape with 3.5 ohm resistance and connected with DC regulated power supply 0-32/5A. The core was fixed on plastic base and fitted on the bottom of one 200L plastic drum. The drum that was not facilitated with magnetic field was considered as control. Both digesters were painted black.

Under experimental conditions applied, the MFF was shown to exert a significant effect on the process of methane fermentation. An increase was observed in the value of methane content in biogas production. The magnetic field of 0.42 [T] caused significant changes in the analyzed parameters of the methane fermentation process. The analysis of biogas composition demonstrated that there were significant differences between control and MFF digester production. A positive effect of the MFF was established in respect to the sedimentation process of anaerobic slurry and reduction of COD concentration in the effluent. At the 0.42 T MF the effectiveness of COD removal increased by ±14.0% compared to the control without the physical factor. Thus, it is necessary to further study the effects of magnetic field on biogas anaerobic digestion using different approach such as substrate pretreatment and development of mix inoculum of methanogenic bacteria in reference to time reduction and amplify production in methane generation as well.