

# RESEARCH FOCUS AREA

## ENZYME TECHNOLOGY

The Enzyme Technology Research group at DUT, under the leadership of Prof. Suren Singh and Prof. Kugen Permaul, conducts research on the discovery, improvement, production and application of microbial enzymes. Many industries are moving towards greener processes based on the catalytic power of enzymes, by substituting the use of harsh chemicals with innocuous enzymes. Enzymes from microbial sources are generally preferred as their biochemical properties can be easily improved. Novel enzymes from various microorganisms isolated from extreme environments are able to function in the harsh environments that many industrial processes dictate. These enzymes have applications spanning agricultural, biomedical and industrial sectors. In addition to its expertise in screening, cloning and expression of enzymes and production by fermentative processes, the group is also researching the degradation of biological macromolecules to produce derivatives of industrial importance. Research in the area of Enzyme Technology currently follows a three-pronged approach:

- Investigation of the fundamental aspects associated with the production of fungal and bacterial enzymes, their characterisation and the modification of their characteristics to enhance industrial applications.
- Investigation of the application of selected enzymes to produce various value-added products.
- Development of *Thermomyces lanuginosus* as high expression level enzyme factory using molecular and bioinformatics methods and tools.
- The group currently comprises 5 investigators (3 are NRF-rated), 2 postdoctoral fellows, 6 doctoral students and 18 masters students. A long-term collaboration exists with TUST in China and the group is currently collaborating with groups in Brazil, Russia, India and the USA. The group has previously had active collaborations with investigators from Sweden, Malaysia and Slovakia.

# LEAD RESEARCHER

## PROF. K. PERMAUL

### CLONING AND EXPRESSION OF ENZYMES

Prof. K. Permaul obtained his undergraduate and postgraduate degrees from the University of KwaZulu-Natal. His early research projects focused on bacterial molecular genetics, especially plasmid biology. He graduated with a PhD in 1999 and spent a year as a postdoctoral fellow before being employed as a lecturer at the Durban University of Technology in 2000. He has steadily progressed up the academic ranks, culminating in the award of a full professorship. He was appointed as Head of the Department of Biotechnology and Food Technology in 2014. His research projects involved: detection and quantification of mycotoxins in food commodities; production of potable water by ultrafiltration; characterisation and production of amylase, inulinase and chitinase enzymes; directed evolution and expression of a xylanase enzyme and genomic sequencing of a thermophilic fungus. Current research projects focus on expression of xylanase, xylosidase, chitinase and other carbohydrase genes; the use of chitin as a bioresource and DNA watermarking. Six doctoral students and thirteen masters students have been successfully supervised and a further 16 postgraduates are currently being supervised or co-supervised. Prof. Permaul is a NRF C-rated researcher who has published in high-impact scientific journals and is involved in peer-review of research for several international journals, as well as for international and local academic institutions and the NRF.

### NATIONAL COLLABORATIONS

Dr R. Govinden, University of KwaZulu-Natal; Prof. B. Sithole, P. Lekha and J. Andrew, CSIR.

### INTERNATIONAL COLLABORATIONS

Prof. E. Nordberg-Karlsson, University of Lund, Sweden; Prof. L. Tong, Columbia University, USA; Prof. Z.X. Wang, Jiangnan University and Tianjin University, China.

Prof. Kugen Permaul  
BSc, BSc (Hons)  
(Microbiology), MSc (Microbiology),  
PhD (Microbiology) (UKZN)

NRF Rating	C2
h-index	17
Masters students (complete)	13
Doctoral students (complete)	6
Masters students (current)	17
Doctoral students (current)	3
Postdoctoral Fellows (current)	1
Collaborators	7

# LEAD RESEARCHER

## PROF. S. SINGH

### ENZYME DISCOVERY AND APPLICATIONS

Prof. Suren Singh is the current Executive Dean of the Faculty of Applied Sciences since 2014. He previously served as Biotechnology and Food Technology Head for over 10 years. His research has been committed to the production and application of several thermostable enzymes, including xylanase, xylosidase, chitinase and proteases from the thermophilic fungus *Thermomyces lanuginosus* for more than 15 years and has successfully completed various projects with several national and international collaborations spanning over many continents, which has resulted in over 70 publications in reputed peer-reviewed international journals, with a NRF C1 rating for the last 9 years. His research has always attempted to push the boundaries, and his group has produced numerous "world firsts" including the whole genome sequence and secretome of *T. lanuginosus*. Currently, his research focuses on exploring a large number of industrially relevant enzymes involved in bioremediation and biodegradation, carbon- and nitrogen-fixation and alternative energy-production. He had fruitful cooperation for many years in areas of microbial resources, industrial enzyme preparations research and industrial strain breeding by metabolic engineering, also via personal exchanges, joint workshops, and joint training of graduate students. More recently, his collaboration with Prof. Liang Tong at Columbia University has produced exciting crystallographic results that ensure a solid foundation for structural proteomics. Prof. Singh has also maintained a NRF funded collaboration for more than 10 years with Prof. Z.X. Wang from China, which has allowed for a steady exchange of staff and students between countries, with new projects focusing on enzyme libraries in 2017. His recent appointment as Adjunct Professor at the J. Craig Venter Institute in San Diego has also initiated a bioinformatics thrust with several new projects in the pipeline. He continues to create opportunities through the Faculty for staff and postgraduate students to extend their research beyond regional boundaries.

## RECENT COLLABORATIONS

### CHINA 2014 – 2017

Title: Prospecting filamentous fungi for thermostable lipases and studies of their enzymatic properties; Prof. Fuping Lu, College of Biotechnology, Tianjin University of Science and Technology.

### USA – COMMENCED SEPTEMBER 2016

Title: Protein crystallography and structural elucidation; Prof. L. Tong, Department of Biological Sciences, Columbia University, New York.

### USA – COMMENCED APRIL 2016

Title: Metagenomics in relation to African population; Prof. K. Nelson; President, JCVI, USA.

Prof. Suren Singh  
BSc, BSc (Hons)  
(Microbiology), MSc (Microbiology),  
PhD (Microbiology) (UKZN)

NRF Rating	C1
h-index	26
Masters students (complete)	20
Doctoral students (complete)	6

Masters students (current)	25
Doctoral students (current)	6
Postdoctoral Fellows (current)	1
Collaborators	9

## LEAD RESEARCHER

### PROF. T. KUDANGA

### LACCASES IN BIOCATALYSIS AND MODIFICATION OF BIOMATERIALS

Prof. Kudanga obtained his PhD (with distinction) from the Graz University of Technology, Austria, where his research focused on the application of oxidoreductases (mainly laccases) in the functionalisation of lignocellulose materials. The study later expanded to the synthesis and in-vitro and ex-vivo assessments studies of bioactive compounds (mainly antioxidants) during his postdoctoral research. He accepted the position of Associate Professor at DUT in 2014 and has put together a group to work in the areas of Biocatalysis and Enzymatic Functionalisation. Recently, he initiated a collaboration with Dr Amonsou for enzymatic modification of food biopolymers from indigenous underutilised crops for the production of gluten-free ingredients and hydrogels. Prof. Kudanga has co-authored 35 papers and contributed several communications in national and international conferences. He is a regular reviewer for more than 10 peer-reviewed international journals of high impact-factor. He also reviews proposals for the NRF, sits on review panels and serves as external examiner for a number of universities. He has won several academic and research awards including the Council Award in recognition of NRF rating (DUT and CPUT), Vice Chancellor's Prize at the NUST, and NUST Book Prize. Prof. Kudanga is a member of several national and international scientific bodies.

## NATIONAL COLLABORATIONS

Dr Marilize Le Roes-Hill, Cape Peninsula University of Technology; Dr Maryna De Wit, University of the Free State; Dr Stephen Amoo, ARC; Dr Lester Davids, University of Cape Town.

## INTERNATIONAL COLLABORATIONS

Prof. Georg Guebitz, University of Natural Resources and Life Sciences, Austria; Prof. Gibson Nyanhongo, University of Natural Resources and Life Sciences, Austria; Dr Silvia Fademrecht, University of Stuttgart, Germany; Prof. Dr Juergen Pleiss, University of Stuttgart, Germany; Prof. Sergio Riva, Italian National Council of Research (C.N.R.), Italy.

Prof. Tukayi Kudanga  
 BSc Hons (Applied Biology and Biochemistry)  
 MPhil (Applied Biology and Biochemistry) MBA,  
 PhD (Biotechnology)

NRF Rating	Y2
h-index	15
Masters students (current)	9
Doctoral students (current)	3
Collaborators	9

# RESEARCHERS

## DR SANTHOSH K. PILLAI

Dr Santhosh K. Pillai attained his graduate and postgraduate degrees from prestigious universities in India. During his early research career, he worked as research associate at the Central Plantation Crops Research Institute in India, for 3 years, where his research focus was on plant microbial interactions and disease development. Later he joined the department of Biotechnology and Food Technology at DUT for doctoral studies and graduated with a DTech in 2010. His doctoral research was based on the bioprocess parameters optimisation for the production of hemicellulases from a thermostable fungus. After completing his doctorate, he was employed as senior research technician and part-time lecturer at DUT and has steadily progressed up the ranks to become a full-time academic as senior lecturer in 2016. His current research area encompasses bioconversion of lignocellulosic biomass to bioenergy/value added products (biohydrogen, bioethanol, biobutanol, oligosaccharides and animal feed); microbial enzyme systems and bioremediation. He is currently supervising/co-supervising two doctoral and eight masters students. Dr Pillai has published in peer-reviewed scientific journals and is a reviewer for several international journals as well as for academic institutions in South Africa and the NRF. He is also successful in acquiring research funds from the NRF and other agencies.

**Dr Santhosh K. Pillai**  
MSc, DTech

h-index	4
Masters students (current)	8
Doctoral students (current)	2
Collaborators	3

Dr Nokuthula Mchunu's research focuses on cloning and expression of thermostable Glycosyl Hydrolases (endoglucanases, glucosidases, xylanases and xylosidases) and their applications and is part of the Enzyme Technology group led by Prof. Suren Singh and Prof. Permaul. Thermostable carbohydrate-active enzymes (CAZymes) such as glycoside hydrolases (GHs), (hydrolyse the glycosidic bonds between two or more sugars or a sugar and a non-sugar molecule within carbohydrates) are of special industrial interest and have considerable importance in biotechnology industry due to their robustness and suitability to harsh processing conditions. Dr Mchunu is currently involved in the supervision of 4 masters and co-supervising 3 doctoral students. Dr Mchunu has recently spent time in China (Tianjin University of Science and Technology and Fuzhou University of Science and Technology) and Sweden (Lund University).

**Dr Nokuthula Peace Mchunu**  
DTech (Biotechnology)

h-index	2
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Masters students (current)	4
Doctoral students (current)	3
Collaborators	3

## HONORARY RESEARCH PROFESSOR

Dr Karen E. Nelson is the President of the J. Craig Venter Institute (JCVI). Prior to being appointed President, she held a number of other positions at the Institute, including Director of JCVI's Rockville Campus, and Director of Human Microbiology and Metagenomics in the Department of Human Genomic Medicine at the JCVI. Dr Nelson received her undergraduate degree from the University of the West Indies, and her PhD from Cornell University. She has authored or co-authored over 150 peer-reviewed publications, edited three books, and is currently Editor-in-Chief of the Journal of Microbial Ecology. She also serves on the Editorial Boards of BMC Genomics, GigaScience, and the Central European Journal of Biology. She is also a member of the National Academy of Sciences Board of Life Sciences, a Fellow of the American Academy of Microbiology, an Honorary Professor at the University of the West Indies and a Helmholtz International Fellow. Dr Nelson has extensive experience in microbial ecology, microbial genomics, microbial physiology and metagenomics. Dr Nelson has led several genomic and metagenomic efforts, and led the first human metagenomics study that was published in 2006. Additional ongoing studies in her group include metagenomic approaches to study the ecology of the gastrointestinal tract of humans and animals, studies on the relationship between the microbiome and various human and animal disease conditions, reference genome sequencing and analysis primarily for the human body, and other -omics studies.

**Dr Karen E. Nelson**  
PhD (Cornell University)

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## POSTDOCTORAL FELLOWS

Dr Govender's research is currently focused on the isolation and characterisation of novel fungal catabolic enzymes for the production and generation of bioactive compounds. These enzymes include xylosidases, phytases, chitinases and N-acetylglucosidases.

His research also focuses on the engineering of metabolic pathways in *Escherichia coli* for the synthesis of precursors required for the generation of industrially relevant compounds. Currently a significant amount of emphasis has been given towards the production of biodegradable plastics from crustacean and fungal biomass. His primary mentor and current postdoctoral supervisor is Prof. Kugen Permaul.

**Dr Algasan Govender**  
PhD (Biotechnology) (UKZN)

h-index	3
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Dr Puri's research is focused on biomimetic sequestration of carbon dioxide using microbial thermostable carbonic anhydrases.

He continues to explore novel thermostable phytases, chitinases and carbonic anhydrases for plant-growth promotion, amelioration in bioethanol production and in improving nutritional characteristics of Mageu, a local non-alcoholic beverage. More recently, he used nanoparticles as support matrices for improving characteristics of enzymes.

His primary mentor is Prof. Tulasi Satyanarayana and he is presently pursuing his postdoctoral research under the supervision of Prof. Suren Singh.

**Dr Adarsh K. Puri**  
PhD (Microbiology) (University of Delhi)

h-index	4
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# RESEARCH OUTPUTS 2015/2016

## NATIONAL CONFERENCES

1. Arumugam, N., Roy, J.K., Kumar, S. and Singh, S. 2016. Exploring lignocellulosic biomass of South African crops for xylooligosaccharide production. In: SASM, Coastlands, Umhlanga, Durban, 17-20 January 2016
2. Nekhumbe, D., Ranjan, B., Kumar, S. and Singh, S. 2016. Comparative study of cyanate hydratase production by different strains of thermophilic fungus *Thermomyces lanuginosus*. In: SASM, Coastlands, Umhlanga, Durban, 17-20 January 2016
3. Ranjan, B., Kumar, S., Permaul, K. and Singh, S. 2016. Cloning, Expression and Characterisation of Cyanate hydratase from the thermophilic fungus *Thermomyces lanuginosus* SSBP. In: SASM, Coastlands, Umhlanga, Durban, 17-20 January 2016
4. Puri, A. K., Permaul, K. and Singh, S. Novel applications of thermostable phytase and chitinases from *Thermomyces lanuginosus*. Abstract proceedings of 27th Annual SASM-KZN Symposium. 17-20 January 2016. 19th Biennial Conference South African Society of Microbiology (SASM), Coastlands Umhlanga Convention centre, Durban, South Africa, 17-20 January 2016.
5. Chanderman, A., Puri, A. K., Permaul, K. and Singh, S. Production, purification and characterisation of phytase from *Enterobacter* sp. ACSS. 19th Biennial Conference South African Society of Microbiology (SASM), Coastlands Umhlanga Convention centre, Durban, South Africa, 17-20 January 2016.
6. Zininga, J., Puri, A. K., Permaul, K. and Singh, S. Screening and production of a thermo and acid stable phytase producer. 19th Biennial Conference South African Society of Microbiology (SASM), Coastlands Umhlanga Convention centre, Durban, South Africa, 17-20 January 2016.
7. Makolomakwa, M., Puri, A. K., Permaul, K. and Singh, S. Batch and fed-batch production of phytase from *Thermomyces lanuginosus*. 19th Biennial Conference South African Society of Microbiology (SASM), Coastlands Umhlanga Convention centre, Durban, South Africa, 17-20 January 2016.
8. Ranjan, B., Kumar, S., Permaul, K. and Singh, S. Cloning, Expression and Characterisation of Cyanate hydratase from the thermophilic fungus *Thermomyces lanuginosus* SSBP. 19th Biennial Conference South African Society of Microbiology (SASM), Coastlands Umhlanga Convention centre, Durban, South Africa, 17-20 January 2016.
9. Arumugam, N., Kumar, S., Permaul, K. and Singh, S. Exploring lignocellulosic biomass of South African crops for xylooligosaccharide production. 19th Biennial Conference South African Society of Microbiology (SASM), Coastlands Umhlanga Convention centre, Durban, South Africa, 17-20 January 2016.
10. Ranjan, B., Kumar, S., Permaul, K. and Singh, S. Comparative study of cyanate hydratase production by different strains of thermophilic fungus *Thermomyces lanuginosus*. 19th Biennial Conference South African Society of Microbiology (SASM), Coastlands Umhlanga Convention centre, Durban, South Africa, 17-20 January 2016.
11. Roy, J.K., Mukherjee, A.K., Singh, S. Efficient extracellular expression of  $\alpha$ -amylase from *Bacillus licheniformis* AS08E in *Escherichia coli* using *Bacillus* signal peptides. 19th Biennial Conference South African Society of Microbiology (SASM), Coastlands Umhlanga Convention centre, Durban, South Africa, 17-20 January 2016.
12. Le Roes-Hill, M., Durrell, K.A., Kudanga, T. and Prins, A. Bioactive compound discovery from actinobacteria in the genomics era. South African Society for Microbiology Congress, Coastlands, Umhlanga, Durban, 17-20 January 2016.
13. Thabi, M.M., Mamewick, J., Kudanga, T., and Le Roes-Hill, M. Oxidation of phenolic compounds from rooibos (*Aspalathus linearis*): improving antioxidant potential. South African Society for Microbiology Congress, Coastlands, Umhlanga, Durban, 17-20 January 2016.
14. Visser, R. Le Roes-Hill, M. and Kudanga, T. Marine actinomycetes as a source of novel antimicrobial agents. South African Society for Microbiology Congress, Coastlands, Umhlanga, Durban, 17-20 January 2016.
15. Weels, S., Kudanga, T., Le Roes-Hill, M., Welz, P.J. Determining antimicrobial properties of phenolics detected in peat samples. South African Society for Microbiology Congress, Coastlands, Umhlanga, Durban, 17-20 January 2016.
16. Ranjan, B., Kumar, S., Permaul, K. and Singh, S. Amelioration of toxic soil contaminants using cyanate hydratase from the thermophilic fungus *Thermomyces lanuginosus*. CATSA 2015 conference. 15 - 18 November 2015
17. Puri, A. K., Makolomakwa, M., Chanderman, A., Permaul, K. and Singh, S. Applications of thermostable phytases in enzymatic catalysis of phytate. CATSA 2015 conference. 15 - 18 November 2015
18. Ranjan, B., Kumar, S., Permaul, K. and Singh, S. 2015. Amelioration of toxic soil contaminants using cyanate hydratase from the thermophilic fungus *Thermomyces lanuginosus*. In: Catalysis Society of South Africa (CATSA) Conference, Cape Town, 15-18 November 20

## INTERNATIONAL CONFERENCES

1. Chanderman, A., Puri, A. K., Permaul, K. and Singh, S. 2016. Phytase from *Enterobacter* sp. ACSS: production, characteristics and applications. Bioprocessing India Conference, Mohali, India, 15-17 December 2016.
2. Ranjan, B., Puri, A. K., Tong, L., Permaul, K., Pillai, S. K. and Singh, S. 2016. Crystallisation and application of a novel cyanate hydratase for cyanate remediation. International Conference on Strategies for Environmental Protection and Management, New Delhi, India, 11-13 December 2016.
3. Arumugam N., Puri, A. K., Permaul, K., Pillai, S. K. and Singh, S. 2016. Agricultural waste as potential biomass for xylooligosaccharide production. International Conference on Current Trends in Biotechnology, Vellore, India, 8-10 December 2016.
4. Ranjan, B., Kumar, S., Permaul, K. and Singh, S. 2016. A novel recombinant cyanate hydratase (rTI-Cyn) from the thermophilic fungus *Thermomyces lanuginosus* for plant growth promotion. SIMB Annual Meeting and Exhibition. 24-28 July, New Orleans, USA.
5. Kumar, S., Arumugam, N., Gerrano, A. and Singh, S. 2016. Xylooligosaccharides: An emerging dietary fibre for food based Applications. Abstract accepted for oral presentation in 18th World Congress of Food Science and Technology, IUFOST 2016, Royal Dublin Society, Ballsbridge, Dublin, Ireland, 21st – 25th August 2016.
6. Kudanga, T., Mthembu, S.M., Mellem, J.J., Amonsou, E.O. Chemo-enzymatic Modification of Bambara and Cowpea Proteins for Improved Hydrogel Properties. IUFOST 18 World Congress of Food Science and Technology, Dublin, Ireland, 21-25 August 2016.
7. Singh, S., Puri, A.K., Mchunu, N.P., Winger, A. and Permaul, K. 2015. Unlocking the potential of a thermophilic fungus. 2015 SIMB Annual Meeting and Exhibition. Philadelphia, USA, August 2-6, 2015. Keynote
8. Kudanga, T., Nyanhongo, G., Guebitz, G.M. Enzymatic surface functionalisation of lignocellulose materials for improving hygienic properties, Invited presentation, International Congress on Biomaterials and Biosensors (BIOMATSEN 2015), Fethiye-Mugla, Turkey, 16-19 April 2015.
9. Puri, A.K., J. Zininga, Permaul, K. and Singh, S. 2015. A thermo-acid-stable and protease-resistant phytase from a newly isolated thermophilic bacterium, *Bacillus ginsenghumi*. 5th Annual International Conference Advances in Biotechnology. 13-15 March 2015, Indian Institute of Technology, Kanpur, India.
10. Singh, S., Puri, A., Mchunu, N., Kumar, S., and Permaul, K. 2015. Unravelling the sequence of a thermophilic fungus. In: International Conference on New Horizons in Biotechnology (NHBT-2015), Trivandrum, India, 22-25, November 2015.
11. Puri, A. K., Zininga, J., Permaul, K. and Singh, S. 2015. Immobilisation of phytase from *Bacillus ginsenghumi* on chitosan-alginate nanoparticles. Second International Conference on Composites, Biocomposites and Nanocomposites (ICCBN), Durban, 28 – 30 October 2015.
12. Singh, S., Puri, A.K., Mchunu, N.P., Winger, A. and Permaul, K. 2015. New Horizons in Biotechnology Conference. Unraveling the sequence of a thermophilic fungus. Trivandrum, India, November 22 - 25, 2015. Plenary

13. Puri, A. K., Zininga, J., Permaul, K. and Singh, S. 2015. A thermo-acid-stable and protease-resistant phytase from a newly isolated thermophilic bacterium, *Bacillus ginsengihumi*. International Conference on Advances in Biotechnology (BioTech). Proceedings: 172-177. Singapore: Global Science and Technology Forum.

## JOURNAL PUBLICATIONS

1. Oyeyinka, S.A., Singh, S., Ma, Y. and Amonsou, E.O., 2016. Influence of high-pressure homogenisation on the physicochemical properties of bambara starch complexed with lysophosphatidylcholine. *LWT-Food Science and Technology*. 74:120-7.
2. Khan, F.I., Bisetty, K., Gu, K.R., Singh, S., Permaul, K., Hassan, M.I. and Wei, D.Q., 2016. Molecular dynamics simulation of chitinase I from *Thermomyces lanuginosus* SSBP to ensure optimal activity. *Molecular Simulation*. 23:1-11.
3. Biely, P., Singh, S. and Puchart, V., 2016. Towards enzymatic breakdown of complex plant xylan structures: State of the art. *Biotechnology Advances*. DOI: 10.1016/j.biotechadv.2016.09.001
4. Adapa, L.M., Azimi, Y., Singh, S., Porcelli, D. and Thompson, I.P., 2016. Comparative study of chemical and physical methods for distinguishing between passive and metabolically active mechanisms of water contaminant removal by biofilms. *Water Research*. 101: 574-581.
5. Oladunjoye, A.O., Singh, S. and Ijabadeniyi, O.A., 2016. Inactivation of *Listeria monocytogenes* ATCC 7644 on fresh-cut tomato using nisin in combinations with organic salts. *Brazilian Journal of Microbiology*. 47: 757-763.
6. Chanderman, A., Puri, A.K., Permaul, K. and Singh, S. 2016. Production, characteristics and applications of phytase from a rhizosphere isolated *Enterobacter* sp. *ACSS. Bioprocess and biosystems engineering*, DOI: 10.1007/s00449-016-1632-7. Current IF: 2.0
7. Oyeyinka, S.A., Singh, S., Venter, S.L. and Amonsou, E.O., 2016. Effect of lipid types on complexation and some physicochemical properties of bambara groundnut starch. *Starch-Stärke*. DOI: 10.1002/star.201600158. Current IF: 1.67
8. Oyeyinka, S.A., Singh, S., Ma, Y. and Amonsou, E.O., 2016. Effect of high-pressure homogenisation on structural, thermal and rheological properties of bambara starch complexed with different fatty acids. *RSC Advances*, 6(83): 80174-80180.
9. Tian, K., Niu, D., Liu, X., Prior, B.A., Zhou, L., Lu, F., Singh, S. and Wang, Z., 2016. Limitation of thiamine pyrophosphate supply to growing *Escherichia coli* switches metabolism to efficient d-lactate formation. *Biotechnology and bioengineering*, 113(1): 182-188. Current IF: 4.16.
10. Oyeyinka, S.A., Singh, S. and Amonsou, E.O., 2016. Physicochemical properties of starches extracted from bambara groundnut landraces. *Starch-Stärke*. DOI: 10.1002/star.201600089. Current IF: 1.67
11. Kumar, A., Chanderman, A. and Singh, S. 2016. Microbial production of phytases for combating environmental phosphate pollution and other diverse applications. *Critical Reviews in Environmental Science and Technology*, 46(6), 556-591. Current IF: 3.47
12. Khan, F.I., Bisetty, K., Singh, S., Permaul, K. and Hassan, M.I. 2015. Chitinase from *Thermomyces lanuginosus* SSBP and its biotechnological applications. *Extremophiles*, 19(6), 1055-1066. Current IF: 2.31
13. Gramany, V., Khan, F.I., Govender, A., Bisetty, K., Singh, S. and Permaul, K., 2015. Cloning, expression, and molecular dynamics simulations of a xylosidase obtained from *Thermomyces lanuginosus*. *Journal of Biomolecular Structure and Dynamics*, DOI: 10.1080/07391102.2015.1089186. Current IF: 2.92.
14. Oyeyinka, S.A., Singh, S., Adebola, P.O., Gerrano, A.S. and Amonsou, E.O., 2015. Physicochemical properties of starches with variable amylose contents extracted from bambara groundnut genotypes. *Carbohydrate polymers*, 133, 171-178. Current IF: 4.07.
15. Naidoo, K., Kumar, A., Shama, V., Permaul, K. and Singh, S., 2015. Purification and Characterisation of an Endoinulinase from *Xanthomonas campestris* pv. *phaseoli* KM 24 Mutant. *Food Technology and Biotechnology*, 53(2), 146-153.
16. Zhang, M., Puri, A.K., Govender, A., Wang, Z., Singh, S., Permaul, K. 2015. The multi-chitinolytic enzyme system of the compost-dwelling thermophilic fungus *Thermomyces lanuginosus*. *Process biochemistry*, 50(2), 237-244. Current IF: 2.52.
17. Khan, F.I., Govender, A., Permaul, K., Singh, S., Bisetty, K. 2015. Thermostable chitinase II from *Thermomyces lanuginosus* SSBP: Cloning, structure prediction and molecular dynamics simulations. *Journal of theoretical biology*, 374, 107-114. Current IF: 2.30.
18. M Zhang, A Govender, Z Wang, S Singh and K Permaul. 2015. The multi chitinolytic enzyme system of the compost dwelling thermophilic fungus *Thermomyces lanuginosus*. *Process Biochemistry* 50:237 244.
19. A Guldhe, B Singh, T Mutanda, K Permaul, F Bux. 2015. Advances in synthesis of biodiesel via enzyme catalysis: Novel and sustainable approaches. *Renewable and Sustainable Energy Reviews* 41, 1447 1464.
20. A Guldhe, B Singh, I Rawat, K Permaul, F Bux. 2015. Biocatalytic conversion of lipids from microalgae *Scenedesmus obliquus* to biodiesel using *Pseudomonas fluorescens* lipase. *Fuel* 147, 117 124.
21. K. Naidoo, A. Kumar, V. Shama, K. Permaul and S. Singh. 2015. Purification and characterisation of an endoinulinase from *Xanthomonas campestris* pv. *phaseoli* KM 24 mutant. *Food Technology and Biotechnology* 53:146-153.
22. Khan, F.I., Govender, A., Permaul, K., Singh, S. and Bisetty, K. 2015. Thermostable chitinase II from *Thermomyces lanuginosus* SSBP: Cloning, Structure Prediction and Molecular Dynamics Simulations. *Journal of Theoretical Biology* 374:107-114.
23. Guldhe, P. Singh, S.K Santhosh, I. Rawat, K. Permaul and F. Bux. 2015. Biodiesel synthesis from microalgae using immobilised *Aspergillus niger* whole cell lipase biocatalyst. *Renewable Energy* 85:1002-1010.
24. F.I Khan, K Bisetty, S Singh, K Permaul and Md. Imtaiyaz Hassan. (2015). Chitinases from *Thermomyces lanuginosus* SSBP and its biotechnological applications. *Extremophiles* 19:1055-1066.
25. V Gramany, F.I Khan, A Govender, K Bisetty, S Singh and K Permaul. 2016. Cloning, expression and molecular dynamics simulations of a xylosidase obtained from *Thermomyces lanuginosus*. *Journal of Biomolecular Structure and Dynamics* 34(8):1681-1692.
26. Kumar, A., Chanderman, M., Makolomakwa, K Permaul and S.Singh. 2016. Microbial production of phytases for combating environmental phosphate pollution and other diverse applications. 46(6) doi: 10.1080/10643389.2015.1131562.
27. F.I Khan, K Bisetty, K-R Gu, S Singh, K Permaul, Md. Imtaiyaz Hassan & D-Q Wei (2016): Molecular dynamics simulation of chitinase I from *Thermomyces lanuginosus* SSBP to ensure optimal activity, *Molecular Simulation*, DOI: 10.1080/08927022.2016.1237024
28. Chanderman A, Puri AK, Permaul K and Singh S. 2016. Production, characteristics and applications of phytase from a rhizosphere isolated *Enterobacter* sp. *ACSS. Bioprocess and Biosystems Engineering* epub. DOI: 10.1007/s00449-016-1632-7
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