



**SCHOOL OF BASIC AND APPLIED SCIENCES
DAYANANDA SAGAR UNIVERSITY,
BENGALURU - 560078**

DOMAIN: EXTREMOPHILES

The School of Basic and Applied Sciences started in the year 2015. Since its inception, research has been the primary focus of the school while uncompromising on academic progress. Considering the spectrum of research which the school harbors, it was a conscious effort to establish a research domain that combines all scientific work at the school. Since Professor VKM joined us at DSU, he had regular interactions with SBAS faculty and understood that the most common area of research platform can be in the field of extremophiles. This led to the establishment of a thrust area – **Extremophiles**.

Establishment of Extremophiles domain in the

On 25th July, 2020, a research domain titled “**Extremophiles**” was established under the able guidance of Prof. V Krishna Murthy, Research Professor, DSU and Dr. Sunil S More, Dean SBAS, DSU. The primary intention behind initiating this research domain is to bring like-minded researchers from various fields under one umbrella to pursue research in a collaborative and a multidisciplinary approach.

Under this Domain five faculty from different departments of SBAS are roped in, and are as follows:

1. Dr. Aneesa Fasim (Department of Biochemistry) - will be heading the domain.
2. Dr. Archana Rao (Department of Microbiology)
3. Dr. Ajay Nair (Department of Genetics)
4. Dr. Smeeta Shreshtha (Department of Genetics)
5. Dr. Susweta Das (Department of Biotechnology)

Aims and Objectives of this Domain:

The research in this domain aims to use a multidimensional design strategy that includes bioprospecting, *in silico* analysis, strain improvement, media optimization, purification, and downstream processing of extremophilic biomolecules for an improved bioprocess design.

The tentative projects are:

1. Extremophilic enzymes (alkalophilic pectinase).
2. Characterization of Heavy Metal Biosorption by the extremophilic exopolysaccharides.
3. PLASTIC DEGRADATION: “PETase” - a promising avenue.
4. Microbial production of PUFA from marine psychrophiles.
5. Extremophiles in Nuclear waste disposal.

OBJECTIVES of each project are:

- a) **Extremophilic Enzymes:** Currently we are working on a project titled “Production, Characterization and Applications of alkalophilic bacterial pectinases”. Pectinase is an important hydrolase having many industrial applications. The objectives of this work will involve screening, isolation, and identification of alkalophilic pectinase enzyme producing microorganisms. It will also aim at understanding the physiochemical features of the enzyme and optimization of the enzyme production using statistical methods.

- b) Characterization of Heavy Metal Biosorption by the extremophilic exopolysaccharides:** Exopolysaccharides secreted by extremophiles help the microorganisms to combat extreme conditions. There are many applications of EPS, one of which is bioremediation of heavy metals. The objectives of this project are extraction of specific exopolysaccharide called mauran from *Halomonas* spp. and study the ability of mauran in heavy metal biosorption.
- c) Plastic degradation: “PETase” - a promising avenue:** The agenda of this project is to target the eco-friendly degradation of the non-biodegradable plastic using microorganisms. The objectives of this project involve screening, Isolation and identification of microbes producing PETase. Further biochemical characterization and strain improvement will be carried out to improve the activity and plastic degrading ability of the strain.
- d) Microbial production of PUFA from marine psychrophiles:** This project involves screening, isolation, identification of microorganisms producing omega 3 fatty acids from deep sea fish. It also aims at culturing and optimization of the omega 3 fatty acid production in these microorganisms under lab conditions. Another approach we plan to take is phenotypic and genotypic screening of PUFA producing microorganism and use metabolic engineering to improve PUFA production.
- e) Extremophiles in Nuclear waste disposal:** As a first step, this project aims at developing a consortium of nuclear waste degrading microorganisms. This will also give us an understanding of the mechanisms that bacteria use to dispose nuclear waste. Armed with this data, we plan to choose the right candidate microorganism for further studies in nuclear waste disposal.

Research Progress

The report not only gives an overview of the research conducted under the extremophile’s domain after its establishment in 2020 but it also showcases the progress in this field since 2016.

There is much progress achieved in the last year. A glimpse of all the achievements is given in the below table. These achievements are further elaborated and presented separately.

Research Status-Quo (2020- 2021)

Instruments Procured	Thermocycler PCR and consumables
Research Funding	VGST grant (1), Seed Money grant (2)
Research Scholars (active)	Extremophile research 5
Publications	Journal Article 2 published/ 3 under preparation
Book Chapters	3 published (springer) + 5 accepted (springer /elsivier)
M.Sc. Projects	Extremophile Research 3

Future projects in the pipeline	46 mini-projects proposed
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Procurement of PCR machine

As a first step towards establishing the research facility in this domain, a PCR machine WEE32 (LA1060) along with the required chemicals were purchased from Himedia. We received the machine on November 25th 2020 and along with the reagents.

Externally Funded Projects

The school was successful in procuring grants in this field. Both major grants from VGST and seed money as well as minor student projects (KSCST) were granted. The details are given below.

Major Projects

S.no	Title	Project Investigator	Granting Agency	Grant Money
1	Bioremediation of pesticides using microbial consortium	Dr. Shobha K Jayanna	VGST – GoK 3 yrs	20 Lakhs
2	Impact of industrial effluents containing heavy metals to water bodies of bangalore: A remedial approach of using microorganisms to overcome	Dr. Shilpa BM	Seed Money – DSU 1 yr	100000/-
3	Isolation and Bioengineering of g-CGTase for the production of industrially important cyclodextrins	Dr. Aneesa Fasim	Seed Money – DSU 1 yr	100000/-

Minor Projects

	Title	Project Investigator	Granting Agency	Year	Grant Money
1	Screening and Isolation of cellulolytic and lignolytic bacteria from gut of composting earthworm – an aid in pretreatment of biomass for biofuel production	Dr. Anu Sharma	KSCST	2018	9,000/-
2	Characterization of actinomycetes and its role in biofuel production using <i>mimosa pudica</i>	Dr. Anand Prakash Dr. Gautham S.A.	KSCST	2017	10,000/-
3	Isolation Of Cellulolytic Microbes And Role Of Microbes In Biodegradation Of Invasive Weed Species For Ethanol Production	Dr. Anand Prakash	KSCST	2017	12,000/-

4	Coffee Pulp And Areca Nut Husk - A Potential Source Of Cellulosic Feed Stock For Bioethanol Production Using Microbial Consortia.	Dr. Anand Prakash Dr. Gautham S.A	KSCST	2016	13,000/-
5	A remedial approach using novel microorganisms to minimize the industrial effluent containing heavy metals to water bodies of bangalore.	Dr. Shilpa B M Dr. Manjula N G	KSC-SPP	2021	6000/-

PhD Scholars: Currently there are 4 research scholars pursuing their PhD in the extremophile area. The table gives the details of the research projects and the mentors working in this area.

S.No	Title	Student Name	Guide Name	Title
1	Microbial Production and Purification Of Industrially Important Carbohydrases	Dr. Lynette Lincoln	Dr.Sunil S.More	Completed
2	Drug carrier potential of Silver Nano composite of Gamma Cyclodextrin in Hydrogel film on Resistant Dermatophytes	Ms. Bhargavi Pinto	Dr.Sunil S More	Ongoing
3	Production, Characterization& Applications of Bacterial Pectinases	Mrs. Mary Arpana	Dr. Sunil S More	Ongoing
4	Isolation, Screening and Identification of Secondary Metabolites from Marine Actinomycetes Against Human Pathogens Causing Lower Respiratory Tract Nosocomial Infections	Ms. Sahar Zarrien	Dr. Archana Rao	Ongoing
5	Bioaccumulation of heavy metals from industrial effluents of bangalore.	Ms. Rashmi G	Dr. Shilpa B M	Ongoing

Research Papers Published: In the last 4 years, 15 research articles are published in this field in peer reviewed journals. The list of the articles is given in the table.

S No.	Title	Authors	Journal Name /Impact factor	Year
1	Microbial production of Omega-3 fatty acids: An overview	Kannan, Nivetha, Rao, S Archana, Nair, Ajay	Journal of Applied Microbiology	2021

			IF: 3.77	
2	Large-scale production of enzymes for biotechnology uses	Fasim, Aneesa, More, S Veena, More, S Sunil	Current Opinion in Biotechnology IF: 8.42	2020
4	Purification and characterization of cellulase from a novel isolate of <i>Trichoderma longibrachiatum</i>	Pachauri, Priyanka, More, S Sunil, Sullia, S B, Deshmukh, Sudha.	Biofuels-UK. IF : 1.496	2020
5	Isolation, screening and optimization of extracellular glucoamylase from <i>Paenibacillus amylolyticus</i> strain NEO03.	Lincoln, Lynette, More, S Veena, More, S Sunil.	Biocatalysis and Agricultural Biotechnology IF: 3.28	2019
6	Purification and biochemical characterization of extracellular glucoamylase from <i>Paenibacillus amylolyticus</i> strain.	Lincoln, Lynette, More, S Veena, More, S Sunil	Journal of Basic Microbiology IF : 1.909	2019
7	Purification and biochemical characterization of an extracellular β -d-fructofuranosidase from <i>Aspergillus</i> sp	Lincoln, Lynette, More, S Sunil.	Biotech. IF: 3.54	2018
8	Purification and biochemical characterization of β -d-fructofuranosidase from <i>Bacillus subtilis</i> LYN12	Lincoln, Lynette, More, S Sunil	Journal of Food Biochemistry IF: 1.662	2018
9	Purification and Characterization of Anti-cancer l-Glutaminase of <i>Bacillus cereus</i> Strain LC13	More, S Sunil, Swamy, Radhika, Mohan, Niveditha, Navyashree, Markuli, Janardhan, Bhavya, N Francois.	Proceedings of the National Academy of Sciences India Section B - Biological Sciences. IF: 0.396	2018.
10	Bacterial invertases: Occurrence, production, biochemical characterization, and significance of transfructosylation	Lincoln, Lynette, More, S Sunil	Journal of Basic Microbiology. IF : 1.909	2017.

11	Purification and properties of beta-cyclomaltodextrin glucanotransferase from <i>Bacillus flexus</i> SV 1.	Reddy, V Shwetha, More, S Sunil, Annappa, S Goutham	Journal of Basic Microbiology. IF : 1.909	2017.
12	Screening, optimization and production of a novel β -cyclodextrinase by <i>Bacillus flexus</i> MSBC 2	Shwetha, V, More, S Sunil, Uday, M Muddapur	Current Trends in Biotechnology and Pharmacy. IF : 0.48	2017
13	Purification and properties of a fungal L-asparaginase from <i>Trichoderma viride</i> pers: SF GREY	Lincoln, Lynette, Niyonzima, Francois N, More, Sunil S	Journal of Microbiology, Biotechnology and Food Sciences. IF : 0.61	2021
15	Properties of Laccase of <i>Bacillus marisflavi</i> Strain BB4 and its Synthetic Dyes Decolorization Analysis	Sharma, Anu, Muthupriya, M, Raj, Radharaman, Shameen, Zainah, Veena, SM, Niyonzima, Francois N, More, Sunil S	Proceedings of the National Academy of Sciences, India Section B: Biological Sciences. IF: 0.396	2021

Book Chapters: Last two years, were very productive in terms of book chapters. We could complete writing 6 book chapters out of which 2 are published and the rest are in print. All the book chapters are published in peer reviewed publishing agencies such as springer and Elsevier. The list of the books is given below

S No	Title	Authors	Publishing House	Status
1	Isolation and Purification of Microbial Exopolysaccharides and Their Industrial Applications	A. Prakruthi, Aneesa Fasim, Archana Rao, Farhan Zameer, K, and Sunil More	Springer Nature, Singapore 2021	Published
2	Extremophilic Fungal Xylanases: Screening, Purification, Assay, And Applications	Aneesa Fasim, Prakruti A, Manjushree H K, Akshay S, Poornima K,	Springer Nature	In Print

		Veena S More, Sunil S More		
3	Biotechnological applications of extremophilic fungi	Aneesa Fasim, Manjushree H K, Prakruti A, Rashmi S, Sindhuja V, Sunil S More	Springer Nature	In Print
4	Fungal extremozymes in green chemistry	Ajay Nair, Archana Rao, Nivetha K, Prakruthi Acharya, Aneesa Fasim, and Sunil More	Springer Nature	In print
5	Molecular Adaptations in Microorganisms for Extremozyme Production	Archana Rao, Ajay Nair, Aneesa Fasim and Sunil More	Springer Nature	In print
6	Extremophiles for Sustainable Agriculture	Archana S. Rao, Ajay Nair, Sunil S. More.	Springer Nature	In print

MSc Student projects – Completed

MSc program at DSU is designed to execute a project by the student in their last semester. Since 2017, around 22 projects in the extremophile area were taken up and completed. The details are given below.

S.No	Title	Guide	Year
1	Isolation, Screening, Purification And Characterization Of Alkaline B-Cyclomaltodextrin Glucanotransferase From Sugarcane Soil Bacterium	Dr. Sunil S. More	2021
2	Isolation, Screening, Partial Purification And Characterization Of Hyaluronidase From Bacteria	Dr. Sunil S. More	2021
3	Solid Substrate Fermentation (Ssf) And Immobilization: As A Strategy to Improve the Production, Stability, And Reusability Of Polygalacturonase (Pgase)	Dr. Aneesa Fasim	2021
4	Quorum quenching bacteria isolated and identified from sewage water to control quorum sensing mediated biofilm formation	Dr. Susweta Das	2021

5	Microbial dye degradation from textile effluents	Dr. Shilpa B M and Dr. Manjula N G	2021
6	Microbial Production Of Omega-3 Fatty Acids	Dr. Archana Rao Dr. Ajay Nair	2021
7	Anaerobic Treatment of Dairy Effluent Under Psychrophilicity.	Dr. Archana Rao Dr. Ajay Nair	2021
8	Isolation, Screening, Optimization, Partial Purification And Characterization Of B-Galactosidase From Bacteria	Dr. Sunil S More	2020
9	Screening & Optimization Of Naringinase From Fungal Isolates	Dr. Sunil S More	2020
10	Partial Purification And Biochemical Characterization Of Bacterial Alkaline Pectinase	Dr. Aneesa Fasim	2020
11	Optimization Of Pectinase Enzyme Using Solid State Fermentation	Dr. Aneesa Fasim	2020
12	Metalaxyl Degradation By Immobilised Cells Of Stenotrophomonas Maltophilia And Pseudomonas Sp.	Dr. Shobha K Jayanna	
13	Microbial Production Of Omega-3 Fatty Acids	Dr. Archana Rao	2020
14	Partial Purification And Biochemical Characterization Of Bacterial β -CGTase	Dr. Sunil S More	2019
15	Isolation, identification And Biochemical Characterization Of Bacterial Pectinase	Dr. Aneesa Fasim	2019
16	Production and purification of pectinase from Bacillus subtilis- 15A-B92	Dr. Sunil S More	2019
17	Isolation, Purification And Characterization Of Laccase From serratea marcesans and Bacillus marisflavi isolates from contaminated soils	Dr. Sunil S More	2019
18	Biodegradation of metalaxyl pesticide in the ginger cultivated soil and assessment of intermediate metabolites by GC-MS	Dr. Shobha K Jayanna	2019
19	Biodegradation of metalaxyl pesticide in ginger cultivated lands of karnatak and soil microbial diversity assay	Dr.Shobha K Jayaanna	2019
20	Biodegradation of Mancozeb by soil Microorganisms.	Dr.Archana Rao	2019
21	Biodegradation of 2,4 Dichlorobenzoic acid by Pseudomonas sp.	Dr.Shobha K Jayaanna	2019

22	Screening And Biochemical Characterization Of Keratinase Producing Micro-Organisms From Poultry Farm Soil Sample	Dr. Aneesa Fasim	2018
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MSc Student projects – Proposed

Under this domain, a systematic approach is being taken and many projects are already proposed for the upcoming year. The members of the extremophile domain have proposed 43 projects. The details of all the projects are given below.

Mini-Projects Proposed	
1	Isolation and Characterization of Biofilm degrading Metalloprotease from microorganism
2	Isolation of quorum quenching bacteria and their application for controlling Biofilm formation and Biofouling
3	Bioengineering of biofilm degrading enzymes targeting exopolysaccharide and protein in biofilm matrix of MDR bacteria
4	Genetic Engineering of Quorum Quenching Enzymes as biofilm degraders
5	Isolation and characterization of BACTERIOPHAGE against Carbapenem resistant <i>E. coli</i> (CRE)
6	Engineering of a chimeric endolysin to target Gram negative pathogens
7	Cloning and Expression of a Bacteriocin—PLANTARICIN—in <i>Escherichia coli</i> and its functional analysis --- Bio preservative
8	Antibacterial and biofilm inhibitory activity of Medicinal Plant Essential Oils against MDR bacteria
9	Bioengineering of PET depolymerase to break down and recycle plastic bottles
10	Genome analyses of ESKAPE pathogens to detect genetic determinants responsible for antibiotic inactivation and virulence
11	Purification And Characterization Of Microbial Hyaluronidase
12	Isolation, purification and characterization of alkalophilic Γ CGTASE
13	Enhancement of curcumin wound healing ability by complexation with γ -cd in chitosan-alginate (ca) hydrogel film
14	Comparative studies between $\alpha/\beta/\gamma$ cd's as efficient drug delivery system for an anti-cancer drug oridonin
15	Isolation, characterization and optimization of bacterial β -galactosidase

16	Statistical Approach To Maximize Alkalophilic Bacterial Pectinase Production
17	Immobilization Of Alkalophilic Bacterial Pectinase Using Calcium Alginate As A Support For Improved Performance
18	Purification, Characterization And Optimization Of A Thermotolerant Isoamylase
19	Screening And Preliminary Characterization Of Exopolysaccharides From Fungal/Bacterial Sources
20	Purification And Characterization Of A Naringinase From Microbial Sources
21	Wound Management by Herbal Active Ingredients
22	Variation in Microbial Growth under Hyper gravity
23	Nano-Encapsulation of Plant Growth-Promoting Rhizobacteria and Their Metabolites Using Alginate-Silica Nanoparticles and Carbon Nanotube Improves UCB1 Pistachio Micropropagation
24	Production of polyunsaturated fatty acids in yeast <i>Saccharomyces cerevisiae</i> and its relation to alkaline pH tolerance
25	Bioinformatic analysis and prediction of the function and regulatory network of long non-coding RNAs in hepatocellular carcinoma
26	Microorganisms Associated with Biogas Production Using Vegetable (<i>Telfairia occidentalis</i>) Wastes, Banana Peel and Pig Dung as Substrates
27	Understanding the host-microbe interactions using metabolic modelling
28	Ice cream structure modification by ice-binding proteins
29	Genetically Engineered Psychrophilic Methanogens for Biogas Production
30	4-epi-Pimaric acid: a phytomolecule as a potent antibacterial and anti-biofilm agent for oral cavity pathogens
31	Heavy metal-resistant bacteria as extremophiles: molecular physiology and biotechnological use of <i>Ralstonia</i> sp. CH34
32	Treatment of dairy wastewater by natural coagulants
33	Bacterial bioluminescence as a lure for marine zooplankton and fish
34	Communication mechanisms in extremophiles: Exploring their existence and industrial applications
35	Production of Inorganic Nanoparticles by Microorganisms
36	Chelating properties of bacterial exopolysaccharides from deep-sea hydrothermal vents

37	Mushroom Packages An Ecovative Approach in Packaging Industry
38	Whey Lactose as a Raw Material for Microbial Production of Biodegradable Polyesters
39	Identifying noncoding risk variants using disease-relevant gene regulatory networks
40	Agnihotra Effect on Microbial Contamination of Air
41	Management of kitchen waste by vermicomposting using earthworm, <i>Eudrilus Eugeniae</i>
42	Biochar production from arecanut waste
43	Agnihotra (Homa) an Ayurveda therapy in the prevention and control of COVID-19

Note: Highlighted projects are inclined towards medical research