

EDITORIAL

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Special Issue 'Microbial glycobio-technology'

Ashok Pandey^{1,2,3} and Vijai Kumar Gupta^{4,5*}

Editorial

Research and technologies involving carbohydrates to carbohydrate-based materials and converting carbohydrates for renewable energy, agri and health fall under the umbrella of glycobio-technology. Microbial glycobio-technology refers to sustainable bioprocesses for the bioconversion of carbohydrates through microbial enzymes and microbial technologies and the generation of tailor-made carbohydrate bioproducts/polymers for various novel applications in bioenergy and bioenergy fuels, biomaterials, in food and nutrition, and pharmaceuticals. This special issue is intended to present a special collection with a thematic scheme: Microbial Glycobio-technology. Eighteen articles, connected to glycan biosynthesis, glyco-enzymology, modification of complex carbohydrates and their corresponding glycoconjugates, including glycans, glycoproteins, glycolipids, biological functions of glycoconjugates and glycolipids, have been published there [1–18].

Food and nutrition

Poultry is one of the most popular animal-based food at global level, therefore, there is need to develop low-cost vaccines to protect poultry against various types of microbial infections. Nowadays, Protein Glycan Coupling Technology (PGCT) is used for development of multivalent poultry vaccine to protect against various bacterial infections.

Some researchers studied a candidate glycan-based multivalent live vaccine that elicits an immune response and protect against avian and zoonotic pathogens like *Campylobacter jejuni*, *Clostridium perfringens* and

avian pathogenic *Escherichia coli* (APEC) [1]. Similarly, Samaras et al. [9] worked on the production of glycoconjugate vaccines expressed in *Escherichia coli* using an automated platform. They developed a real-time automated platform allowing the identification of the most appropriate *E. coli* strain and genetic constructs to be applied in ongoing research.

In another study, Zhang et al. [8] discussed human milk oligosaccharides, the 3rd most ample constituent of human milk after lactose and lipids. They studied the effects of human milk oligosaccharides on the infant gut microbiome alongwith the mechanism of action behind the beneficial impacts of human milk oligosaccharides.

Glucosylglycerol, a natural osmolyte from bacteria and plants, is used as a cosmetic and food-and-feed ingredient. Therefore, some researchers enzymatically synthesized glucosylglycerol using a whole cell-based catalyst [10].

Bioenergy and bioproducts

With increasing global population and industrialization, there is accelerating energy demands which is a great concern worldwide. International researchers showed increased attention towards ecofriendly production of renewable energy fuels from different types of biomass substrates using microbial systems. Ramamurthy et al. [12] highlighted the bacterial application to develop biofuels and bioenergy.

In another study, Thangavelu et al. [2] investigated the bioconversion potential of *Candida tropicalis* ASY2 to produce biodiesel from sago processing wastewater (SWW). They observed that the microbial lipids from *C. tropicalis* strain as alternative oil substitutes for sustainable biodiesel production.

Microalgae is also an alternative to petroleum-based fuels. Sirohi et al. [3] discussed about different omics

*Correspondence: vijai.gupta@sruc.ac.uk

⁴ Biorefining and Advanced Materials Research Center, SRUC, Kings Buildings, West Mains Road, Edinburgh EH9 3JG, UK
Full list of author information is available at the end of the article



techniques to improve the product yield by algal strain manipulation. Similarly, Chuzelet et al. [4] used metagenomic screening coupled with glycoanalytics to discover enzymes. In another study, Marella et al. [5] investigated the mechanisms involved in organic carbon acquisition in diatoms and the development of sustainable diatom biorefineries to produce novel biomolecules.

Microbes offer many pathways towards bioremediation and utilization of agricultural wastes. For example, Bhatt et al. [11] addressed recent advances and applications of microbial glyco-conjugates in the biological removal of organic pollutants-contaminated environments. They found that glycoconjugates create a bridge between microbes and organics, which helps to accelerate microbial degradation of pollutants. In another study, Muniraj et al. [13] attempted to explore the mechanism of humic substance (HS) formation from coir pith wastes using the enzyme tyrosinase.

Tools for biomedical research

Carvalho et al. [6] analysed fungal cell walls using recombinant endo- β (1,3)-D-glucanases. The authors observed the effectiveness and reproducibility of 12 recombinant endo- β (1,3)-D-glucanases and reported the significance of these enzymes for various biological applications.

Recombinant therapeutics plays an important role in disease management, and yeasts are used for synthesizing pharmaceutical recombinants. Madhavan et al. [7] reviewed the development in yeast gene-manipulation techniques for biopharma protein synthesis.

In another study, Vigosova et al. [14] highlighted the role of multi-pathogen infections in Alzheimer's disease (AD). They reported that the coexistence of multiple pathogens and biofilms in AD's etiology is helpful in its diagnosis and treatment [14].

Koirala et al. [15] investigated dextran synthesis through fermentation of brewers' spent grain (BSG), with *Leuconostoc pseudomesenteroides* DSM20193 and *Weissella confusa* A16. Moreover, Asemoloye et al. [16] discussed different protein engineering approaches for enhanced production of important lignolytic enzymes.

Thakur et al. [17] reported the potential uses of rhamnolipids (RLs) in cosmetic, pharmaceutical, food and healthcare industries as potential therapeutic agents. At the same time, Mo et al. [18] studied a novel multi-stress-tolerant probiotics *Meyerozyma guilliermondii* GXDK6 with aroma-producing properties and reported its potential application in the fermentation industry.

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Author details

¹Centre for Innovation and Translational Research, CSIR-Indian Institute for Toxicology Research (CSIR-IITR), Lucknow 226001, India. ²Centre for Energy and Environmental Sustainability, Lucknow 226029, Uttar Pradesh, India. ³Sustainability Cluster, School of Engineering, University of Petroleum and Energy Studies, Dehradun 248007, Uttarakhand, India. ⁴Biorefining and Advanced Materials Research Center, SRUC, Kings Buildings, West Mains Road, Edinburgh EH9 3JG, UK. ⁵Center for Safe and Improved Food, SRUC, Kings Buildings, West Mains Road, Edinburgh EH9 3JG, UK.

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References

- Mauri M, Sannasiddappa TH, Vohra P, et al. Multivalent poultry vaccine development using Protein Glycan Coupling Technology. *Microb Cell Fact.* 2021;20:193.
- Thangavelu K, Sundararaju P, Srinivasan N, Uthandi S. Bioconversion of sago processing wastewater into biodiesel: optimization of lipid production by an oleaginous yeast, *Candida tropicalis* ASY2 and its transesterification process using response surface methodology. *Microb Cell Fact.* 2021;20:167.
- Sirohi R, Joun J, Choi HI, Gaur VK, Sim SJ. Algal glyco-biotechnology: omics approaches for strain improvement. *Microb Cell Fact.* 2021;20:163.
- Chuzel L, Fossa SL, Boisvert ML, et al. Combining functional metagenomics and glycoanalytics to identify enzymes that facilitate structural characterization of sulfated *N*-glycans. *Microb Cell Fact.* 2021;20:162.
- Marella TK, Bhattacharjya R, Tiwari A. Impact of organic carbon acquisition on growth and functional biomolecule production in diatoms. *Microb Cell Fact.* 2021;20:135.
- Carvalho VSD, Gómez-Delgado L, Curto MÁ, et al. Analysis and application of a suite of recombinant endo- β (1,3)-D-glucanases for studying fungal cell walls. *Microb Cell Fact.* 2021;20:126.
- Madhavan A, Arun KB, Sindhu R, et al. Customized yeast cell factories for biopharmaceuticals: from cell engineering to process scale up. *Microb Cell Fact.* 2021;20:124.
- Zhang S, Li T, Xie J, et al. Gold standard for nutrition: a review of human milk oligosaccharide and its effects on infant gut microbiota. *Microb Cell Fact.* 2021;20:108.
- Samaras JJ, Mauri M, Kay EJ, et al. Development of an automated platform for the optimal production of glycoconjugate vaccines expressed in *Escherichia coli*. *Microb Cell Fact.* 2021;20:104.
- Schwaiger KN, Cserjan-Puschmann M, Striedner G, et al. Whole cell-based catalyst for enzymatic production of the osmolyte 2-O- α -glucosylglycerol. *Microb Cell Fact.* 2021;20:79.
- Bhatt P, Verma A, Gangola S, et al. Microbial glycoconjugates in organic pollutant bioremediation: recent advances and applications. *Microb Cell Fact.* 2021;20:72.
- Ramamurthy PC, Singh S, Kapoor D, et al. Microbial biotechnological approaches: renewable bioprocessing for the future energy systems. *Microb Cell Fact.* 2021;20:55.
- Muniraj I, Shameer S, Ramachandran P, et al. *Bacillus aryabhata* TFG5-mediated synthesis of humic substances from coir pith wastes. *Microb Cell Fact.* 2021;20:48.
- Vigosova D, Nemergut M, Liskova B, et al. Multi-pathogen infections and Alzheimer's disease. *Microb Cell Fact.* 2021;20:25.
- Koirala P, Maina NH, Nihtilä H, et al. Brewers' spent grain as substrate for dextran biosynthesis by *Leuconostoc pseudomesenteroides* DSM20193 and *Weissella confusa* A16. *Microb Cell Fact.* 2021;20:23.
- Asemoloye MD, Marchisio MA, Gupta VK, et al. Genome-based engineering of ligninolytic enzymes in fungi. *Microb Cell Fact.* 2021;20:20.

17. Thakur P, Saini NK, Thakur VK, et al. Rhamnolipid the Glycolipid Biosurfactant: emerging trends and promising strategies in the field of biotechnology and biomedicine. *Microb Cell Fact.* 2021;20:1.
18. Mo X, Cai X, Hui Q, et al. Whole genome sequencing and metabolomics analyses reveal the biosynthesis of nerol in a multi-stress-tolerant *Meyerozyma guilliermondii* GXDK6. *Microb Cell Fact.* 2021;20:4.

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